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Screens, the brain... and the child

[ÉDUCATION LE POMMIER !]

Summary

“The child is a researcher, closely supervised. Like a true researcher, a child can conduct investigations that lead him to knowledge. However, s/he must be guided and accompanied by the teacher’s questions and work within the confines of an established subject, rather than one simply picked for a certain occasion.”

In: Georges Charpak, *La main à la pâte. Les sciences à l’école primaire*, Flammarion, 1996

“When, guided by his teacher, a child enters the world of objects and phenomena; shows curiosity and develops mental faculties; tackles the reality of nature; learns to observe, discuss things in the hubbub of the classroom and reason in the depths of the self, discovering there the valuable presence of mathematics; perfects – by writing up experiments or practicing with short presentations – the art of speaking, with precise vocabulary and strict syntax; is helped connect the freshly acquired – as yet monodic – knowledge with others, the door opens to the polyphony of the world, and culture; and does all this alla gioconda*…then we can hope that this child understands what it is to be educated and the value that being educated brings.”*

In: Yves Quéré, *Enseigner, communiquer*, Le Pommier, 2008

“The brain that understands is no longer a mysterious cranial box in which storms brew and passions are unleashed, things which the teacher can only know by what s/he sees or hears from the pupil. Every day we know a little more about this brain that learns, and its extraordinary plasticity. Teaching can gain much from it, while remaining a subtle art; this was the case for medicine, helped along by biology thanks to Louis Pasteur.”

In: Pierre Léna, *Enseigner, c’est espérer*, Le Pommier, 2012

Introduction

There is no question that screens have an impact on our daily lives, whether individually or in a group. But does this impact stop at the professional, cultural, recreational and relationship aspects of our lives or do they closely affect certain faculties of the brain? Everything we do with or in front of a screen (watch television, play video games, look up information online, work at a computer, read a mail while on the phone, use social networks, etc.) requires an effort from our mental faculties, and therefore our brain.

What makes the “Screens, the brain and the child” project unique is that it brings together two subject issues that have been entirely revolutionized since the second half of the 20th century. These are information and communication technologies (ICT) and cognitive sciences. It has two goals: the first is to help children discover the functions of the brain that are affected by ICTs, making them aware so that they develop the ability to use screens in a moderately and self-regulatory fashion. The advantage of this original perspective is that it joins good ICT practices, in terms of civic-mindedness, morale and health, together with the physiological workings of the brain, the discovery of which at primary school level can certainly be considered a secondary benefit of this project.

The undeniable omnipresence of screens

In today’s society, screens are omnipresent and are an integral part of our everyday activities. Television, the cinema, billboards, computers, telephones, video games, touch screen terminals and GPS are just a few examples. They provide an access to a vast amount of information (text, sound, fixed or animated images) and act as an interface for communication. New perspectives never cease to appear in every field – be it professional, cultural, social or recreational.

Despite – or maybe even due to – their massive diffusion, in particular their presence in homes, screens provoke both enthusiastic and reluctant responses.

Digital literacy

Screens are still seen as a new invention by the elder sections of the population, because they experienced their arrival and their evolution; for young people, there is nothing original about this technology. They exist since before they were born, and are a natural part of the familiar world of these “digital-age natives”. This familiarity, together with their apparent ease of use, must not lead us to ignore the necessity of digital literacy, which is essential to fully benefit from the potential of screens and acquire a well-reasoned command.

The discovery of cerebral functions and screens

When we are in front of a screen, we perceive, we are attentive, we feel emotions…in other words, using devices with screens engages our brain’s attention in a variety of ways. When we use them, we engage in cognitive processes, learning strategies and modes of information that other activities, such as reading a book, have little or no impact on. This is why digital culture encourages a certain type of memory and attention, changes our interaction with others, helps us renew our creativity and has a previously unknown power of attraction for our imagination.

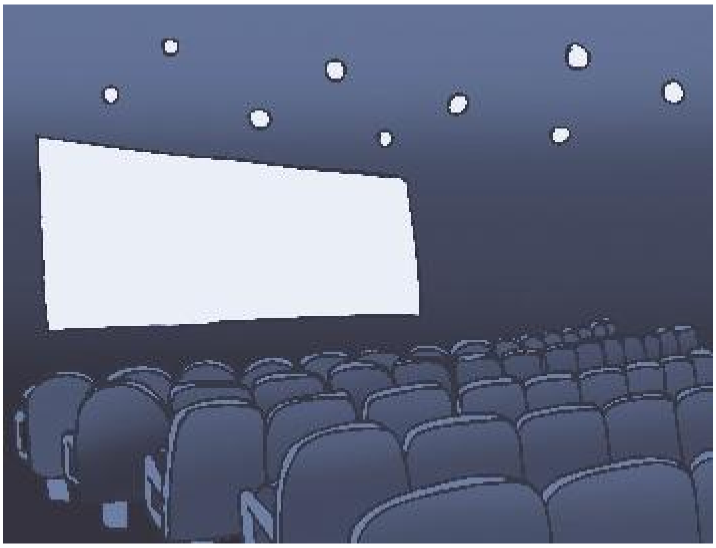
The necessary link with elementary school curricula

Screens enter children's lives at an increasingly early age. In official curricula, a command of ICTs is part of the common core of knowledge and skills that every pupil must acquire during compulsory schooling. The use of ICTs in basic learning objectives is accompanied by protective measures in schools along with making pupils and their teachers aware and responsible. Learning about the digital world plays an important part in the curriculum as early as elementary school.

Scientific overview

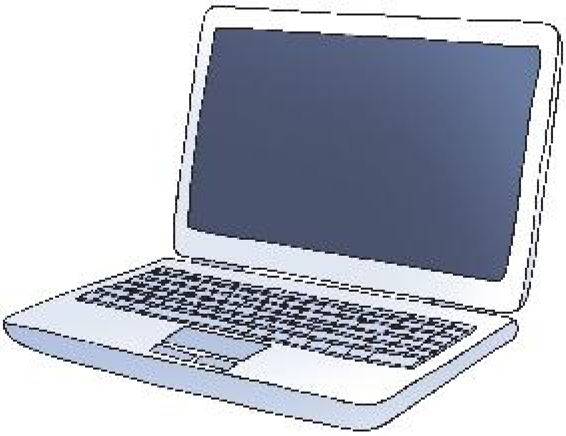
Screens

We use the term “screen” to refer to the visual interface of a wide variety of multifunction devices, from “traditional” audiovisual media (such as cinema and television) to digital technologies for information and communication such as computers, games consoles, digital tablets, telephones, GPS, interactive terminals, digital billboards, etc. These screens share the characteristic of transmitting information, mainly visual (but also auditory) using an electronic support.



Digital technologies

Digital technology uses electronic systems capable of transmitting information represented by a finite number of discrete values, generally figures. The information is coded as a series of figures, often using the binary system. . Binary language (or system) uses the sole characters “0” and “1”, enabling all the letters of the alphabet and all the characters that we regularly use to write text to be translated (for example, “A” is 01000001). Other codes allow images or sounds to be translated. Eight binary figures (bits) make up an octet, which is the basic unit of binary language, or the digital unit that allows a quantity of data to be measured.



A computer is a programmable machine conceived for executing operations (such as calculations and logical operations) automatically using binary data as well as organizing and processing information. Computer science, which evolves in tandem with developments in electronics, concerns not just computers, but also automatons, robots and embedded systems (electronic components that operate a program within a device, which can be a plane, a car, a camera, a cell phone, etc.).

Screen functions

Different forms of physical interface present multiple functions:

– Create, store, share content and access information (text or multimedia), using word, image and sound processing software. Content may be stored on hardware media (CD, DVD, USB) and shared on the Internet;
– Communicate and work together remotely, also by using the Internet network;
– Simulate and interact through simulations. Computing power that enables the modeling of complex systems has revolutionized scientific research and opened up new perspectives for teaching and professional training (such as surgery and aviation). Simulations can also be used for recreational use, with the best example being video games, which incorporates a simulated space with objects and characters, the movement and action of those characters within the space and their reactions to the various maneuvers by the player.

Internet

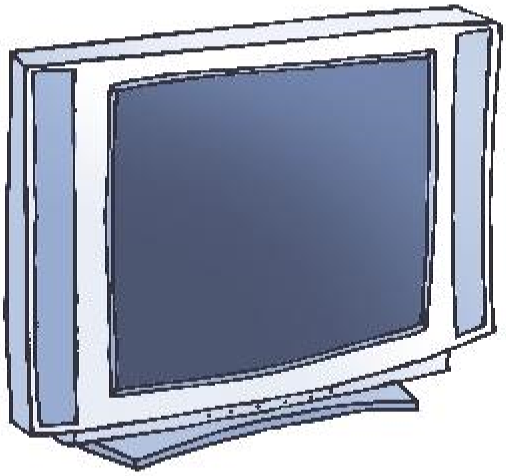
The Internet, a network of connected computers, is a part of the ICT family. It enables the transmission of data from one computer to another, which in turn renders several uses possible:

–The World Wide Web is made up of billions of pages interconnected by hypertext links, and includes blogs (online diaries), social networks (services that enable the creation of a network of communication and sharing relationships), discussion forums and online shopping sites.

The pages and sites (that are coherent structures made of several pages) are hosted on special computers (servers). Sites are accessed by a protocol (http), an address (URL) that is unique to each document, and a browser.
The web is constantly being reorganized, with pages constantly removed and created (several web archiving projects exist);
– Electronic mailing and instant messaging services;
– Voice communication services – similar to telephone calls, but which are transmitted across internet protocols – and audiovisual communication such as video-conferencing;
– document transfer services;
– Online gaming.
The Internet and the web were not invented at the same time. Internet comes from Arpanet, a computer network system developed in the United States in the 1960s for military use. The web was created in 1989 at the CERN (European Organization for Nuclear Research) to make resource-sharing easier for scientists.

Screens and interactivity

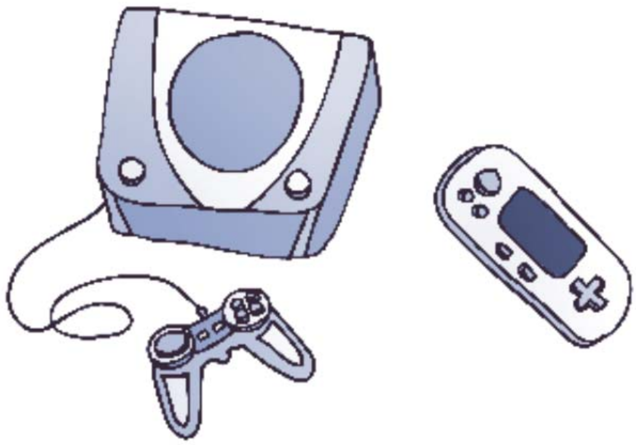
Screens provide an interface with content in visual format. There are different levels of interaction, however.



At level 0, the user is in a seemingly passive position and cannot react to content. But s/he is mentally active, registering and attempting to understand what is being presented. This is the case in the cinema, and on advertising and informational screens. At the next level, the user shows a greater degree of activity, though it remains limited. While watching the television, s/he can change channels; with a DVD player, s/he can fast forward and pause; with a GPS, a map can be explored by choosing the viewing position and display options.

Today, computers, games consoles, digital tablets and telephones allow the user to act or react to all or part of what is presented on the screen, to varying degrees and following different methods.

A text, sound, static or moving images can be produced, including virtual characters and objects with which other users can interact. In the case of video games, movement can be given to objects (such as a deck of cards) or characters, while remaining limited in the possibilities of interaction established by the game's developer.



Man/machine interaction: input

To interact with the machine, gestures are often limited to typing on the keyboard and moving the computer's mouse. Recent developments allow other entry methods, which enable the user to interact physically with a more "natural" interface:

– touch screen surfaces are becoming more and more common (touch screen terminals, digital tablets, some telephones and mp3 players) ;

- sensors and voice recognition software enable a machine to react to sounds produced by the user

- "kinetic" games consoles, which have sensors that enable visual recognition of the user's movements

– these captors are also used in the production of certain animated films where the movements of live actors are transferred to virtual characters ;

- gyroscopes are sometimes installed in games consoles, cameras and telephones, rendering the interface sensitive to the change in angular position imposed by the user, in relation to one or several axes.

Man/machine interaction: output

Different output modes now provide us with multiple information formats. Screens are therefore rarely limited to the visual mode alone:

– cinema, television, consoles, computers and GPS demand both visual and auditory perception;

– Certain interfaces respond to the user's action by tactile stimulation such as vibration, heat stimulus, or by "force feedback" (which gives the user the impression of touching a resisting object). The user must use a peripheral device such as a telephone, joystick, stylus, etc.);

– Recent technological developments include flight simulators, which mechanically reproduce the different conditions of acceleration.

Images, usually seen on screens of limited dimensions and placed opposite the user, can also be projected onto huge panoramic screens or on small screens designed to be worn as glasses, even onto multiple screens that surround the user, such as the walls of a room (immersive environment).

Virtual reality

The term "virtual" has become more commonly used since the rise of ICT. The expression "virtual reality" refers to the interfaces through which information can both be received as well as sent, in as "natural" a manner as possible and in an environment as immersive as possible. This means that the stimuli that do not come from the computer are reduced to a bare minimum. This means the developers of these systems must know the human physiology perfectly and in particular the senses of perception. The use of virtual reality is currently limited to professional contexts, for example professional training for firemen or pilots. However, the term "immersive" now also refers to video game environments with particularly "convincing" content, designed to captivate the user.

In some cases, the images produced by the computer are superimposed on the perception of the real world. Using specific software, a cell phone can scan a special code printed on a book or a bus stop, or simply recognize an object in the real world (such as a monument) and display the information concerning these different objects on the screen. This is referred to as "augmented reality". This application is becoming increasingly widespread and is not limited to professional use.

Recent developments

The development of new interfaces is shifting towards increasingly immersive systems, greater portability and a growing number of functions Cell phones, mp3 players and games consoles now take the shape of little pocket computers with embedded cameras, programs to touch up images, systems to listen to and record sounds, games, communication systems and Internet connection.

Today, children with a portable games console are actually owners of an extremely sophisticated multifunctional device – a product of the latest advances in physics.

Screens and the brain

Screens, which help us acquire new capacities (such as communicating across great distances almost instantly), by providing us with easily accessed information and by inspiring creativity, influence our mental aptitudes to memorize and reason, to perceive and be attentive, to communicate and work together, to imagine and create, to understand and to think. All of this does not prevent a number of complex issues from arising, adding to an already significant list of other problems such as data protection, the right to privacy, the digital divide between generations or social classes, communitarianism, etc.

Let us take memory as an example. Memory is a mental function inherent to learning. This is not the first time man has used a memory other than his own. He has always sought to pass on and preserve fact, traditions and skills throughout the ages, beyond his own lifetime. As a memory replacement, around 5,000 years ago he invented writing. Remember that according to Socrates, in Plato's Phaedrus, the written word could become a threat to memory and thought. Such a threat is often subject for debate today, faced with the changes brought by ICT. Internet is today considered to be an external "memory", a gigantic library that could make remembering facts ourselves pointless, as they are permanently available online.

Using the same word for our own memory and the storage capacities of a computer may be misleading. Scientific progress in understanding the cerebral mechanisms of memory offers some elements that can be used to safely use ITC.

Firstly, they allow us to understand the difference between memory and the internet in terms of registering, storing and recovering information. They also show us that in order to reason, to know well and to have an opinion, our memory must reconcile the newly registered information with the information it has already stored. A recommendation such as "there must be a balance between our memory and Internet's external memory" is established by combining the advantages of ICT with what science teaches us on how the brain functions.

This method of looking at some of the issues raised by ICT – outlined briefly here – provides food for thought on questions such as: can screens make us more violent? Can we become addicted to the Internet or video games? Do video games improve our attention capacity? Are we developing our intelligence with screens? Can they help us learn without any effort? Etc.

The human brain

The brain is an organ that is particularly developed in humans, and more specifically the zone located at the front – called the frontal lobe. While it only represents 2% of our bodyweight – 1.2-1.6 kg – the brain uses 20% of the organism's total energy, a sign of its intense activity.

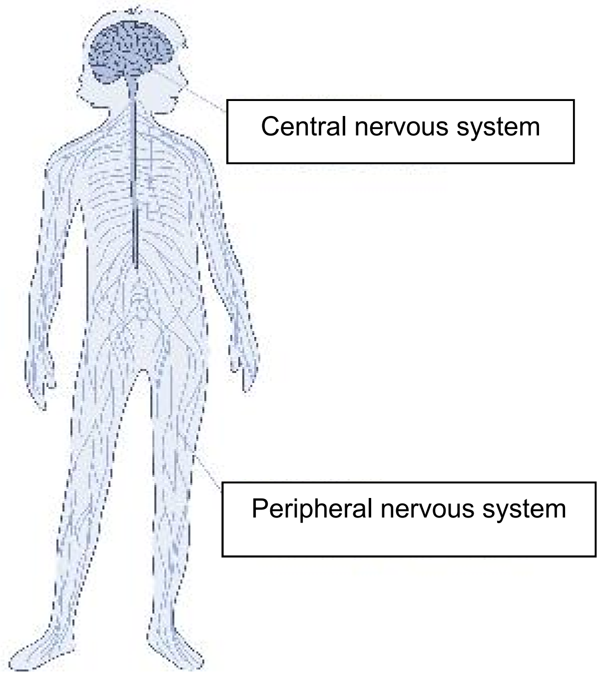
Not only does the human brain take care of all the mechanisms necessary for us to live and move, but it also allows us to talk, think, reason, remember, concentrate, decide, be aware, plan, learn, feel emotion and socially interact. These mental functions are also known as cognitive functions because they allow us to acquire, maintain, transform or use our knowledge. They are familiar to us in daily life, but their mechanisms are still largely unknown.

The study of the brain and mental functions – currently a highly popular research domain – is the meeting point for neurobiologists, psychologists, neurologists, psychiatrists, philosophers, linguists, sociologists, anthropologists, computer scientists, etc.

The brain is a part of the nervous system, which comprises:

– the central nervous system (CNS) with the brain and the cerebellum (which controls the execution of movements and balance) the brainstem (which controls the vital functions – breathing, blood circulation, heart rate, digestion, etc.) and the spinal cord (the link between the CNS and the peripheral nervous system, the PNS);

–The PNS is made of nerves which carry messages from the viscera and the outside towards the CNS, which prepares the response, and inversely, from the CNS to the viscera for the vital functions and to the muscles for voluntary movements. The autonomic nervous system helps control the unconscious processes essential for life.



The brain's structure simplified

The brain has a right and left hemisphere. Each plays a specific role (for example, for most people, the left hemisphere is the seat of language), but they are closely linked to one another, both anatomically and functionally.

Each hemisphere has:

- the frontal lobe cortex, where we find the prefrontal cortex. How they develop is specific to humans. They control the decision-making, executive and short-term memory functions, the fine-tuning of emotions and thinking, among others. The zones that control motor function are located at the back of the frontal lobe;

– the parietal lobe cortex is implicated in the representation of our bodies and space, motor function, tactile perception and relating sensory input to memory;

– the temporal lobe cortex, which holds the primary auditory cortex and the regions implicated in language comprehension and memory. Beneath the temporal lobe are (not indicated on the diagram) the limbic system with the amygdala, essential for emotions, and the hippocampus, which is crucial to memory;

– the occipital lobe cortex, mainly involved in vision.

No region of the brain works alone. They are all connected through multiple networks of neurons. The brain is fully active when, for example, we wish to register, recognize, name, describe, grasp or use an object.

The brain is made up of three main elements:

– Neurons;

– Glial cells. These cells surround the neurons and play an important role, mainly in their nutrition and protection;

– Blood vessels. The brain is one of the organs with the most blood vessels.

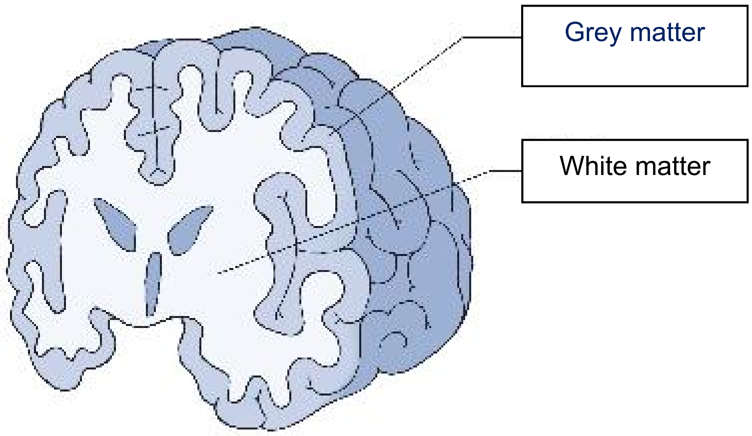
The neuron: a cell unlike any other

The neuron, characteristic of the CNS, has three parts:

• A cell body, or soma. The cell bodies together form the cerebral cortex (the brain's outer layer of gray matter) and dense masses of gray matter deep in the brain (such as the thalamus, the hypothalamus and the basal nuclei).

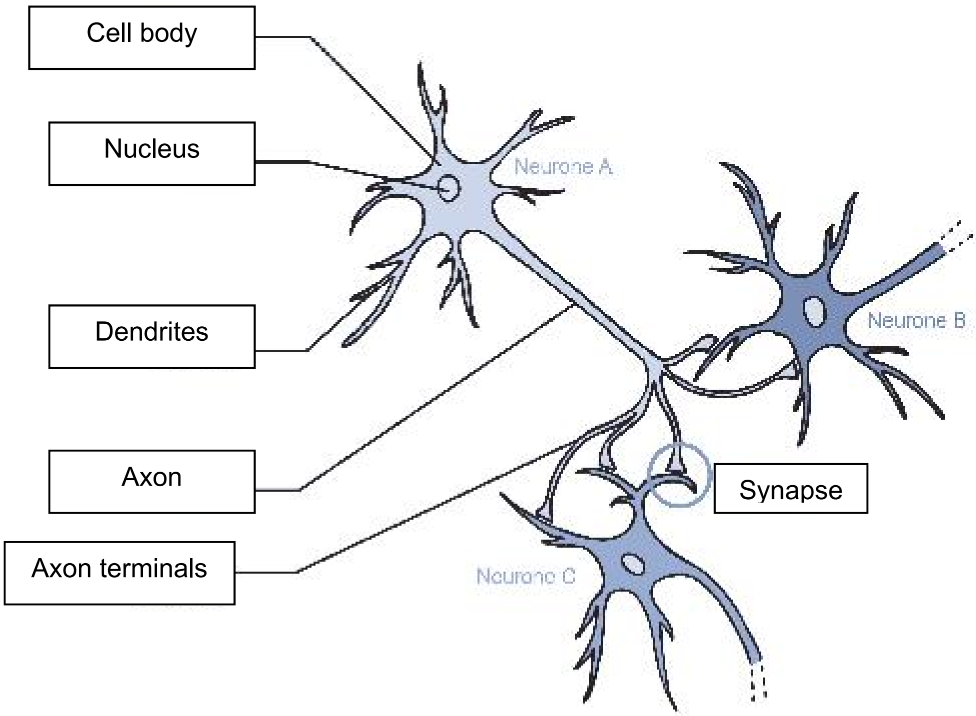
•Two types of projections: dendrites, which are short with several branches, and an axon. There is a single axon per cell and it is surrounded by myelin, a fatty sheath that speeds up the transmission of nerve signals. In the brain, the axons form white matter, located underneath the cortex.

Between the axon terminal and the dendrites or cell body of other neurons, there is a narrow gap, a few microns wide, called the synapse.



Axons send high speed messages (up to 1,000 signals per second) in the form of electric impulses produced by the neurons.

The messages travel in one direction from the cell body of the neuron towards the axon's terminals, and on towards the dendrites of the next neuron. At the synapse, the signal changes from an electric to a chemical one with the release of neurotransmitters which travel across the synaptic cleft and stimulate or inhibit the next neuron. Among the approximately sixty neurotransmitters currently identified by science, the most well-known are dopamine (sometimes called the "feel-good" messenger), serotonin and acetylcholine.



The number of neurons in the human brain is considerable – almost 100 billion. Each neuron is connected to between a thousand and ten thousand others, so the number of synapses in the human brain is colossal, estimated at approximately 100 trillion.

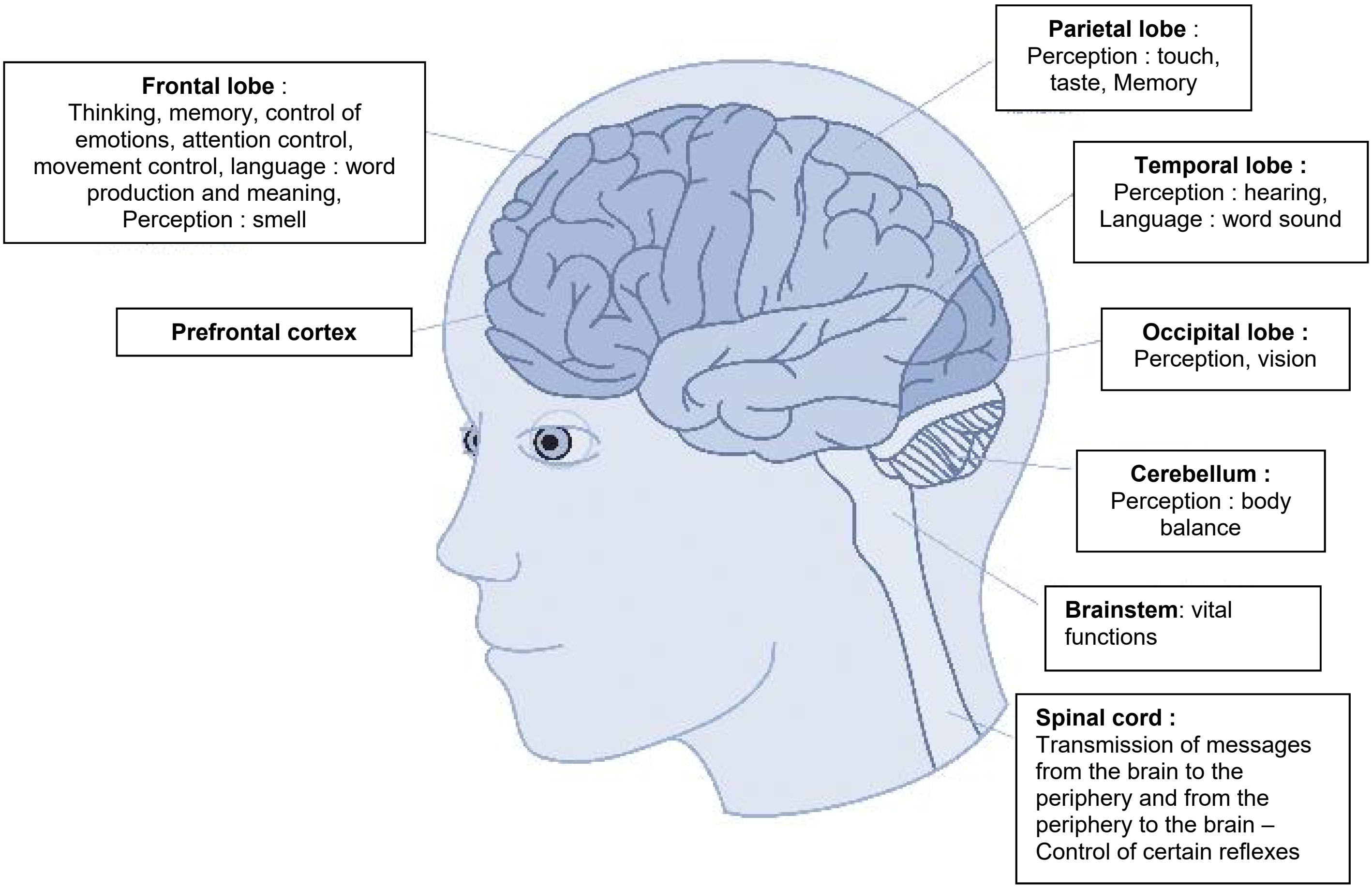
Synaptic plasticity: a lifelong phenomenon

The innumerable connections between neurons create a network in the brain. The formation of new synapses, the pruning of unused synapses and the strengthening of existing synapses – known as synaptic plasticity – is the cornerstone of the brain's development, learning, adaptation and memory processes. These processes select and strengthen certain synapses at the expense of others. Strengthening enables the specific neuron pathway of something learned to be conserved, and the synapses then transmit the signals along this pathway with increasing speed and efficiency. Childhood is the period during which synaptic plasticity is greatest. It is essential that certain very general experiences are gained early so that the brain can develop functions such as those related to perception or language.

The effect of the physical environment on the development of postnatal cerebral pathways can be demonstrated by the following example: if a kitten is left without light for the first month of life, at the end of the month the kitten's eyes will be intact, but the kitten's vision will be impaired.

Without light, the cerebral pathways needed for vision cannot be created. The first months of life are a sensitive period for a cat's vision.
As for the importance of social contact, if we take the case of neglected children who grow up without any social or affective stimuli, it is evident that the restoring of cognitive function is possible but will be closely dependent on the age of the child. If they are placed in a favorable environment very young and receive proper education, it is possible for the child to catch up on this developmental delay.
Nonetheless, synaptic plasticity enables learning and determines how easy, fast or efficiently we learn all throughout our lives. We can, for example, learn foreign languages or music at any stage in life, though it will be more difficult than during childhood.
A person's life experience, from childhood to adulthood, permanently influences how his/her neuron networks will develop. This explains our individualization – each individual sees the world, acts, thinks and forms relationships in a unique way – and why each brain is unique. Similarly, heritability influences development and cognitive functioning throughout our life, and why all human brains are alike.

A newborn baby's brain already has its neurons in place and this number does not seem to significantly increase (aside from slight increases in specific regions of the brain). But it continues to develop after birth and until puberty. Only 10% of a newborn's neurons are interconnected, and it is therefore after birth that the brain becomes considerably more complex, with the gradual establishment of almost all its synapses according to its interaction with the outside world, its experience and what it learns.



Pedagogical overview

Structure of the unit "Screens, the brain… and the child"

This unit proposes a series of activities based on the different ways our brain interacts with screens. These activities are designed for children aged 6-11 (kindergarten to 5th grade). They have been approved by scientists and didactic experts and tested in classes with varying profiles (rural/urban, advantaged and less advantaged), with experienced teachers and beginners.

The activities are spread over 20 themed lessons (two of these are optional), with an introductory and a final lesson. The themes dealt with focus on:

– perception (sensory perception, illusions, perception of movement and space)
– attention (concentration and distraction, divided attention, controlling natural reflexes)
– emotions (recognition, representation and feeling emotion)
– living together (communication and cooperation)
– perception of time (representation and estimation of time)
– sleep
– memory (short and long-term memory, strategies for memorizing)
– imagination
– voluntary movements
– the brain seen on the screen

Each theme is introduced with a scientific explanation for the teacher.

The inquiry-based approach

This unit suggests tackling the issue of the screen's impact on the brain by placing the class in an inquiry situation. The lessons follow the *La main à la pâte* principles with priority given to the active role of the pupil and his/her curiosity, inquiry approach and critical thinking. With the teacher's help, the pupils begin with a situation that requires them to ask questions, they seek out tools to answer their questions, organize practical activities or discuss among themselves to identify the different issues and share opinions while respectfully debating with their classmates

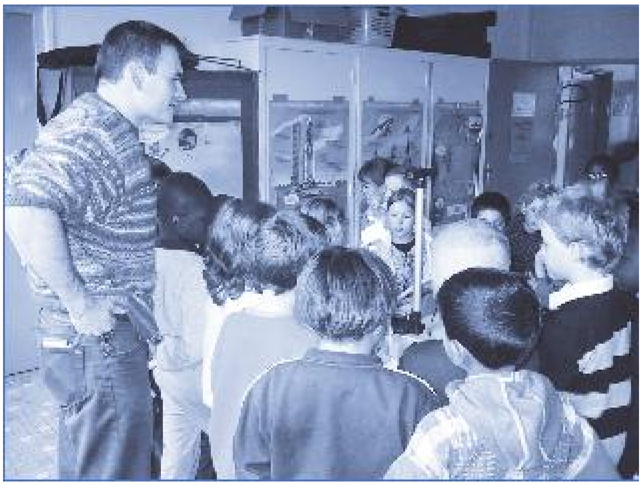
in order to come to a shared conclusion. Even if it is not always feasible to organize experimental activities in the classroom within the field of study of brain function, the inquiry-based approach is always at the heart of the activities proposed.

The 10 principles of *La main à la pâte*

1. Children observe an object or phenomenon in the real, tangible world and experiment with it.
2. In the course of their investigations, children use arguments and reasoning, pooling and discussing their ideas and results, constructing their knowledge, as a purely manual activity is insufficient.
3. The activities the teacher proposes to pupils are organised in sequences within a teaching unit. They are related to official programmes and offer pupils a great deal of independence.
4. A minimum of two hours a week is devoted to the same theme over several weeks. Continuity of activities and pedagogical methods is ensured throughout the school programme.
5. Each pupil keeps an experiment book, written and updated in his own words.
6. The main objective is a gradual appropriation by pupils of scientific concepts and techniques, along with consolidation of oral and written expression.
7. Families and/or the neighbourhood take part in work done in class.
8. Locally, scientific partners (universities, engineering schools) support class work by making their skills available.
9. Locally, teachers' colleges make their pedagogical and didactic experience available to teachers.
10. Teachers can obtain the teaching units, ideas for activities, and answers to various questions at the website www.fondation-lamap.fr. They can also take part in collaborative work by exchanging ideas with colleagues, trainers and scientists.

The teacher's role

In an inquiry-based approach, where the pupil's activity is prioritized and encouraged, the teacher is:

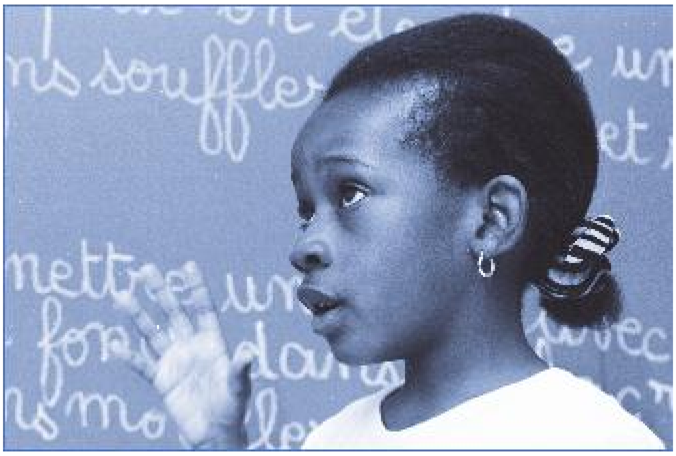


– tutor, when helping guide the pupils towards reflection and their own construction of knowledge and the acquisition of competences and social skills;

– moderator, when giving the pupils the opportunity to discuss and debate – "What do you think ?" "What do you think of your fellow pupil's opinion? Do you agree with what was said?" – instead of giving a right or wrong answer;

– and lastly mediator between pupils and science. It is entirely possible that the class comes to a shared conclusion without being correct (we can all be both in agreement and wrong). In this case, the teacher could suggest looking at the scientific facts using books, documents and the unit's scientific explanation.

Language proficiency



Language proficiency, which is essential for knowledge building, is particularly developed in this unit. Oral communication – when working in small groups or with the class – discussion, justifying pupils' suggestions and ideas and narrative are extremely present in the different phases of each lesson.

Using their experiment notebook – a key tool for the inquiry-based approach – pupils write down their questions, hypotheses and observations, describe how their activities unfolded, record their results or look back over a previous activity, in order to create a scenario. The "Screens, the brain and the child" unit also proposes using a variety of systems of representation: texts, drawings, diagrams, graphs and charts.

Writing also enables pupils to share what they understood and raise questions with other pupils and people outside the class.

The written accounts of their experiments will be the result of their group effort to contrast ideas and suggestions. They shall therefore be seen as "valid" work, and should respect spelling and grammar rules and include rich, precise vocabulary. This is particularly important in the "Screens, the brain and the child" unit, with the production of a "Charter for correct use of screens", which is built on the written recommendations of the pupils themselves throughout the unit.

Individual, group and class work

The unit lessons alternate individual work with group work and class work. This alternating encourages the sharing of experience, increases exchange between pupils and with the teacher with the aim of finding a group solution to the question raised in the lesson. Exploratory and experimental activities are often led by the pupils divided into small groups, which encourages pupils to speak, actively participate and work together.

Discussion among the whole class is essential to develop civic-mindedness and a sense of citizenship, specific to the *La main a la pate* approach.

Lesson plan

Introductory lesson

The introductory lesson is mainly a discussion that will help pupils put forward « spontaneous » ideas on the themes to be developed throughout the unit, which can adapt and expand as the project progresses. It is crucial that they are considered. The teacher can assess the changes that occurred and help the pupils become aware of the effects of their investigative approach on their own ideas.

The observations and conclusions established during the unit when contrasted with their initial representations will lead them to fully grasp the issue: *"Become aware of the impact of screens on the brain's functions and identify correct usage".*

Themed lessons

Each themed lesson follows a three-stage structure:

– 1. Inquiry stage

Inquiry is the driving force behind each lesson, where discussion, expression and exchange among pupils play an essential role. It begins with the teacher directly asking questions, either by showing pupils a document or video, or using everyday situations the pupils are familiar with. The pupil's initial thoughts are important, and these may be individual or formed within a group. The problem to be resolved will take shape from the variety of suggestions provided, an analysis of their different aspects and even their differences of opinion. The role of the teacher is to guide the discussion which will make the pupils aware of the issue and, after forming their ideas (hypotheses), identify the ways to tackle it.

– 2. Activity stage

During this stage, pupils must put their ideas to the test following the inquiry stage. Guided by the teacher, the pupils work towards finding solutions to the problem at hand. The teacher must ensure that the methods of research are discovered by the pupils themselves insofar as this is possible, as they must not simply carry out the teacher's instructions. The unit proposes a variety of inquiry methods: experimentation, observation, reflection, classification, documentary research and construction.

– 3. Pupils structure the shared knowledge that they have obtained, draw a conclusion and write up their report.

This is the class knowledge-building stage, achieved through class discussion helped by the teacher. Knowledge-sharing enables the pupils to compare results and thought processes, open doors to new questions and inquiries and form a conclusion that they all agree on. In this way, they can take stock of the activity they have completed, generalize and conceptualize. It is completed by the writing up of a collective report, generally textual.

Final lesson

The final lesson involves a discussion where students look back over the messages and recommendations gathered throughout the unit, enabling them to draw up a "Charter for the correct use of screens". This charter, together with other class work produced during the unit, could be the feature of a final presentation, in which the pupils share the knowledge with their school friends, parents and families, and possibly a wider audience.

Information for parents

Informing parents is one of *La main à la pâte*'s principles. However, the issue of screens dealt with in this unit is a subject that most parents are already highly aware of. This is why specific information on how this unit is taught in classes could be an opportunity for exchanges between the children and their parents, on the one hand, and stimulate the participation of parents in various stages of the unit, in particular during the last lesson, on the other hand.

An information letter is provided for parents in the appendix.

Summary of lessons

No.	Lesson	Lesson time	Objectives
Introductory lesson		60-90 min.	• Encourage pupils to put forward their ideas on screens, the brain and its functions • Prepare activities for next lessons

Theme: Sensory perception

1	Images and sounds	60-75 min.	• Discovering how we use our vision and hearing when we interact with screens • Encourage pupils to reflect on how to work together in order to understand multimedia content
2	Colors and flavors (optional)	75-90 min.	• Discovering that an image seen on a screen can awaken memories and sensations (flavors, smells, etc.)
3	An illusion of movement	60 min.	• Discovering that cinema, television and animation use certain phenomena of visual illusion
4	2D/3D	90 min	• Get pupils to think about the idea of two and three dimensions • Help pupils understand the factors involved in 3D cinema
5	Space on screen	60 min.	• Thinking about ways of showing space: representations assessed from our own position (egocentric) and those assessed from an external point of view • Compare how we perceive space on screen and in reality
6	Big or small? Illusions of size (optional)	60 min	• Learning how creators of images use the size of an object to indicate its position in space and that they can invent the relationship between size and position • Discovering the relationship between the position of an object and its apparent size

Theme: Attention

7	Concentration and distraction	60 min	• Enable pupils to think about attention (whether it is voluntarily directed or captured by objects or events) and the notion of distraction. • Enable pupils to think about the fact that attention has its limits and how we can « pay attention to our attention levels »
8	Dividing attention	45 min	• Enable pupils to think about the difficulty of carrying out several tasks at the same time • Enable pupils to think about the fact that attention has its limits and how we can « pay attention to our attention levels »
9	Controlling automatic behaviors	45-60 min	• Enable pupils to think about things we do automatically, without having to pay attention • Enable students to become aware of the importance of knowing how to inhibit or control certain automatic behaviors

Theme: Emotions

10	Communicating through emotion	60 min	• Think about emotions and their functions individually and in a group • Working on expressing emotions • Activating and expanding emotion-related vocabulary
11	Emotions on screen	60 min	• Understanding that screens portray emotions and make us feel emotions

Theme: Living together

12	Discussing and communicating	60 min	• Enable students to understand the various means of communication that enable us to discuss with others • Enable students to understand the special features, advantages and risks of communicating remotely via internet

Theme: Perception of time

13	Screen time	30 min	• Enable students to think about how the duration of an event is shown on screen and to become aware of how this time can be manipulated
14	The passing of time	45 – 60 min	• Make children aware of the notion of passing time, as well as the difference between estimating and accurately measuring its length

Theme: Sleep

15	Sleep time	75 min	• Help pupils become aware that sleep is a need • Enable pupils to think about the importance of sleep, things that have a negative impact on sleep, the signs and effects of not having enough sleep

Theme: Memory

16	My memory and screens	60 min	• Show pupils that some memories are personal and others are shared with a group • Show pupils that screens can act as replacements for the memory, and that this has advantages and drawbacks
17	Memorization strategies	60 min	• Show pupils that we have long term and short term memories • Increase pupils’ awareness of a few memorization strategies

Theme: Imagination

18	Using the imagination	60-120 min	• Get pupils thinking about notions of what is real and what is imaginary • Show pupils how special effects can bring an imaginary idea to life

Theme: Voluntary movement

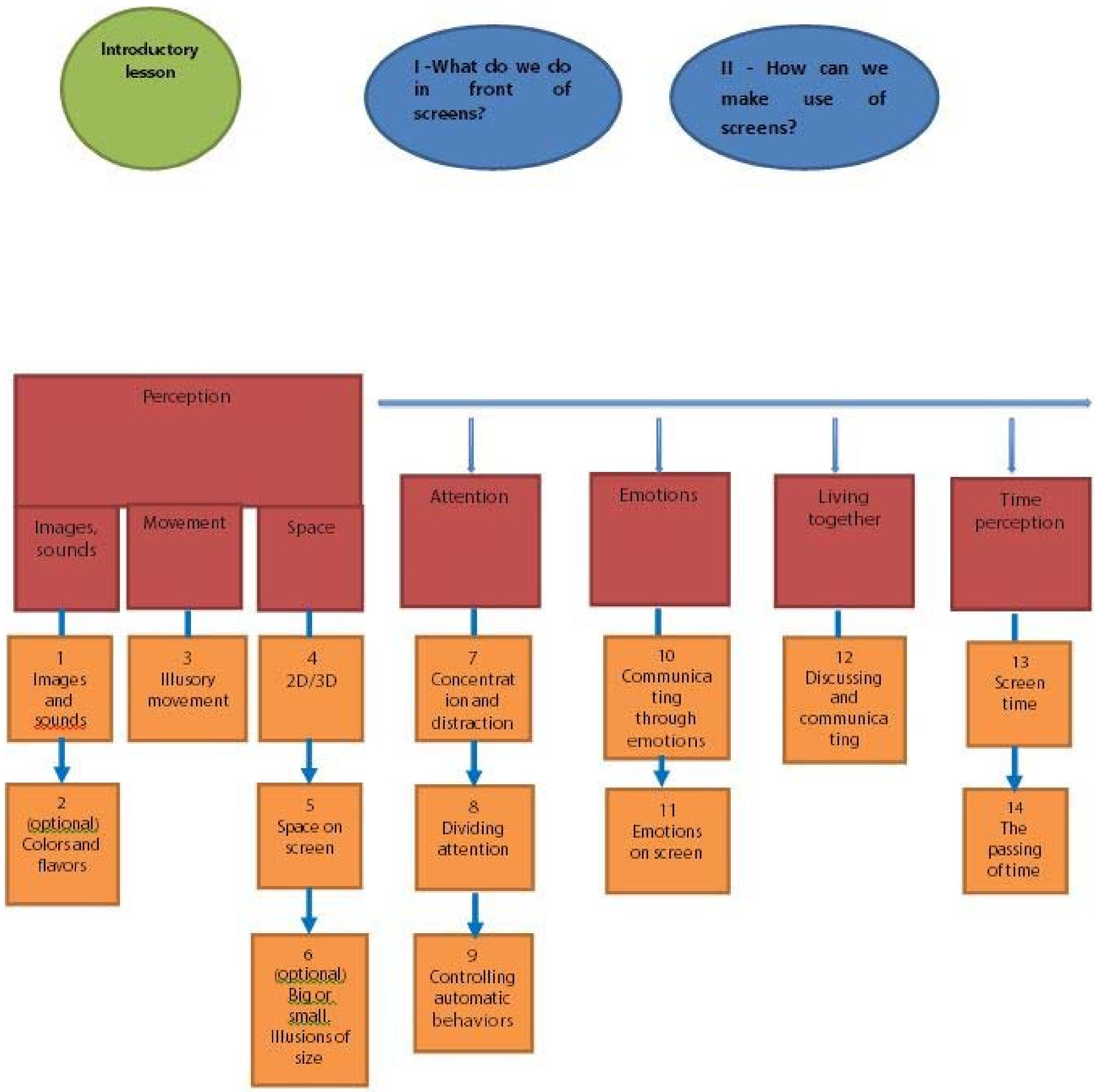
19	Movement in front of a screen	60 min	• Become aware of the variety of our movements • Realise that we are not motionless in front of a computer but that we only execute small movements

Theme : A look at the brain

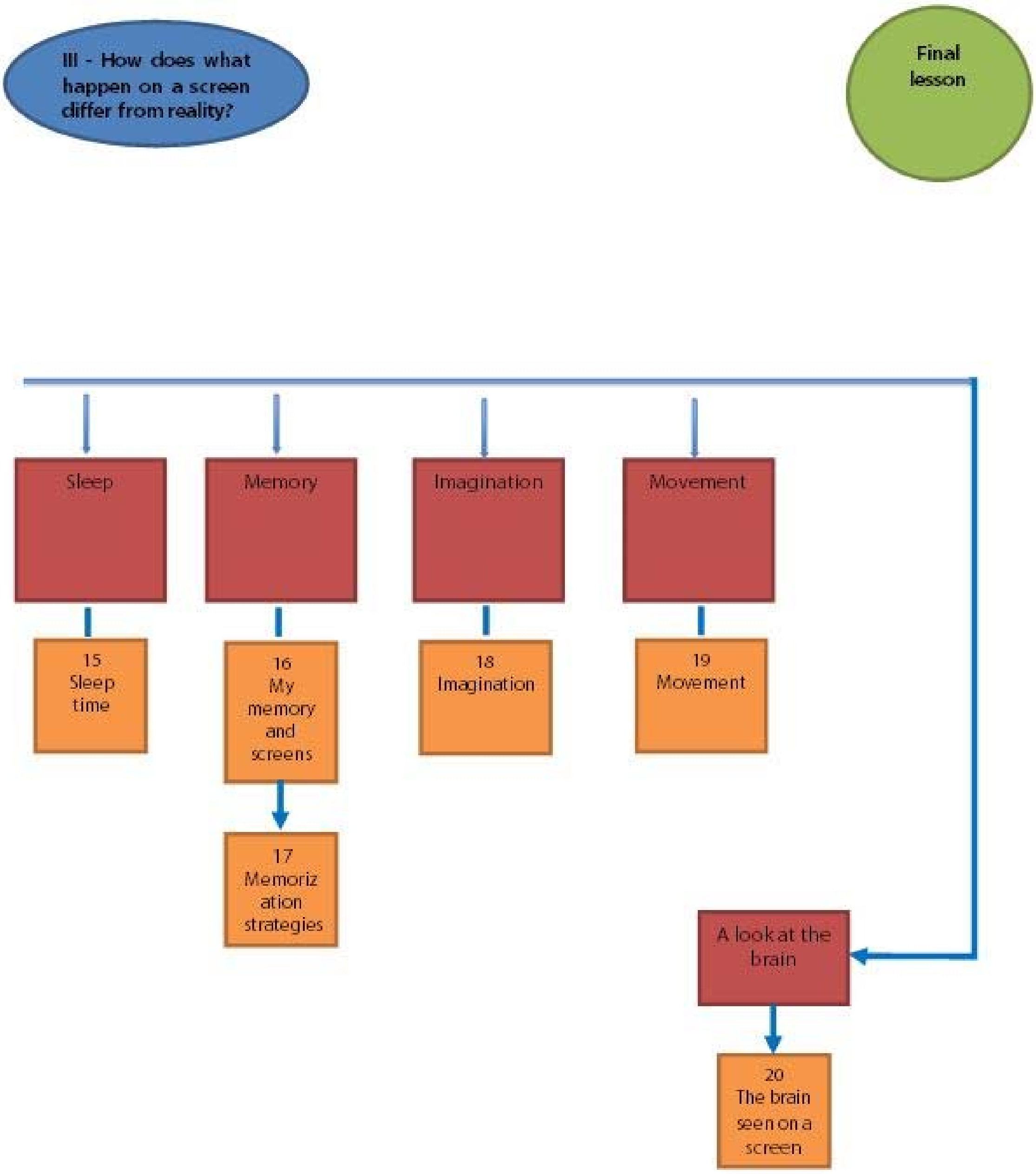
20	The brain seen on a screen	60 min	• Discover how new technologies allow the brain and its functioning to be studied

Final lesson	Beyond the classroom walls

Lesson sequence



The lessons in the "Screens, the brain and the child" unit are grouped together by theme (e.g. Perception, Emotions, or Living together) which correspond to different functions of the brain specifically affected by interaction with screens. Within each theme, the order of the lessons follows a coherent logic,



developing the knowledge of a function of the brain involved in screen interaction.
The conceptual basis underlying both the progression between themes and within them is represented in the above diagram.

Unit implementation

Adapting the project to class requirements

In order to adapt the unit to a class, the teacher must take note of the conditions required for each lesson as well as the scientific overview that accompanies them. S/he may adapt the lesson plan or the materials for each lesson to the constraints of the class, be they material or human (for example, if a class is divided between several levels), by taking the pupils reactions and class interests into account (e.g. the teacher may choose to develop a lesson in a multidisciplinary context).

The precise description of each lesson plan allows teachers who are not fully familiar with the inquiry-based approach to adapt the unit to their preferences. For each lesson, the aims, skills, resources and time required and the vocabulary that pupils should master upon completion are all indicated. At the beginning of each lesson, a paragraph with gray background shows the teacher the goal(s) of the suggested activities, without him/her having to reveal it from the outset to the class, and thereby avoid spoiling the subject for the class.
Sample questions and conclusions – that the teacher may even use as a basis – are provided. Pupils' statements and the photos illustrating the pamphlet were recorded during the test phase of the unit.

Length of the project

Based on a schedule of an hour-long lesson per week, the unit takes 22 weeks to complete. This does not include the time necessary to prepare a presentation or other event to close the project.
The entire unit does not have to be completed: the teacher can choose the lessons s/he would like to try and invent a unique activity program. However, the topics selected for the lessons are not arbitrary.

Choosing the program activities

The introductory lesson, the final lesson and the lessons for the "Sensory Perception" theme (excluding the two optional lessons) are essential for any program.
For a given theme, we recommend all of the corresponding lessons. A careful balance should be maintained between the lessons that lead to discovery of the brain's functions and those with a more general scope (civic-mindedness or ethics, healthy living, etc.). Three standard programs are suggested, with variable duration and each answering a question: « what do we do in front of screens? What can we do using screens? How does what happens on a screen differ from reality? The teacher can decide on one or several.

What do we do in front of screens?

No.	Lesson
Introductory lesson	
1	Perception: images and sounds
2	Perception: colors and flavors (optional)
3	Illusory movement
4	2D/3D
5	Space on screen
6	Big or small? (optional)
7	Concentration and distraction
8	Dividing attention
9	Controlling automatic behaviors
13	Screen time
14	The passing of time
15	Sleep time
19	Movement
Final lesson	

How can we make use of screens?

No.	Lesson
Introductory lesson	
1	Perception: images and sounds
2	Perception: colors and flavors (optional)
3	Illusory movement
4	2D/3D
5	Space on screen
6	Big or small? (optional)
10	Communicating through emotions
11	Emotions on screen
12	Discussing and communicating
16	My memory and screens
17	Memorization strategies
18	Using our imagination
20	A look at the brain
Final lesson	

How does what happens on a screen differ from reality?

No.	Lesson
Introductory lesson	
1	Perception: images and sounds
2	Perception: colors and flavors (optional)
3	Illusory movement
4	2D/3D
5	Space on screen
6	Big or small? (optional)
13	Screen time
14	The passing of time
18	Using our imagination
Final lesson	

Assessment

Writing up the "Charter for Using Screens Better" throughout the unit and the organization of an event such as an exhibit at the end of the project is a method of assessing overall what the pupils have learned about cognitive functions, together with the messages they prepared and retained for sensible, self-regulated use of screens.

Material required for the unit

The material required for the unit is inexpensive and is generally nothing more than everyday school items. However, parts of the lessons requires the use of digital equipment: computer and video projector for watching short vides specifically designed for the unit and presented on the project website (www.fondation-lamap.org/cerveau). One lesson (Lesson 7 on Concentration and distraction) requires internet access to watch a video.

Most lessons use the worksheets found at the end of this unit: a certain number of these sheets should be copied in color, others in A3 format.
Teachers should provide a large sheet for the introductory lesson for the poster that accompanies the project.
If one is available, an interactive whiteboard (IWB) can be used to show the videos, replace the project poster, project the A3 sheets, draw tables that feature in several lessons, note questions, ideas, results, conclusions. The worksheets can then be downloaded directly in PDF format to the class computer from the website.
Each should have an experiment notebook (the photocopies of the A4 sheets can be kept in plastic pockets or folders).

Material	Lesson
Large sheet (A0) for poster*	*introductory*
A3 pages	*5, 18*
Video or game sequence, computer to download it, Video projector to watch it*	*1, 3, 7, 9, 11, 13, 14, 18*
Computer	*19*
Video camera or camera with record/pause function	*18*
Internet (during the lesson)	*7*
Color photocopies*, A3 photocopies *	*initial, 2, 4, 8, 12*
A4 photocopies	*3, 4, 5, 6, 8, 10, 14, 15, 16, 17, 20*
Post-it*	*2*
Food coloring	*2*
Strawberry, lemon or mint essences or flavoring	*2*
Clear glass jars	*2*
Sticky labels	*2*
Scissors, glue, stapler or paper clips	*3, 10*
Timer	*8, 13, 14*
Wooden sticks	*6*
Red and blue markers	*4, 6, 18*
Thin card	*4*
Transparent “projector” slides	*4*
Ruler	*6*
Bean seeds for sprouting, jar, cotton wool	*13*
Sheep or pig brain	*20*

* or IWB

Ties to the common core

Through its wide variety of content and the approach taken, the “Screens, the brain and the child” project

helps pupils acquire knowledge, skills and aptitudes in oral and written language, mathematics, ICT, humanist culture, social and civic skills, independence and initiative, scientific reasoning and inquiry.

Namely:

- be capable of written and spoken expression using appropriate, precise vocabulary
- use simple units of measurement; using measuring instruments
- recognize, describe and name simple shapes and solids
- know how to organize numerical or geometrical information, justify and asses the plausibility of a result
- read, interpret and create certain simple representations: tables, graphs
- use the computer to find information, research and present work completed
- show critical thinking concerning information and how to process it
- express emotions and preferences in reaction to a work of art, using knowledge acquired
- invent and produce artistic or expressive texts or artwork
- participate in dialogue: speaking in front of others, listening to others, formulating and justifying a point of view
- cooperate with a partner or a group of classmates
- work in groups, take part in a project
- practice the inquiry-based approach: learning to observe, question, form a hypothesis and validate it, discuss, prepare basic diagrams
- think critically

Teaching unit: class activities

Introductory lesson

Duration	60 – 90 min
Material	For the class: • Large poster prepared by the teacher before the lesson based on the model suggested below. It should be hung on the classroom wall and completed as each lesson is completed. • Worksheet 1 (printed in A3 format or copied onto the board with the images displayed using magnets or using an IWB).
Aims	• Encourage pupils to share their ideas about screens, the brain and its functions • Prepare the activities for the next lessons
Skills developed	• Practicing the inquiry-based approach: learning to observe, question, form a hypothesis and validate it, discuss, prepare basic diagrams • Clear oral expression using appropriate language • Discuss, raise questions, defend a point of view
Vocabulary	Brain, screen, brain functions

The aim of this lesson is to present the project and encourage pupils to discuss their ideas about the brain's functions and screens ("what the brain does in front of a screen"). The goal is to get pupils talking about their own impressions rather than look for the "right answer". During the discussion, the teacher should encourage pupils to give reasons for their answers, and possibly go further into detail.

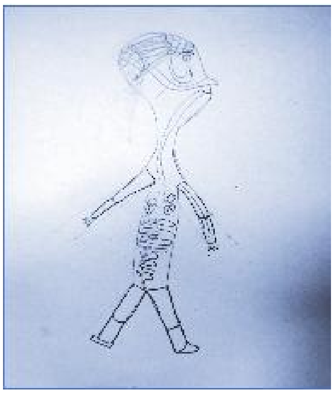
Introduction to the project

"Brains…

The teacher asks the class "What do you know about the brain?" and the class make suggestions. Pupils' responses may be numerous and varied, for example: "it's what we have in our heads", "it's soft and white, no, beige", "it's what helps us think", "when our brain doesn't work anymore, we are dead".

Note for teachers

One interesting variation may be to ask pupils to answer through drawing their image of the brain. These drawings should be kept for the final lesson.



The teacher can pick up on some of these ideas to encourage the discussion along, with questions such as: "What are we able to do with the help of our brain?" On the board, the teacher writes: "We use our brain for..." and the pupils give their suggestions, for example: "thinking about things, getting ideas", "tasting things", "knowing things", "learning things we didn’t know before”, “reading, writing and counting”, “understanding when somebody tells us to do something”, “hearing noises”, “talking”, “smelling things”, “making up stories”, “seeing things”, “moving, walking”, “breathing”, “doing exercise”, “knowing when to go to the toilet”, “sleeping and dreaming”, “remembering things”, “liking or hating things”, “living”, etc.

The teacher asks if the class can put their answers into categories, based on what the brain “does”, i.e. its functions. The class makes suggestions for categories, and the teacher writes the list on the board, for example: “makes the body work”, “makes the body move”, “thinks”, “senses what is around us”, “learn”, “remember”, “have feelings”, “communicate”, etc. Each category should be written in a different color, and the teacher listens to the pupils’ suggestions and underlines all the things in the list that could be categorized. For example: “sense what is around us: see things, listen to music, smell things”, etc.

Note for teachers

Having planned the lesson program for the class to work on prior to the introductory lesson, the teacher may choose questions that lead the pupils to specifically mention their ideas on the brain functions that the will be studying.

Scientific note

Some ideas suggested by the pupils may be incorrect. For example, the pupils may mention reflexes, while these do not necessarily always involve the brain. If a pupil says “*when we put our hand into water that is too hot, we take it out immediately*”: in this instance, it is the sensory nerve that reacts to the sensation of heat, the spinal cord and the motor nerve that make us remove our hand.

… and screens”

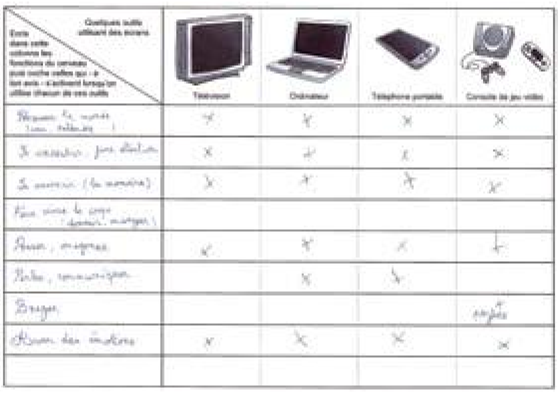
The teacher announces that this year, in science class, they will be looking at what the brain does, with a particular goal: to understand what happens in the brain when we use certain technologies we interact with mainly through screens.

The teacher asks the pupils: “What is a screen? What objects do you know of that have screens?” The class makes suggestions which are listed on the board. Generally, pupils have a lot of ideas, for example: “computers”, “the cinema”, “the television”, “video games, but some are just boxes that are connected to screens”, “Internet, but we use it on the computer or on the telephone”, “mobile phones”, “mp3 players”, “digital cameras”, “billboards in town, or on the highway”, etc.

Note for teachers

Pupils often tend to mention brands of video games or types of computers (laptop, PC, etc.). In order to give structure to their ideas, the teacher may tell them to mention objects belonging to a specific category, for example “all video game consoles”.

The teacher attaches the table from Worksheet 1 to the board, mentioning the different “screens”. Another option is to copy the table onto the board directly, and attach the images of different objects in the boxes on the first row using magnets, or with an IWB if available. The teacher then asks the class: “In your opinion, what brain functions are involved when using these objects?” In the left-hand column on worksheet 1, the teacher copies the category list of brain functions given by the class (“what my brain does”). To start the discussion, the teacher can ask



specific questions: “for example, what does the TV screen make our brain do?” These questions, which are reiterated for each screen, are the basis for the class discussion. As more ideas are suggested by the class, the teacher ticks the corresponding boxes on the board. The class may come to a consensus on some of their suggestions. For example,

all of these “screens” show us images and produce sound; therefore, our perception is at work. Some will give further detail on this, pointing out that other senses are not involved, such as taste. Or “some video games make us move our whole body, but we don’t move when watching T.V.” Some pupils may object, saying “we move in front of the television, and we can even do exercises”. Another example: “screens let us communicate”, “people who are focused on their screen look like they’re alone”, “but at the same time, the Internet lets us talk to people, and we can play video games with others”.

Objectives of the “Screens, the brain and the child” project

The teacher explains to the class that throughout the unit, they will be trying to learn more about what our brain does and how some of its functions are involved when we use screens.

The class goal will be to write a charter, based on what is discovered during each lesson, which offers suggestions on how to use these tools correctly.

The teacher than reveals the “Charter for Using Screens Better “which will accompany the project and the class will complete throughout the lessons. It should be attached to the classroom wall, where it should remain for the duration of the unit. This will help the pupils grasp the coherence of the project, and make it easier to come up with short summaries of the skills they develop during each lesson and see what is to follow. At the end of the project, the charter could be hung in the computer room or somewhere in the school, shown to other classes, parents, the town and possibly an exhibition that the pupils prepare in order to share what they have learned (see final lesson).

The model below can be used to create the poster for the charter. For younger pupils, drawings, photos and written text can be added.

Charter for Using Screens Better

I use my brain to…*	**For proper screen use, we recommend:**
Perceive images and sounds	
Perceive time passing	
discuss and communicate with others	
express and share emotions	
remember	
pay attention	
sleep	
…	

*this column should be completed with the functions that the teacher plans to study throughout the unit. The functions mentioned above are given as examples.

Perception

Scientific overview

Lesson 1. Images and sounds

Lesson 2. Colors, tastes and smells (optional)

Lesson 3. Illusory motion

Lesson 4. 2D/3D

Lesson 5. Space on screen

Lesson 6. Big or small? The illusion of size (optional)

Scientific overview

Perception refers to all the processes that allow the brain to interpret information from the outside world and from our body using our sense organs. Studies on perception seek to answer different questions including: “How do we recognize objects?” “Is recognizing faces different to recognizing objects?” “What happens when we perceive objects with several senses (sight, hearing, touch, etc.)?”

How do we get information from the outside world and from our body?

Senses are the first level of perception. Sense organs have receptors that react to physical or chemical changes in the environment. For instance, the retina is sensitive to light waves; the cochlea (in the ear) is sensitive to sound waves; skin is sensitive to mechanical stimuli (such as pressure or vibrations), physical stimuli (temperature) or chemical stimuli; nose cells and taste buds are sensitive to chemical stimuli; and receptors in muscles, tendons and joints are sensitive to changes in position. The five traditionally recognized senses do not fully represent the wide variety of interactions possible between receptors.

Furthermore, the characteristics of our sense organs determine which information is collected. For example, the human eye only distinguishes wavelengths between approximately 0.4 and 0.8 µm. The ear only detects frequencies between 16,000 and 20,000 Hz. Some phenomena therefore escape our notice entirely. Other animal species have different sensory characteristics and, as a result, perceive the world differently to us.

How do sense organs work?

Sense organs transform changes in physical or chemical phenomena into nerve signals (electrical impulses). For example, in the case of vision, light travels through the different components of the eye until it reaches the retina, where the two types of retina cells, cones and rods, contain photosensitive pigments. When light hits these pigments, they transform the light signal into an electrical nerve signal. The optic nerve, which is attached to the retina, conveys these nerve signals to the brain along millions of axons.

What does the brain do with the visual information it receives?

Perception is not just about registering physical or chemical states. The brain also analyses objects and scenes and interprets them coherently in a matter of milliseconds without us even being consciously aware of it. To do so, it has to solve problems like identifying objects from different points of view or objects that are partially hidden, recognizing the same color in different light conditions, and co-coordinating information from both eyes. Nerve signals are first sent to the primary visual cortex in the occipital lobe, then to other neural circuits. Groups of millions of specialized neurons interact permanently, in parallel and synchronously, to process the basic characteristics of an object – contrast, color, orientation in space, form and movement. In addition, the brain uses different neural networks for tools, animals, human faces, etc. To interpret an object or scene, the brain analyses our perceptions using memories, logic, deductive capacities, expectations, and more. As a result, several people may interpret the same image in different ways.

How does our vision of the world correspond to reality?

Most of the time, our brain's perceptions of the world are accurate and precise enough for us to almost immediately interpret our environment and take appropriate action. Our visual system has evolved over millions of years (the ability to quickly analyse whether we were confronted with predator or prey was essential to the survival of our species).

However, sometimes we do not correctly perceive what is physically present in the world around us, even when our sense organs are working properly. When this occurs, we experience sensory illusions. Different kinds of illusions help show many of the ways in which the brain analyses and interprets information from our environment.

Lesson 1 – Images and sounds

Duration	1 hour – 1 hour 15 minutes
Material	For the entire class: • Computer connected to a video projector or IWB • Video 1, downloaded from the project website
Aims	• Demonstrate how we use sight and hearing when interacting with screens • Get pupils thinking about how their cooperation is useful in understanding multimedia content
Skills developed	• Clear oral expression using appropriate language • The ability to use observations and descriptions to carry out investigations • The ability to discuss, question and justify a point of view • Critical thinking with respect to a piece of information and the way in which it is processed
Vocabulary	Hearing, soundtrack, perception, senses, vision

Initial question

The teacher asks the class to use the ideas that were formulated during the introductory lesson on the ways in which screens are perceived by the brain, through sight and hearing in particular. The teacher then asks, “Do we need to see and hear to understand what is happening on a screen or in the world around us?” If necessary, he/she can also ask, “Is just sight or just hearing enough, or do we need both senses at once?”

The children write the question in their experiment notebook and discuss ideas. Because they are talking about screens, pupils will probably talk about the “audiovisual situations” they know of: films, cartoons, animated images (on television, in films or on computers) and video games.

Some pupils will probably attempt to discuss day-to-day situations without one of these two senses (understanding lessons, crossing the road safely, etc.) and suggest covering their eyes or blocking their ears. If this happens, the teacher can ask how the same effect can be achieved using a screen – by cutting images or sounds.

Note for teachers

Some children may mention specific examples of visual or hearing problems, especially if one of their classmates or family members is affected. Teachers can help them think about this by explaining that people with vision or hearing impairments still process information about their environment:

– By using the deficient sense as best as possible (with hearing aids, glasses or contact lenses)
– By using other senses: the visually impaired use touch (for example, the Braille alphabet to read) and hearing (for example, audio books); the hearing impaired use sight (for example, sign language)
– By getting help (from a person or guide dog).

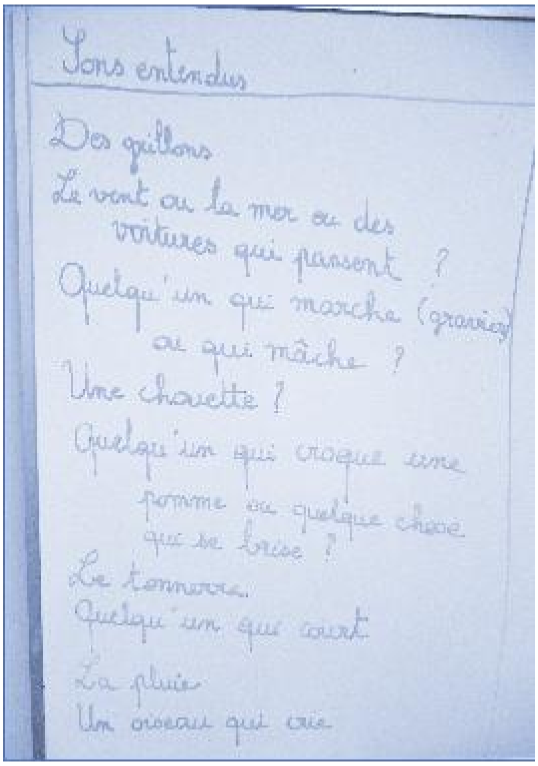
Activity: sounds and images

To learn more and develop pupils' ideas, the teacher tells the class that it is going to take part in a group experiment. Without saying more, he/she asks the class to sit in front of the device used to watch Video 1 (supplied with the unit) and listen to the soundtrack.

1. Listen to the soundtrack without images

The teacher gives the class the following instructions: "You are going to hear sounds. Listen carefully and try and identify what made them: a person, an animal, an object, a natural phenomenon, etc." He/she then plays the soundtrack without images by selecting this option in the viewer. The soundtrack can be played a second time if required.

After listening to the soundtrack, the class shares its ideas. ("What sounds did we hear? What made them?") The teacher writes them on the board.



The teacher can contribute to the debate by asking questions: "Is it easy to guess what made the noises? Is it easy to find words to describe the sounds? Is it easy to distinguish between an animal noise and noises made by objects or natural phenomena? Are some sounds repeated?"

The teacher can also explain that we interpret sounds using our own knowledge. We can recognize hooting for what it is and identify its source if we have already heard an owl hooting in the wild or on a recording. The teacher next asks, "Can you describe what is happening? Are there clues as to when the story took place (does it take place at day or night, which season is it, etc.)? Do you know where it takes place (in a city, in the countryside, at the seaside, in a house, outside, etc.)?"

Pupils put forward their ideas, which may be very different and imaginative. The class then chooses one possible version of the "story" and writes it on the board in two or three lines.

For example: “It is windy. An owl is hooting. It is night-time. A person or an animal is walking. Something snaps. There is a flapping sound. Suddenly, thunder booms.”

Note for teachers

– If the class takes a while to get going, the teacher can help by asking questions about what the sounds could be (a person, an animal, an object or a natural phenomenon) and what the temporal clues mean (for example, “You heard an owl hooting, so do you think the story takes place during the day or at night?”).

– Pupils often say “I heard the wind” or “I heard an owl” instead of saying “I heard a howling that could have been the wind” or “I heard hooting that could have been an owl”. The teacher could use this exercise to encourage pupils to distinguish between:

- The sound and what makes the sound (in other words, cause and effect)
- Observations (sounds) and assumptions (the story).

2.Watch the video without sound

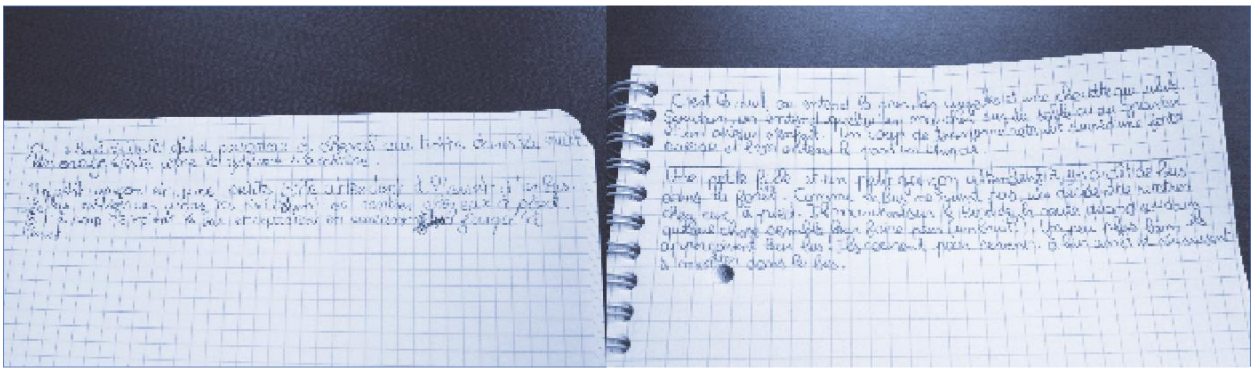
The teacher then suggests that the class watch a video. He/she selects the version of the video without sound in the viewer. He/she asks pupils to pay close attention to the things they see and note them down afterwards. The video can be played a second time if required.

Pupils share their observations and list all the items they recognized on the board. If necessary, the teacher can ask the class for more information, for example: “How are the children dressed?” “Are there leaves on the trees?” “In your opinion, what season is it?” etc. The teacher next asks pupils to describe what happened, to tell the story, based on the story they just saw (in other words, only using information gained through sight).

As a group, the class writes a second summary of the story next to the first. For example: “It is a summer’s night. Two children are waiting for the bus near a forest. The leaves on the trees are moving. The bus still hasn’t arrived, so they start walking along the road. As they walk, something frightens them, but they keep going. It looks like it is going to rain. Suddenly, they turn around and run back to the bus stop.” The teacher then asks the class questions like: “In your opinion, does this video correspond to the soundtrack we listened to earlier?” “Could some of the things in this video be connected with what we guessed when listening to the soundtrack?” “Are there things that do not correspond with the sounds we heard?” “Are there objects or people that make no sounds?”

Note for teachers

To better organize the pupils’ suggestions, the teacher could draw up lists in the form of a table (with the items heard on one side and the items seen on the other) and connect items using different colored whiteboard markers.

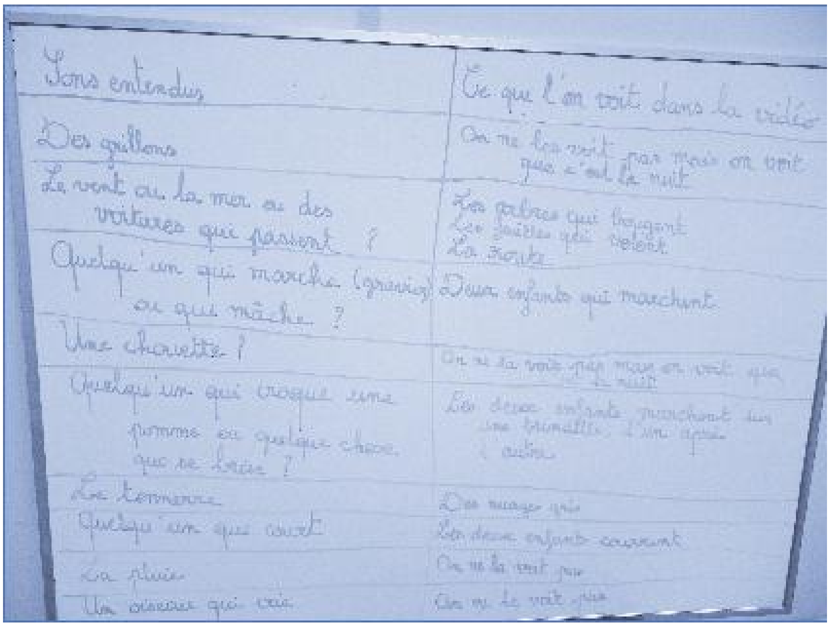


For the next step, the teacher helps pupils to think about how sight and hearing complement each other. For example, he/she asks:

– Whether the images help decide between different interpretations of the sounds they heard (for example, the repeated crunching sound corresponds to the children walking and not someone chewing) and whether the images confirm any hypotheses (for example, the owl's hooting indicates the story takes place at night, which is confirmed by the images)

– Whether the images provide additional information that could not have been obtained by hearing alone (for example, the images give us information about the characters – a little blond girl and a little brown-haired boy – and what they are doing – waiting for a bus)

– Whether they saw everything they heard (for example, they could hear the owl but not see it – only through hearing do they realize it is present; it is there but hidden from sight).



The class observes that listening to the soundtrack then watching the video helps them better appreciate and understand the story. If necessary, the teacher can point out that the soundtrack gave the class more freedom to invent lots of different stories. Now, the stories are more similar. The absence of images left much more room for the imagination.

If the pupils have not already done so, the teacher can mention the crack that they heard in the soundtrack, which was followed by the sound of a bird flapping its wings. The teacher can ask the class whether there are any clues as to what happened at that precise moment: "Why did the bird take off?" The class will eventually note that both children stepped on a twig one after the other. Pupils will ask themselves whether the snap corresponds to one of these events. With the clues they have, it is impossible to tell for certain.

Sight helps confirm some hypotheses as to the sources of the sounds they heard. However, uncertainties remain. How can the class make sure its version of the story is correct and eliminate any doubts? The class may suggest watching the images and sound at the same time.

3. The video with images and sound

The teacher plays the video with both images and sound so the class can check whether its "script" is correct. If the teacher has discussed the snapping twig, the pupils will notice that it is the little girl who walks on the twig and causes the owl to fly away.

As a class, the pupils write a third summary of the story, which the teacher writes on the board next to the first two. For example: "It is a windy summer's night and an owl is hooting. Two children are waiting for a bus near a forest. Fed up with waiting, they start walking along the road. The little girl steps on a twig, which snaps and makes an owl take off suddenly. The children are frightened but keep walking. Suddenly, there is a thunderstorm and they run back to the bus stop."

At this point, the class compares the three versions of the story: the version based on sound alone, the version based on images alone, and the version based on the video with images and sound. They note that some aspects (in particular, "Who snaps the twig that makes the owl fly away?") cannot be confirmed without playing the images and sounds simultaneously.

4. The video with images and sound: alternative soundtrack

Finally, the teacher once again asks for the pupils' attention. He/she plays the video with an alternative soundtrack – where the sound of thunder and rain has been replaced by the sound of a bus arriving. The teacher asks, "How has the story changed?"

The class realizes that changing the soundtrack completely alters our interpretation of the image: the characters are no longer running to take cover from the storm but running because the bus is arriving. They write a final summary of the story. For example: "It is a windy summer's night and an owl is hooting. Two children are waiting for a bus near a forest. Fed up with waiting, they start walking along the road. The little girl steps on a twig, which snaps and makes an owl take off suddenly. The children are frightened but keep walking. Suddenly, they hear the bus arriving and run back to the bus stop."

Scientific note for teachers:

– The teacher can mention that, when watching the video with both sound and images, we receive two distinct impressions (what we see on the one hand and what we hear on the other) but we mesh them into one single interpretation. ("We understand everything at once"). This is an opportunity to underline the fact that our brain produces this interpretation using the information it receives from our sight and hearing: "The brain combines information from the eyes, ears and other sense organs and interprets it."

– This is also an opportunity to mention that we would have learned even more about the story if we had been able to use our senses of touch, smell and taste.

– Finally, the teacher can underline the importance of looking after our sense organs.

Written conclusion

As a class, pupils come up with a general conclusion that they write down in their experiment notebook. For example: "We understand stories on screen better when we see and hear what is happening at the same time: our vision and hearing work together."

Contribution to the “Charter on Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better”. This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: “When we try to understand what is happening around us, we use all our senses: we must be careful to look after them. On screen, stories are told by sounds and images together; it is good to know this because it helps us better understand the story.”

Extension: sound effects workshop

Unlike family videos, professional films often have separately recorded soundtracks that are coupled with images during editing. Special effects can be created this way. This is how films are dubbed (dubbing is when films recorded in foreign languages are edited so the dialogues are in English).

As an extension exploring film history and artistic creation, the teacher (who may choose to work with a visual arts teacher) can suggest the class record its own soundtrack (using either the video viewed during the lesson or an excerpt from a cartoon that the class has chosen). This could be an opportunity to teach pupils a few techniques by which sound effects are produced artificially in the studio, and let them invent their own sound effects. Some of the many examples include:

- Pouring grains of rice onto an umbrella to create the impression of rain falling
- Banging together two empty coconut shells to create the sound of horses hooves
- Banging a sheet of metal to create the sound of thunder
- Using two bags of cornflower to create the sound of footsteps in the snow or someone falling
- Taking two corners of a handkerchief and pulling it to create the sound of birds taking flight
- Making different sounds with the mouth and hands.

Lesson 2 (optional) – Colors, tastes and smells

Duration	1 hour 15 – 1 hour 30 minutes
Material	For the entire class: • Worksheets 2, 3, 5 and 6 (printed in color or projected using an IWB) • Post-it notes • Yellow, red and green food coloring (sold in supermarkets) • Colorless food essences or flavorings (natural or artificial) corresponding to these colors – lemon, strawberry and mint (sold in supermarkets or chemists) • A jug of water For each group of pupils: • 1 set of transparent jars (4 per group minimum) • 1 colored dot sticker or label per jar • Worksheet 4 (printed in color)
Aims	• Demonstrate how images on screen can bring back memories and stimulate the senses (taste, smell, etc.)
Skills developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses, and defend a point of view • Clear oral expression using appropriate language • The ability to discuss, question and justify a point of view
Vocabulary	Flavor, representation, mental representation

This lesson explores the relationship between sight, smell and taste. The activity aims to find out what happens and how we feel when color, flavor and smell do not match based on our knowledge and expectations.

Trigger and initial question

The teacher asks the class to use the ideas that were formulated during the introductory lesson on the ways in which screens stimulate one of the brain's functions: perception. The teacher puts the yoghurt drawings (worksheet 2) on the board and asks the class, "What do you see?" In most cases, pupils answer, "Yoghurts." If necessary, the teacher can ask whether they are real yoghurts and the class will reply that they are images representing yoghurts. The teacher then asks, "Which of these two yoghurts would you most like to try? Why? Have you ever tried yoghurt that is the color of the second picture? What flavor would it be? How do you know?"

The pupils discuss the ways in which colors can suggest tastes or smells, and the ways in which one particular color can make us think about specific objects (for example, brown makes us think of chocolate and the muddy color makes us think of…).

Note for teachers

Prior knowledge of vocabulary on senses is essential. It is important for the class to use words such as *aroma, perfume, smell, taste, flavor* and *coloring* correctly. The words "aroma" and "perfume" refer to smells. "Flavor" refers to tastes.

The teacher shows the class two new images (worksheet 3) and asks, "In your opinion, what flavor is each of these yoghurts?" Pupils then discuss the reasons why they think a yellow yoghurt is most probably banana or lemon flavored, why a pink yoghurt is most probably strawberry, and so on.

After letting the class talk about food colors and what they represent, the teacher asks the initial question: "Does what we see influence what we taste or smell?" He/she writes it on the board so pupils can copy it into their experiment notebook.

Activities: colors, tastes and smells

The teacher tells the class that it is going to design an experiment to answer the question above. He/she presents the material pupils can use: transparent jars, a jug of water, tubes of soluble food coloring (green, red and yellow) and bottles of flavoring (mint, strawberry and lemon). "How can we use this material to answer our question?" The class will come up with different experiment protocols. The following are two examples.

First example

1. In different glass jars we mix different combinations of water, coloring and flavoring. In some jars, the colors and flavors match (for example, red coloring and strawberry flavoring); in others, they do not (for example, red coloring and lemon flavoring).
2. On a sheet of paper, we note what each jar contains so we do not forget.
3. We choose a classmate who did not watch us mixing the flavoring and coloring and ask him/her what he/she tastes and smells.
4. We note his/her answers on the piece of paper where we wrote down what the mixtures were.

5. Finally, we check whether our classmate made any mistakes and, if so, when.

Second example

1. In different glass jars we mix different combinations of water, coloring and flavoring. In some jars, the colors and flavors match (for example, red coloring and strawberry flavoring); in others, they do not (for example, red coloring and lemon flavoring).
2. On a sheet of paper, we note what each jar contains so we do not forget.
3. We choose a classmate who did not watch us mixing the flavoring and coloring and blindfold him/her.

4. We ask him/her to smell each jar, say what he/she thinks the fragrance is, and note down his/her answers on the piece of paper where we wrote down what the mixtures were.
5. We then take off the blindfold and show him/her the colors of the mixtures. We get him/her to smell the jars again and note down his/her answers.

6. Finally, we check whether the classmate made any mistakes and, if so, when.

Note for teachers

– The teacher can ask questions to encourage pupils to think about experiment conditions: “What do you think will happen if a classmate who has watched you preparing the jars takes part in your experiment?” “Can we make mistakes even when the colors and flavors match?”
– The teacher also gets the class thinking about the need to use the same quantities of water, coloring and flavoring in order to compare the different mixtures. He/she underlines that adding three to four drops of flavoring is sufficient.
– He/she also encourages pupils to think about the fact that, for the experiment to work, they must not mix the colors amongst themselves or the flavors amongst themselves, which some pupils could be tempted to do.

The protocol chosen by the class is written on the board and in the experiment notebook. Pupils are now ready to start experimenting in small groups of four or five pupils.

Colors / Flavors	GREEN	RED	YELLOW
MINT	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐
STRAW-BERRY	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐
LEMON	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control " pupil: YES ☐ - NO ☐

Note for teachers

– If necessary, the teacher can describe a protocol he/she has chosen. It is not impossible for children aged between 5 and 7 to come up with an experiment protocol; however, it is essential to carry out only one.
– To help collect answers, the teacher can suggest pupils use worksheet 4. For children between 5 and 7 years of age, it is preferable to draw up a joint worksheet to note down results.
– In asking each group to prepare four mixtures, the class covers a wide range of combinations without having to use up nine jars per group. However, if the teacher has sufficient time and material, he/she can allow pupils to test all nine combinations.

Sharing results

The teacher asks each group to show its completed worksheet 4 on the board. Pupils discuss their experiences, mentioning, for example, “If the strawberry coloring is used, the red mixture smells more like strawberry than the other colored mixtures,” and, “It is difficult to recognize the strawberry smell when the mixture is yellow” or “The yellow mixture with strawberry flavoring is strange, it’s hard to tell what it smells like.”

The teacher asks the class to answer the question on the board: “Does what we see influence what we taste or smell?” The class concludes that it is more difficult to guess the taste or smell of a substance if its color is different to that which is usually associated with that substance. Similarly, colors often make us think of tastes or smells, which is why food packaging is often red for strawberry yoghurt or bright yellow for banana yoghurt. “Just looking at the packaging makes you want to eat it!”

The class discusses this idea and may even come to the conclusion that designers know of these mechanisms and use them in printed or television advertisements to make us want to buy products.

Written conclusion

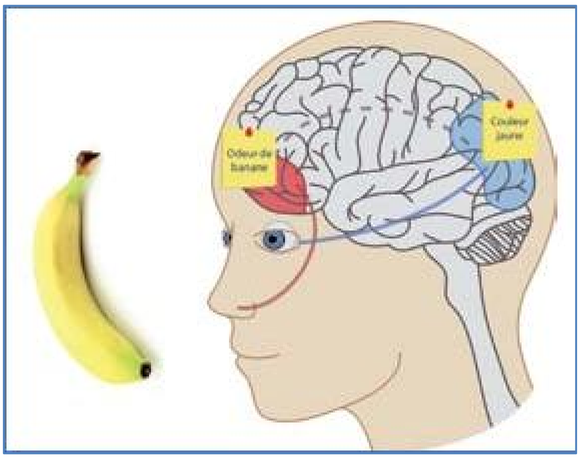
As a class, pupils come up with a general conclusion that they write down in their experiment notebook. For example: “When colors and flavors do not match, we have difficulty identifying a taste. What we see and what we know influence what we smell with our nose. Generally speaking, our senses work together.”

Contribution to the “Charter on Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better”. This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: “Images can be used to make us want something. When we look at screens, we must be aware of the power of images.”

Further study: demonstration

It is possible to demonstrate how the brain processes the information it receives from the eyes, nose and other senses. We do not just smell with our noses: it is the brain that allows us to interpret information transmitted via the nerves in the sense organs. This is why things we have seen and done influence what we smell.

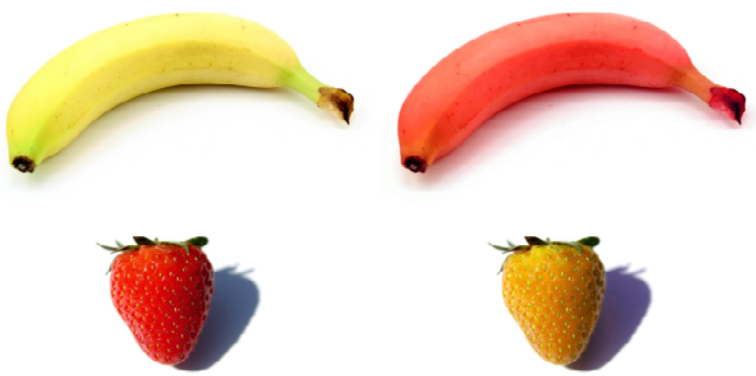


The teacher puts a diagram of the brain up on the board (worksheet 5). We can see the sense organs, the nerves that transmit information from the eyes and nose to the brain, and some parts of the brain. The teacher points these parts out to pupils and explains how information perceived by the nose and the eyes is sent to the brain.

He/she then puts the image of the banana up on the board (worksheet 6). The banana is long, yellow and tastes like a banana.

The teacher writes each of these three words on Post-it notes. When we eat a banana for the first time, the brain processes information on its color, shape and taste. The teacher takes the Post-it notes and places them on the brain. He/she draws a thin line connecting the three. The more bananas we eat, the stronger the connection between "yellow", "long" and "banana taste" becomes in our brain. The teacher makes the line thicker. He/she repeats the process, using the strawberry as an example (red, round, strawberry taste) (worksheet 6).

"Now take a banana without looking at it. Feel its shape (it is long); put it in your mouth (it tastes like a banana). You can be sure it is yellow because our brain associates these three characteristics; they are very strongly connected. Imagine if you opened your eyes and the banana was red – what a surprise that would be!"



The teacher then puts up the picture of the red banana (worksheet 6). "A yellow strawberry would be just as surprising. All these sensations (yellow, long, banana taste) and the connections between them are called "mental representations" (yellow strawberry on worksheet 6).

"At the same time as the brain stocks and connects information in the memory, it produces endless mental representations. It uses them to remember things but also to anticipate what we will smell, see, touch or taste. Thanks to this mechanism, when we see a picture of a banana, a strawberry or some yoghurt on screen, we can anticipate what it will taste and smell like."

Note for teachers

The teacher can have pupils play a more active role in the demonstration. This activity takes around 15 minutes.

The teacher chooses six pupils and gives each a sheet of A4 paper on which one phrase is written: *yellow, long, banana taste, red, round* or *strawberry taste*. When he/she reads out "long" followed by "banana", the two children with these sheets of paper join hands (creating a connection between them). When he/she adds "yellow", the third child joins the other two (another connection is created). The process is repeated for the strawberry. The children keep holding hands. The teacher begins again with "long" and "banana". What will the third word be? He/she shows them the red banana – surprise! They children have to undo the connections already created (stop holding hands) and create new ones.

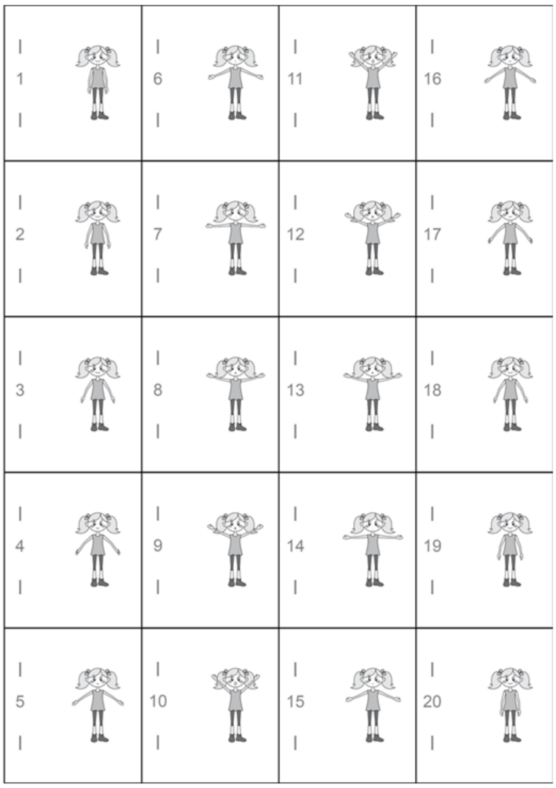
Lesson 3 – Illusory motion

Duration	1 hour 15 minutes
Material	For the entire class: • Computer connected to a video projector or IWB • Video 1, downloaded from the project website For each pupil: • Worksheet 7 • Stapler or paper clips
Aims	• Show how film, television and animations use different visual illusions
Skills developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses, and defend a point of view • The ability to discuss, question and justify a point of view
Vocabulary	Illusion

This lesson demonstrates the techniques that are used to make us perceive movement on screens.

Initial question

The teacher asks the class to use the ideas that were formulated during the introductory lesson on the ways in which screens stimulate one of the brain's functions: perception.



He/she plays video 1, a cartoon, and asks pupils, "What did we just see?" In response to the question, "Were the people standing still or moving?" the class will probably agree that the characters were moving. The teacher then writes on the board the question that will guide the lesson's activities: "How is it that we see people moving on screen?" The children write it down in their experiment notebooks.

The class then discusses this question. Some pupils may mention the rapid display of sequences of images – the forerunners of "motion pictures." However, they may have no answers.

Activity: flipbooks

To explore this issue further, the teacher gets the class to work on a series of images. He/she hands out copies of worksheet 7 to everyone. This worksheet has twenty numbered images that pupils are asked to carefully cut out.

Each child has a set of 20 images. The teacher asks the class, “What do you notice about these pictures?” The class notes that there are tiny differences between each drawing, that they are numbered and that they are in a specific order.

The teacher then sets the pupils a challenge: “By shuffling around these 20 drawings, make the figure move. You can use staplers or paperclips if you need them.”

Sharing results

After allowing pupils to work on their own for a while, the teacher asks a few of them to show him/her how they solved the challenge.

During discussions, the class may suggest a possible solution: holding the non-illustrated part of the images between the thumb and index finger of one hand and quickly flipping the images with the other.

The teacher asks pupils to put the images in order and staple them together. He/she then asks them to test different variants (one at a time) to see if the figure still moves in the same way, for example:

– Flipping the images more slowly
– Removing some of the images
– Changing the order of the images
– Using the same image on all the cards.

Pupils note the results of each variant in their experiment notebook.

During the discussion that follows, the class will probably come to the conclusion that, to create the illusion that the figure is moving, all of the images (each of which is slightly different) are required, the images must be in the right order and they must be flipped quickly.

To show how sequences of still images are used in videos, the teacher plays video 1 again, choosing the “slow motion” option in the viewer menu.

The teacher can explain that creating the impression that objects or characters are moving using static images is called “illusory motion”. There are many different kinds of illusions, which affect all of the senses. They show how our brain processes information transmitted by the sense organs.

Note for teachers

– The teacher can explain that the object each pupil has just created is called a “flipbook” and that flipbooks led to the invention of the first film in 1895. If he/she has one, he/she can show the class a film reel where it is easy to see the succession of still images.

– The teacher can ask pupils to think about the term "motion picture" if they have not already done so during the lesson. One picture by itself is not moving: motion pictures are films that are made up of a succession of many pictures.

Written conclusion

As a class, pupils come up with a general conclusion that they write down in their experiment notebook. For example: "On screen, it looks as if people are moving. But we are actually just observing a series of still images, each of which is slightly different."

Contribution to the "Charter on Using Screens Better"

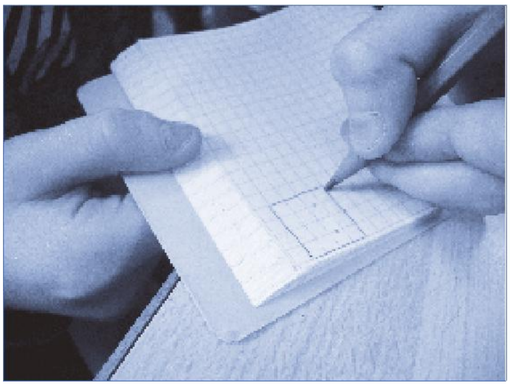
At the end of this lesson, the class works as a group to write a recommendation for the "Charter on Using Screens Better". This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: "When I am watching a film, cartoon or video game, I get caught up in the characters' movements and actions. I need to be aware that they are just illusions, but that doesn't mean I cannot enjoy the experience."

Scientific note

The motion illusion is caused by two phenomena: one in the retina and the other in the brain. When an image is imprinted on the retina, it does not disappear immediately, but is stored for a few tenths of a second. After this period of time, retina cells are once again sensitive and perceive the next light signal. In this way, the image we see right now is superposed onto the image we just saw. However, illusory motion is also dependent on the brain's ability to interpret a series of quickly replaced, slightly different images as a smooth, continuous movement.

Further study

– As an extra activity, the teacher can suggest that pupils make a flipbook at home using their own drawings, or photos that are taken one after the other and shown in fast succession. Or they could make other animation toys (such as thaumatropes or zoetropes) that create illusory motion.
– The teacher can also do further work on this topic by studying the origins of film and early motion pictures by demonstrating (and perhaps building) other mechanisms creating illusory motion.



Lesson 4 – 2D/3D

Duration	1 hour 30 minutes
Material	For each pupil: • Worksheets 8 and 9 For half of the groups: • Worksheet 10 (printed in color or copied onto a sheet of A4 paper) For the other half: • A pair of 3D glasses (bought or made beforehand by the teacher using worksheet 11, a sheet of thin cardboard, an overhead projector transparency and two permanent markers in red and blue)
Aims	• Get pupils thinking about the concepts of two and three dimensions • Help pupils understand the factors involved in 3D films
Skills developed	• The ability to recognize, name and describe frequently observed shapes and solids • Investigative techniques: observing and asking questions • Clear oral expression using appropriate language
Vocabulary	2D, 3D, dimension, direction, illusion

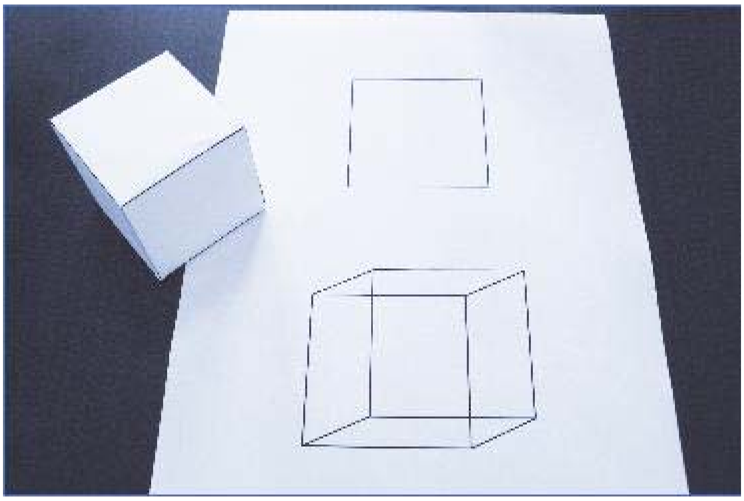
This lesson explores the concept of "3D" as it is used on screen (in films, on television, and in video games) and the geometric properties of objects that are two- or three-dimensional. The aim is to demonstrate that what films call "3D" is actually a visual illusion – a two-dimensional figure is perceived as a three-dimensional volume thanks to technical artifice.

Initial question

The teacher asks the class to use the ideas that were formulated during the introductory lesson on the ways in which screens stimulate one of the brain's functions: perception. He/she asks the class: "Have you ever heard of 3D? Can you try to explain what it is?" Pupils discuss these questions. Generally, several children know the term as a result of the increasing number of 3D films being released. They may suggest, for example: "It's when the image comes out of the screen"; "It's when the image jumps out at us"; "It's the way the image is made"; "3D is more realistic than 2D"; "With 3D, it's like we can touch the images"; "It's a way of depicting images"; "You need special glasses to see 3D images"; etc.

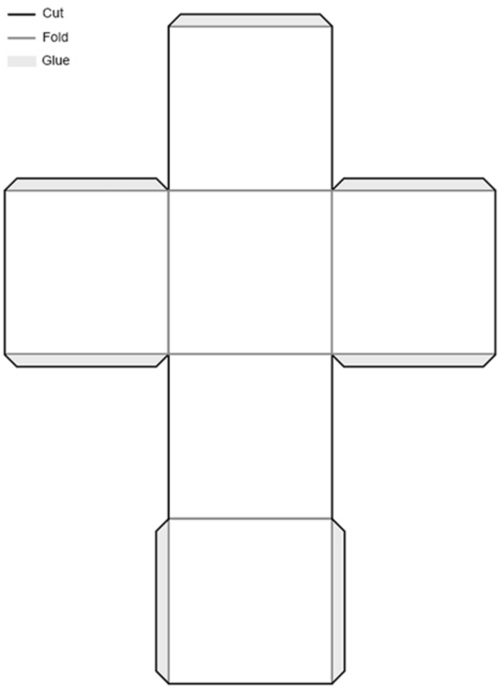
By asking questions, the teacher encourages the class to think about the concept of "dimension". For example, he/she could ask: "What does the 'D' in '3D' stand for? How is 3D different to 2D? Can you name some 2D objects and some 3D objects?" The class discusses these questions. Often pupils know the terms "two dimension" and "three dimensions" but lack clear knowledge of the underlying concepts. The teacher writes the initial questions on the board: "What is 3D? What is the difference between 2D and 3D?" Pupils write the questions in their experiment notebooks.

Activity: 2D and 3D



The teacher gives each pupil a copy of worksheets 8 and 9. On these worksheets are: a drawing of a square (in two dimensions), a drawing of a cube (in two dimensions, with the third dimension in perspective) and a cube pattern to cut out (once folded, the cube will be a three-dimensional object).

The teacher asks, “Can you describe the objects pictured here?” The pupils reply, “There’s a square”; “That one’s a cube”; “No, that’s a drawing of a cube”; “That’s a pattern, we can use it to make a real cube” etc. Often pupils have already made cubes and therefore recognize the pattern. The teacher then asks the class to make the cube using the pattern. Pupils work individually.

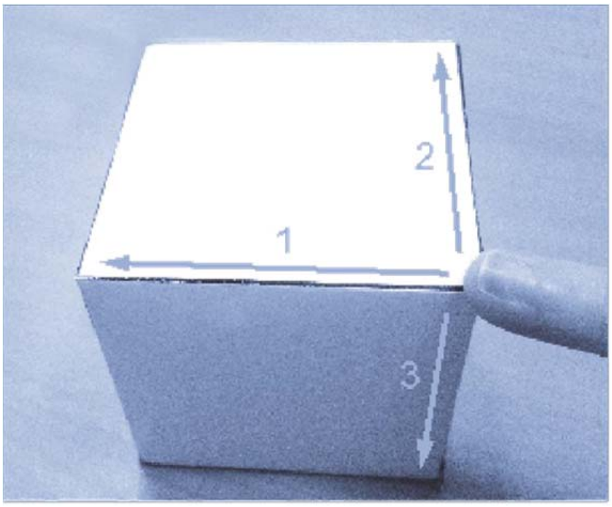


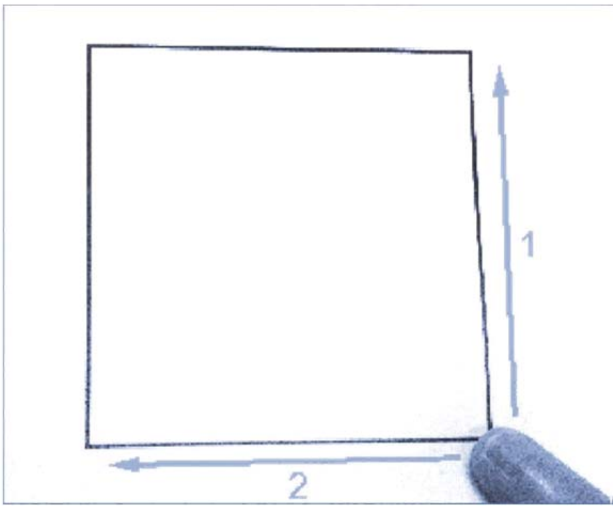
At the end of this time, each pupil will have three objects in front of him/her. The teacher says to the class: “Look at these three objects. What do they have in common? How are they different?” If necessary, to get things started, he/she can ask the class to compare the square drawing on worksheet 8 and the cube built using worksheet 9. Pupils discuss, and make comments like: “The square has four sides and is flat; the cube has 12 edges and 6 faces”; “Each face of the cube is a square”; “The drawing of the cube looks like it has 6 faces, but it’s actually flat, like the square” etc. To help the pupils organize their ideas, the teacher can draw a table with two columns on the board: “What is the same” and “What is different”.

The teacher then asks, “Which of these objects do you think is two-dimensional? Which is three-dimensional?” Pupils give their answers. Most of the time, they say that the square is two-dimensional and that the cube is three-dimensional; however, they are unsure about the drawing of the cube. Some might say, “In the drawing the cube stands out, it has depth: there’s a front and a back.” Others might reply that it is three-dimensional, to which the rest may object, “It doesn’t look as if the front of the cube stands out from the paper.”

The teacher asks the class to put their cubes on the table, put their fingers on one of the points and run their fingers along the edges one direction at a time: “In how many directions can we go?” The pupils carry out their test: they can run their fingers in three possible directions – from left to right (or right to left), from top to bottom (or bottom to top) and from back to front (or front to back). These are the “three dimensions”.

The teacher asks the class to do the same to the square drawn on worksheet 8: the finger can only go in two directions – it is therefore a two-dimensional object.



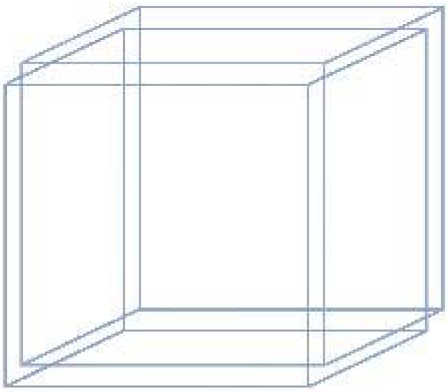


Written record

As a group, the class writes a definition explaining the difference between two and three dimensions. For example: “For objects drawn in two dimensions, we can only follow two directions. For three-dimensional objects like the cube, the contours go in three directions: from left to right, from front to back and from top to bottom.”

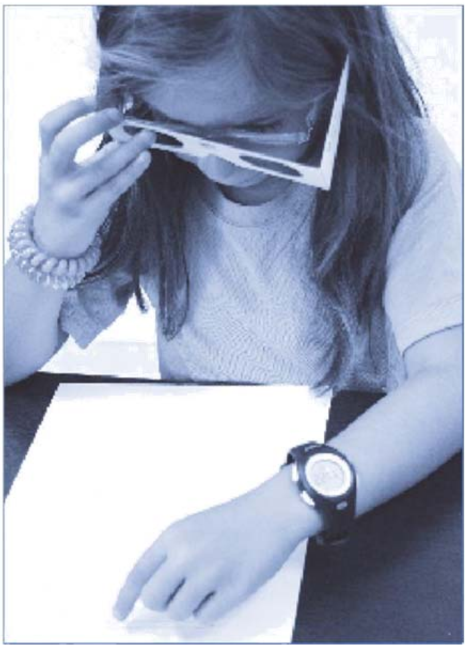
The teacher asks, “Based on the work you just did, is the drawing of the cube on worksheet 8 two- or three-dimensional?” Pupils test with their fingers. Some may be tempted to follow the lines from a single point and interpret the result as three dimensions. If so, the teacher can use questions to guide them. For example, he/she can ask whether, in doing this, they are really going “from left to right (or right to left), from front to back and from top to bottom.” After pupils have shared their results, the class concludes that the finger can only move in two directions on a sheet of paper, just like for the square above. The drawing of the cube is therefore two-dimensional. However, it represents a shape that is three-dimensional in real life: the cube that they cut out and folded using worksheet 9.

Activity: 3D illusions



The teacher asks the class the following question: “Based on the definition we just wrote, what do you think about three-dimensional films?” The class discusses their ideas. Some may begin by saying, “We see objects the same way as we see the cube,” or that objects have “a left and right, a front side and a rear side, a top and a bottom.” Some may object, saying, “We can’t really touch the objects, our hand goes through them.” The teacher then asks, “How can we find out more?” The answer is to study a 3D image.

The teacher splits the class into groups of four or five pupils. Half of the groups are given worksheet 10 printed in color or drawn on a sheet of A4 paper. The other groups are given a pair of 3D glasses. The teacher gives the following instructions: “In your groups, look at the image or object you are holding and describe it in a few lines. What shapes do you see? Which colors? Choose one person to be a note-taker to write down the group’s ideas.”

Sharing results

After the groups have completed their descriptions, note-takers read out their work and the teacher writes a summary of the two objects' characteristics on the board. For example:

– For the drawing: "It is a drawing on white paper. We can see two drawings of cubes, one on top of the other: one cube is red, and the other is blue. They are overlapping." If the class does not come up with this information, the teacher can ask, "Is the object two- or three-dimensional, based on our definition? It's two-dimensional."

– For the glasses: "They are glasses made out of white cardboard. There are holes for the eyes. The arms run along the side of the face and hook over the ears and there is a nosepiece for the nose. The plastic in front of the left eye is red; the plastic in front of the right eye is blue."

The teacher then asks, "How do you think we are going to use these objects? What is going to happen?" The pupils make suggestions, which are written on the board. For example: "If we put on the glasses and look at the drawing, it will seem as if there is just one cube that stands out from the page"; "If we put on the glasses, the cube will jump out of the page"; "When we wear the glasses, we see in 3D."

After pairing up the groups (one group with the drawing, the other the glasses), the teacher asks the pupils to take turns looking at the cube drawing with the glasses. The class confirms that it sees the cube in 3D.

The teacher turns their attention back to the object characteristics that the pupils wrote on the board. He/she asks: "Do you think all these characteristics are necessary for us to see the 2D drawing as if it was in 3D? What happens if we change something about the drawing or the glasses?" The pupils discuss this idea. For example, "It wouldn't work if we didn't put on the glasses / if we changed the color of the glasses / if we changed the color of the drawings / if the drawings were not overlapping / if we covered one eye" etc. The teacher writes these ideas on the board.

Written conclusion

As a class, pupils come up with a general conclusion that they write down in their experiment notebook. For example: "3D images look like they stand out from the screen. But they are not real three-dimensional objects: they are just pictures that are drawn or filmed in a special way. This technique creates the illusion of a 3D object.

Contribution to the “Charter on Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better”. This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: ““When I am watching a film or video game, I might actually believe characters or objects jump out of the screen. I need to be aware that they are just illusions created using special techniques, but that doesn’t mean I cannot enjoy the experience.”

Scientific note

In everyday life, objects are three-dimensional. To create the impression of real life in films or videos, we must show the objects as they are – in other words, in three dimensions and not flat. We are able to distinguish an object from drawings or photos of that object because we have two eyes. Because they are set a few centimeters apart, each of our eyes has a slightly different point of view. The left eye sees the left side of the object and the right eye sees the right side. Using this information, the brain perceives the object’s volume.

Three-dimensional films are created using specially designed software that produces one image for the right eye and another for the left. However, glasses are necessary to ensure that each eye only sees the image it is supposed to. They stop the right eye seeing images intended for the left eye, and stop the left eye seeing images that are for the right eye. Each eye therefore sees the object from a slightly different angle, which means the brain perceives a 3D object.

Lesson 5 – Space on screen

Duration	1 hour
Material	For each pupil: • Worksheet 12 For each group of pupils: • A3 paper
Aims	• Get pupils thinking about different forms of spatial representation: first-person (egocentric) perspectives and third-person (allocentric) perspectives • Compare the ways in which space is perceived on screen and in real life
Skills developed	• Investigative techniques: observing and asking questions • The ability to discuss, question and justify a point of view
Vocabulary	Avatar, perspective, spatial representation

This lesson explores the ways in which space is represented in video games and films: from a first-person perspective (the character's viewpoint) or a third-person perspective (from an external and viewpoint that is independent of the character). These perspectives require the brain to alternate between different types of spatial representation (egocentric and allocentric) and attempt to "see the world through someone else's eyes".

Preliminary note for teachers

This lesson is more suitable for older pupils (aged 8 to 11) rather than younger pupils (aged 5 to 7).

Initial situation

The teacher gives each pupil a copy of worksheet 12. He/she then asks them to look at the pictures and, working alone, note their observations in their experiment notebook. The class then shares their views. They note that the two images depict the same scene of a video game from two different perspectives: "In the first picture, we see the scene and the character from above; in the second picture, we see the scene through the character's eyes as if we were the person."

The children discuss this observation. They may mention other examples from video games or films, for example: “In video games we can change perspective by pressing a button”; “In some films it is as if we fall over ourselves or as if we were actually in other countries.”

Activity: spatial representation

The teacher asks pupils to imagine that the classroom (or gymnasium) is the setting for a video game. The desks form a maze that pupils must navigate through. He/she asks the class: “What do you say to a classmate (a “player” or “avatar”) to help him/her get from one point to another point? Are there different ways of guiding him/her?”

The teacher divides the pupils into groups and uses two distinctive objects to mark two points in the classroom: point A (the starting point) and point B (the finishing point). Each group develops a strategy for getting their “avatar” from point A to point B and notes these instructions on a large sheet of paper.

Sharing results

Each group nominates a speaker to share the group’s strategy with the rest of the class. Some groups may have chosen to formulate instructions from their own point of view: “We told him/her to take one step to his/her left, one step to his/her right, etc.” This is like using the arrows on a keyboard to guide an avatar in a video game. Other groups may have chosen to formulate instructions from a third-person point of view: “We told him to go around the pole, then go from table one to table two, then towards the teacher’s desk, etc.” If pupils do not raise one of these possibilities, the teacher can use the two images in worksheet 12 to refresh their memory.

Next, each group chooses one person to be an “avatar” and another to be a “guide”. The teacher secretly gives these “guides” a new finish line that the “avatar” does not know of. The avatar sets off from point A and the guide uses the selected method to guide him/her to point B. Following these tests, the class discusses the advantages and drawbacks of each method.

Note for teachers

The teacher may ask pupils to find examples of both types of spatial representation (for example, GPS devices, maps, topographic maps, etc.).

Written conclusion

As a class, pupils come up with a conclusion that they write down in their experiment notebook. For example: “When characters move around on screen, we either see things from a first-person perspective or from a third-person perspective. When we see things from a first-person perspective, it can feel as if we were moving and acting ourselves, even though we are sitting in front of the screen.”

Contribution to the “Charter on Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better”. This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: “When I am playing a video game, I may feel as if I am the hero who is moving around on screen, but I need to remember that a game is just a game.”

Lesson 6 (optional) – Big or small?

The illusion of size

Duration	1 hour 30 minutes
Material	For each pupil: • Worksheets 13, 14 and 15 • Wooden sticks (for example wooden skewers or chopsticks measuring 20 to 25cm) on one end of which the teacher has marked a red line using a felt-tip pen • Black felt-tip pen • Ruler
Aims	• Demonstrate how image editors use the size of the objects pictured to suggest their position in space and create a relationship between size and position • Observe the relationship between an object's position and its apparent size
Skills Developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses, and defend a point of view • The ability to read, interpret and develop simple representations: tables, graphs • The ability to make measurements with a ruler • The ability to use common measurements and measuring instruments
Vocabulary	Illusion, perspective, apparent size, real size

This lesson explores optical illusions that affect how we perceive space, and images in particular. To calculate depth, our brain uses different clues, including the size of objects. By playing with these clues, image editors can create the illusion of depth and other special effects.

Initial question

At the start of the lesson, the teacher gives each pupil a copy of worksheet 13. He/she asks pupils to look at the image and asks: "What can we see in this picture? Do you think the two boys are the same size?" Pupils share their views. Some will say, "The two boys are the same size." Others will say, "The boy at the back looks bigger." The teacher then asks, "Does this seem normal to you?" The pupils give their opinions. Some may say that the boy at the back is "a giant".

The teacher asks, "How can we check if Boy B is bigger than Boy A?" The pupils measure the size of both boys by using a ruler or by cutting out one image and laying it over the top of the other. The teacher asks, "If both boys are the same size, why do we get the impression that the boy at the back is bigger?" The pupils discuss this question. Answers may include, "Because he almost touches the ceiling"; "He takes up the whole tunnel"; "He is further back in the tunnel" etc.

During the discussion, the teacher asks, "What happens when we see someone who is far away in real life?" The answers given by the class may include, "In real life, when someone is far away, they look smaller." If the class does not mention this idea, the teacher may raise it, because it underlies the concepts of real and apparent size. The teacher then suggests they test this hypothesis.

Scientific note

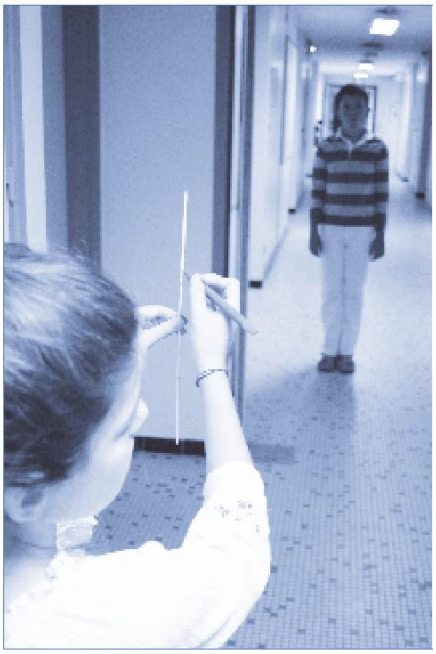
A smaller object close to us and a bigger object further away from us may be the same size in the retina. Nevertheless, we are able to distinguish between the two. This is because the brain analyses the objects using contextual information indicating how far away they are. In this way, two objects that are the same size in the retina can appear to be different sizes if the context affects their apparent size. This is the optical illusion.

Activity: close up and far away

This activity has two parts. The first takes place outside in the playground (or the gymnasium) and aims to demonstrate how an object's apparent size varies depending on its distance from the viewer. The second takes place in the classroom.

1. Field testing

To find out what we really see when someone moves away from us, the teacher asks pupils to carry out an experiment in the playground (or the gymnasium, if it is big enough). Each pupil takes a felt-tip pen. Once in the playground the teacher also hands out wooden sticks that he/she has previously marked with a red line.



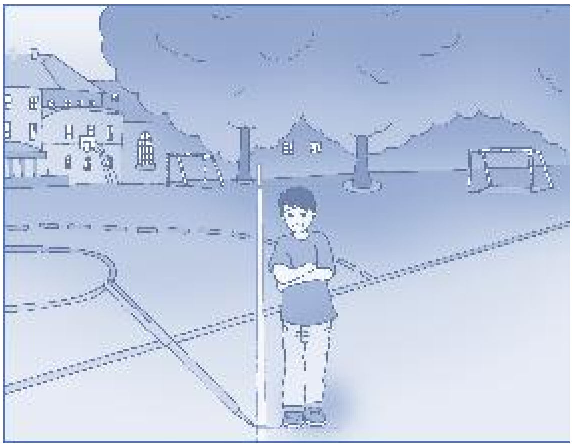
The pupils form a horizontal line at one end of the playground. The teacher asks one pupil to gradually move away from the rest of the group. He/she asks the class, "What do you think will happen to your classmate as he/she moves away: will he/she get bigger, smaller or stay the same size?"

Note for teachers

The teacher may ask pupils to think about the importance of having a fixed reference point for measuring (staying in the same place to make measurements), having a marker for the top of the pupil's head and making other marks on the wooden stick. In mathematics, this is a good starting point when comparing measurements.

To answer the above question, the teacher asks pupils to make measurements using the wooden stick. To do so, he/she gives instructions. For example, "Your classmate is going to walk away, stopping three times when I ask him/her to. Each time he/she stops, take the wooden stick with the red line at the top in one hand and hold it out from you horizontally. Closing one eye, line up the red mark with the top of your classmate's head and, with your black pen, make a mark where his feet are. This will allow us to measure his/her apparent size – the size we perceive."

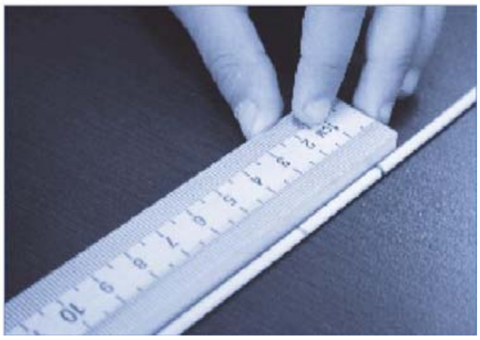
The pupil starts walking away. The teacher stops him/her when he/she has walked 10 meters (approximately 10 adult steps). The rest of the class makes their measurements. Next, the pupil walks to the middle of the playground, where the others take another set of measurements. Lastly, he/she walks to the edge of the playground, where the others take a final set of measurements.



Note for teachers

The teacher may ask older pupils (aged 8 to 11) to find their own ways of comparing measurements of the apparent size of the pupil who moves around the playground. Pupils may suggest using their rulers with zero as the starting point and the other lines to measure the heights observed.

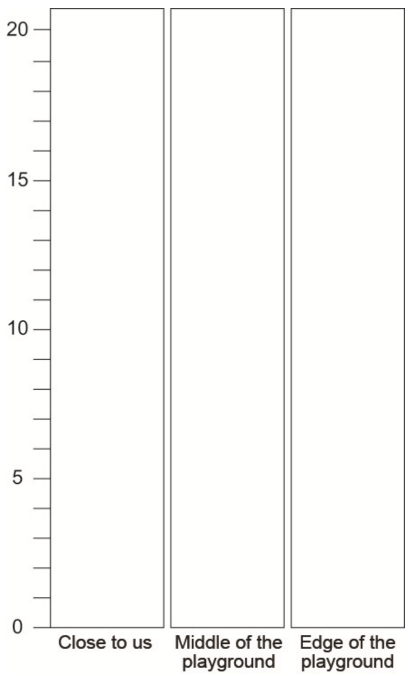
2. Graphing results



Back in the classroom, the pupils put their wooden sticks on the desk and use their rulers to measure the distance between the red mark and the three black marks. To help note the results, the teacher may ask them to fill in the following table.

	Close to us	**Middle of the playground**	**Edge of the playground**
Apparent size	*E.g. 12 cm*	*E.g.: 7 cm*	*E.g.: 2 cm*

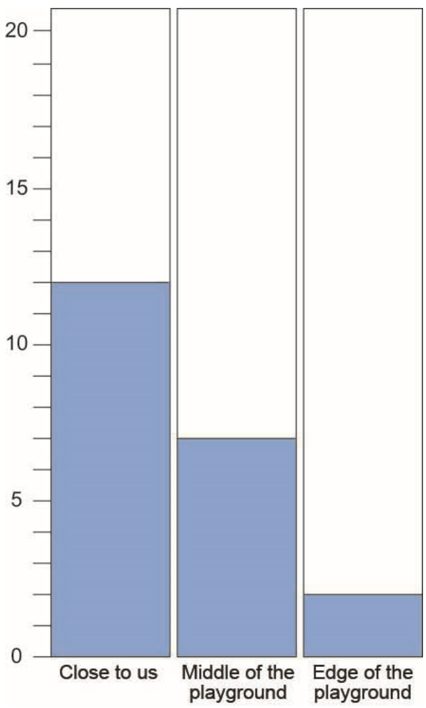
Depending on their age, the pupils can be asked to process the data in different ways, including:



– Drawing up a simple list or table, as above

– Comparing the values using the mathematical symbols >, < and =

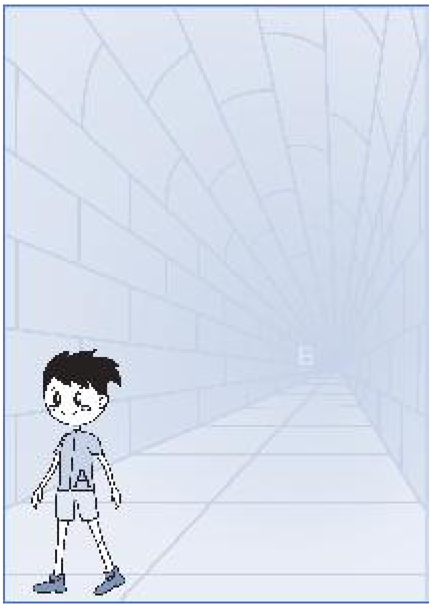
– Making a graph, for example by using worksheet 14. For each situation (close to us / middle of the playground / edge of the playground), the teacher asks pupils to draw a horizontal line corresponding to the height they measured, then to color the area underneath the line.



Note for teachers

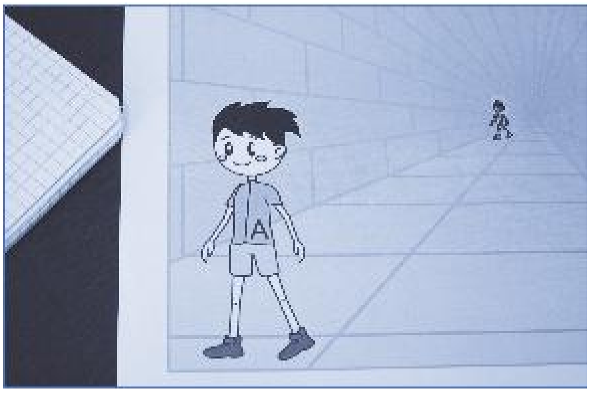
If the teacher wishes, he/she may use this exercise to show pupils that the measurements taken differ from person to person. He/she may also talk about the variation of measurements that would be obtained if the same pupil did the exercise several times. Depending on the pupils' ages, he/she may discuss the concept of averages.

Sharing results and drawing a conclusion



As a class, pupils share their results and come up with a conclusion that is written on the board and in their experiment notebook. For example: "When an object or a person moves away from us, they look smaller but we know they are still the same size."

The teacher asks pupils to apply this conclusion to the image they saw at the beginning of the lesson. After handing out a copy of worksheet 15 to all pupils, he/she asks them to draw a boy at the back of the tunnel that could be the boy seen in the foreground who has walked away.



This allows the pupils to add further information to their conclusion. For example: "To make it look as if an object or a person is far away in a drawing, he/she/it must be drawn smaller than if he/she/it was close up."

Contribution to the "Charter on Using Screens Better"

At the end of this lesson, the class works as a group to write a recommendation for the "Charter on Using Screens Better". This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: "We must be aware that image editors can play with our perceptions to create effects that are funny, scary, etc."

Scientific note

Artists draw lines on paper to make us understand one representation of space. Spatial representation varies widely from civilization to civilization and from era to era. In the Western world, the rules of perspective, which helped artists show depth, appeared during the Renaissance in the 15th century. This geometric method makes it possible to represent objects on a flat surface as they appear when we see them (height, width and depth), as well as their distance from the viewer. The rules of perspective are still used today, including in films and video games. Designers know that to make an object appear closer or further away, they must modify its size. However, some artists play with size to surprise viewers.

Attention

Scientific background

Lesson 7. Concentration and distraction

Lesson 8. Multi-tasking

Lesson 9. Controlling natural reflexes

Scientific overview

Attention is a mental process that is essential to conscious cognitive functions. It helps us select information, determine how such information is processed by the brain, and control possible distractions. It also influences our perception of the world, others and ourselves.

How can attention be illustrated?

Attention is like a spotlight aimed at an object or a single goal. This metaphor demonstrates that at any given moment, we can only see part of the world around us. However, it does not take into account that we have to make an effort to stay focused.

What role does attention play?

The role of attention is to act as filter for incoming information. Attention focuses on what the brain considers important, chooses what information to process based on our goals and ignores insignificant or distracting information. Elite athletes or musicians, for example, must be able to hone their attention to be very selective.

Attention is related to awareness. Most of the time, we are not aware of our breathing, but by simply moving our attention to it, we become aware of it. The same applies to thoughts, emotions and sensations that we experience.

Can we pay attention to several tasks at once? Can we divide our attention?

A task is a controlled action requiring a mental effort and a precise goal. Learning helps us to be able to do a great number of tasks automatically without paying attention to them. As such, automatic behaviors (walking, riding a bike, reading, etc.) cannot be considered tasks.

People are not able to truly multi-task. The brain can manage or coordinate two tasks at a time by alternating between them very quickly (a few milliseconds), but the tasks are most like not actually carried out simultaneously. Trying to do several tasks at once leads to stopping some of them and increases the risk of making mistakes and time spent completing the others.

Can our attention be captured by an outside event?

Attention is not entirely under a person’s control. It can be captured by various stimuli, allowing us to adapt to a change in our environment (e.g., when an alarm goes off). Things we are used to no longer attract our attention, which is captured by new and unexpected things (which is quite useful if a dangerous situation arises). We live in an information-driven society today, where innovation is constantly required to surprise us and capture our attention.

Can we alternate between states of attention and distraction and vice versa?

We are constantly switching between states of attention and distraction in our daily lives. We can decide at any time to redirect our attention. This fluidity of attention enables us to remain aware of what is going on in the world around us while doing a task. A person's ability to concentrate varies according to many factors: fatigue, emotions, habits, motivation, etc.

Is attention necessary to learn?

Attention is a pillar of learning. First, it is necessary for perception, understanding and memorization. Second, learning allows us to develop automatic behaviors. Attention is also required to block automatic behaviors at times. For example, you cannot walk the same way on steep terrain as you would on flat ground. Walking can no longer be an automatic behavior; you must pay attention to keep yourself from walking normally and adapt to the environment.

Our capacity develops progressively in early childhood, changes significantly between the ages of 4 and 6 and again during puberty, and continues to develop until early adulthood.

Where is the seat of attention in the brain?

There is no real “brain center of attention,” but there are several neural networks for attention in which the prefrontal cortex plays a crucial role.

Lesson 7 – Concentration and distraction

Duration	1 hour
Material	For the entire class: • Computer with internet access connected to a video projector or IWB • Video available at the following address: http://youtu.be/IGQmdoK_ZfY; (contact our team through the website if you have trouble accessing the link)
Aims	• Get pupils thinking about the ideas of attention (either intentionally directed or captured by objects or events) and distraction • Get pupils thinking about how attention has limits and that it is possible to "pay attention to our state of attention"
Skills developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses and defend a point of view • The ability to discuss, question and justify a point of view
Vocabulary	Attention, concentration, distraction

In this lesson, pupils work on the mental faculty of attention, a faculty which allows us to voluntarily concentrate while being susceptible to distraction by our environment.

Trigger

Note for teachers

– The short video, which is good for all ages, was developed by a laboratory that carries out cognitive psychology research.

– This lesson uses the video to encourage questions from pupils. Nevertheless, teachers in classrooms that do not have easy internet access can skip ahead and start at the "Discussion" section.

Watching the video

First, the teacher tells the pupils they will watch a short video and give them an instruction: "You are going to watch a video that shows two teams passing balls back and forth. You have a job to do: count the number of passes that the players in white make – and only the players in white." The teacher plays the video, asking the pupils to not talk until the end. After the video is over, s/he asks the pupils to write down how many passes they counted in their experiment notebook.

The teacher then asks the class: "how many passes did you count between the players in white?" The pupils give their answers. S/he then asks: "Did you notice anything else during this video? Did something happen? Something that had nothing to do with the players?"

Some of the pupils will have seen a person wearing a gorilla costume and will say so. Others will not have noticed. As they discuss the video, there will be certain pupils who correctly counted the passes who did not see the gorilla. The teacher asks those who did not see the gorilla "Why didn't you see it?" and the pupils will answer: "Because we were concentrating on the players in white, on counting the number of passes."

The teacher then asks the pupils – particularly those who saw the gorilla – if they noticed anything else surprising during the film. It is likely that none of them will have noticed that when the gorilla appeared, the curtain in the background slowly changed from red to yellow and that a player from the black team left the stage. The teacher plays the film a second time so that everyone can watch for these events and notice the changes. Generally, those who saw the gorilla (and stopped counting the passes) did not see the curtain change color or the player in black leave the stage. The teacher asks: "How is it possible that we don't notice this type of thing on the screen?" The pupils talk, offering suggestions such as "When we are concentrating on something, we might miss something else happening at the same time," that we "Can't pay attention to everything at once," or that "Even on screen, we can't see everything if we aren't looking for it."

Discussion

The teacher gets the class to share its results by asking "In our daily lives, are we sometimes concentrating so much on one thing that we don't see what's going on around us?" Pupils generally respond to this question based on their own experiences: "Sometimes, when we're playing ball and are concentrating on the game, we might not notice that one of our teammates fell down," "When I'm playing video games, I don't hear my sister calling me," "When I'm reading, I don't like for people to talk to me because it's distracting."

The class comes up with a conclusion to summarize these ideas, which is then written on the board and in their experiment notebook. For example: "When we are concentrating hard on something, we don't notice everything going on around us."

Activity: Concentration and distraction

The teacher touches on the pupils' examples: "When we are really concentrating on something, can we still be distracted from it?" The pupils offer suggestions, such as "Yes, by someone who calls our name or yells" or "By someone who taps us on the shoulder."

The teacher asks the class to split up into pairs and do an experiment to see if and how it is possible to distract someone who is trying to concentrate (obviously, without being violent). If the pupils have trouble coming up with a situation, the teacher can suggest that one of the pupils do a task (e.g., read a text from any book quietly) while the other student tries to distract him or her and attract their attention. Do the activity for a minute or two. The teacher can have pairs reverse roles if time permits.

Note for teachers

– For this activity, the point is not to successfully distract the student from his/her task but to get the class to discuss the things that can distract their attention – such as unexpected events, movements or noises.

– For children who are not yet able to read quietly aloud, the teacher can ask them to draw instead.

Sharing results

When pupils return to their seats, they can discuss all of the various ways they tried to distract their partners: movements (waving a hand), noises (talking in their ear), tapping their shoulder, moving their face close to the other student's, etc. The discussion should deal with what distracted the pupils – in other words, what captured their attention. The answers are written on the board.

The teacher can direct the discussion to the issue of screens and explain that they have many features to attract our attention (loud sounds, bright or sudden light, constant movement, bright colors, unexpected things happen, etc.) and hold it (a suspenseful scenario, a goal to score, a score to beat, etc.).

Scientific note

Video games make use of various factors to capture and hold the user's attention. Because they are games, they require the active participation of one or more players. Furthermore, they often combine a moving image, noises (sometimes dialogue), music, bright colors that change and a number of surprising elements, all the time setting a goal or score to reach which is often part of a captivating or suspenseful scenario. Video games are among the best "attention getters" in the audiovisual world.

The teacher asks the "concentrating" pupils to describe their strategies to remain attentive to their task: "I held my head in my hands," "I put my hands over my ears," etc. if they had to make a particular effort.

To take the discussion further, the teacher asks if there are situations where it is absolutely necessary to concentrate. The pupils may suggest things such as "To do your homework", "To color a picture without going outside the lines" or "To score a goal when playing football." The teacher asks if, on the contrary, there are times when it can be useful to not be completely immersed in a task. The pupils might say, for example, that sometimes "You have to be able to stop paying attention to a video game and answer when your mom calls you to dinner," or "You have to be able to react to a fire alarm, even if you're doing math problems, so you can avoid danger."

Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook. For example:

"We are able to concentrate and be distracted. Whether watching a screen or doing something else, we can pay attention and concentrate. When we are really concentrating, there are things we do not see or hear. Our attention can be captured by things that attract our senses."

Contribution to the "Charter for Using Screens Better"

At the end of this lesson, the class works as a group to write a recommendation for the "Charter on Using Screens Better." This recommendation is then added to the poster that was hung on the classroom wall during the introductory lesson. For example:

"Screens easily attract our attention, but it is important to realize they can distract us from paying attention to what is going on around us."

Lesson 8 – Multi-tasking

Duration	45 minutes
Material	For the entire class: • Worksheet 16 (printed on A3 paper or projected on the IWB)
Aims	• Get pupils thinking about how difficult it is to do several tasks at once • Get pupils thinking about how attention has limits and that we can "pay attention to our state of attention"
Skills developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses and defend a point of view • The ability to discuss, question and justify a point of view • The ability to read, interpret and represent data in simple format, i.e., tables and graphs
Vocabulary	Attention

Initial question

The teacher asks the class to use the ideas that were formulated during the prior lesson on attention and the necessity to make an effort to concentrate and not get distracted. S/he asks the question "Can we pay attention to several things at once?" and has each student write it in their experiment notebook. The class talks about the question and the teacher writes their ideas on the board. Some may think it is possible while others do not. The teacher asks them to justify their answers with examples from their own experiences. As the pupils talk, some may say they can "Pay attention to cars on the road while riding their bike," "Watch TV and do their homework," "Listen to music and study," etc. ; Others may disagree, saying "You can't hear what the teacher is saying if you talk to your neighbor," "If the TV is on, you can't do your homework well," "If you listen to music in the street, you can't hear the cars," etc. The teacher makes a list of the examples on the board.

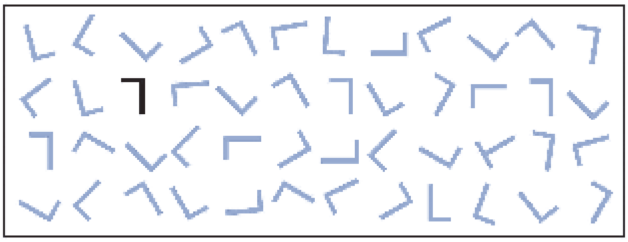
Activity: Multi-tasking

To explore this issue further, the teacher suggests the class come up with an experiment. S/he writes a list on the board of three simple tasks for the pupils to do. For example:

Tap a rhythm with one hand on the table ("tap-tap-tap-tap")

Look at a picture and find the intruder (the "T" in the middle of the "Ls") on Worksheet 16 that the teacher puts on the board

Listen to a text being read and count the number of flower names given.



Text:

"In my little garden, near a well and a bench,
Fragrant white lilacs grow. From April to
July, the lily-of-the-valley blooms
And the acacia blossoms over a pond."

The teacher then asks the class: "How do you think we can test to see if we can do two or three things at the same time? You can use the tasks written on the board." The pupils talk about it and make suggestions. For example, they may suggest doing the three tasks on their own or in groups: first a single task, then two at the same time, then all three at the same time.

Note for teachers

– If the pupils do not think of it themselves, the teacher can suggest they need to identify an indicator of "success." They can observe whether the tasks were completed, how many errors were made, or how long it took to complete the tasks (as the number of errors or time spent increase, the task can be considered as more poorly executed).

– The teacher can suggest that pupils not repeat the same task, because repetition encourages automatic behavior.

The pupils write down the following in their experiment notebook: the tasks, the conditions of the experiment (e.g., Task 1, Tasks 1+2, Tasks 1+2+3), and the student completing which part of the experiment. They should then write down if Task 1 was successfully completed (and in how much time, with how many errors); if two tasks (Task 1+2) were successfully completed, etc.

Note for teachers

The teacher can ask the pupils to organize their data in a table before discussing the results. For example:

	Task 1	Tasks 1+2	Tasks	...
Student 1	Succeeded			
Student 2		Failed		
Student 3			Failed	
Student 4	Succeeded			
Student 5		Succeeded	Failed	
…				

Sharing results

After the pupils have traded places and completed the experiment several times, they should write down their results in their experiment notebooks and discuss their observations as a group. They will see that pupils may have been able to do a single task, sometimes two if they stopped the third, or that they weren't able to do any of the tasks:

"As the number of tasks to complete increases, it becomes impossible to do all of them because we have a hard time concentrating on several tasks at once."

At this time, the teacher helps the pupils make a general conclusion that often "We think we can do two things at once" but that this is not true. For example, "When we talk in class, we miss part of the lesson because we are not listening to the teacher. If we want to hear the teacher, we have to stop talking," "When we do our homework in front of the TV, we stop concentrating on our work to watch TV, then go back to our notebook to concentrate on our work."

Through his/her questions, the teacher helps the pupils realize that we actually "switch or alternate" between tasks when we are trying to concentrate on two tasks at once.

Note for teachers

To show how the brain works on several tasks at once, the teacher can use the example of pausing a DVD: "If we need to talk to someone while watching a movie, we have to hit pause or we'll miss part of the movie and won't understand what's going on." By doing so, it takes longer to watch the movie. The same goes for a number of situations, such as "If we do our homework while watching TV, we alternate between the two activities and take longer to do our homework while also increasing the likelihood of making mistakes."

During the discussion, it may come up that certain activities are easier to do at the same time. For example, tapping a rhythm quickly becomes automatic, and when that happens, we can add another task that requires attention.

Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook. For example:
"It is not possible to do several things at once unless some of the actions are automatic. Often, we think we can do two things at the same time, but we take longer to do them and might make mistakes."

Contribution to the "Charter for Using Screens Better"

At the end of this lesson, the class works as a group to write a recommendation for the "Charter on Using Screens Better." This recommendation is then added to the poster that was hung on the classroom wall during the introductory lesson.
For example:
"To do something well, we have to avoid distractions. Whether in front of a screen or not, we should try and do only one thing at a time."

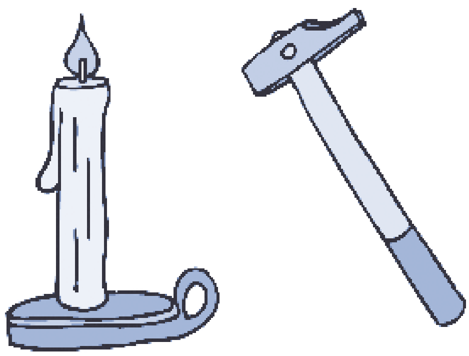
Lesson 9 – Controlling automatic behaviors

Duration	1 hour
Material	For the class: • Computer connected to a video projector or IWB • Video 4 "Tap/blow" which can be downloaded from the project website For each student pair: • Worksheets 17 and 18 (printed in color; Parts A, B and C should be cut out) beforehand by the teacher • Stopwatch
Aims	• Get pupils thinking about actions that are done automatically without having to pay attention • Help pupils gain awareness about why it is important to be able to ignore certain automatic impulses
Skills developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses and defend a point of view • The ability to discuss, question and justify a point of view • The ability to read, interpret and represent data in simple format, i.e., tables, graphs
Vocabulary	Automatic behaviors, control, mastery

Trigger

The teacher asks the class to use the ideas that were formulated during the prior lesson on attention and the difficulty of doing several tasks well at the same time, unless the tasks are automatic behaviors (repeated enough times to become automatic).

In a computer room or in the classroom, the teacher divides the pupils into groups to watch Video 4 "Tap/blow" and explains the rules of the activity: "When an image of a hammer appears on screen, tap the desk. When an image of a lit candle appears, blow. But if the candle isn't lit, don't do anything!"

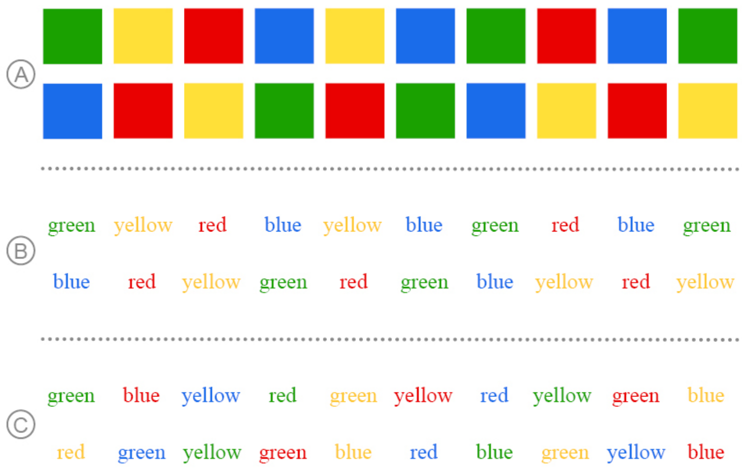


The teacher explains that the goal is not to "get a perfect score" but rather to pay attention to their natural instincts. After the pupils do the activity, the teacher asks:

"Is it easy not to make mistakes and not do the 'forbidden' action?" The class talks about their impressions as a group, suggesting, for example, that "You have to make an effort to not blow when you see the unlit candle," "Just when you get used to doing something, the game makes you change." If the teacher thinks the class is ready, the discussion can move towards what video games require of their minds, especially with regards to attention and automatic behaviors. The discussion can end with pupils' observation that video games are an activity that requires you to pay close attention and ignore automatic behaviors.

The teacher then asks the pupils to give other examples from their daily lives about times when they keep themselves from doing certain actions that would normally be automatic. The class talks about their own experiences, suggesting games such as “Simon Says,” playing sports, etc.

Activity: The Stroop Effect



To explore this issue further, the teacher tells the class they are going to do an experiment. The three parts (A, B and C) of Worksheet 17, which should have been cut out beforehand, will be passed out sequentially to the pupils.

The teacher asks the pupils to pair off, with one student being the ‘scientist’ and the other the ‘test subject’. S/he gives each scientist a stopwatch and each test subject a copy of Section A that has been folded in half (to not show the contents immediately).

S/he gives the following instruction: “Inside this paper are colored rectangles. When I say so, the test subjects will open the paper and say the colors. Meanwhile, the scientist will time how long it takes the test subject to read them all, starting the stopwatch at the first word and stopping after the last. You should also count the number of mistakes the test subject makes. Then write down the time and number of mistakes in your notebook.” If necessary, the instruction can be repeated to make sure everyone has understood, then the teacher gives the pupils the signal to start.

Next, the teacher passes out a copy of Section B (folded in half) to each test subject and tells the pairs to do a new test: “The test subject has a new task: to say the color of the ink used to write the words on the paper as quickly as possible. Like in the previous exercise, the scientist will time how long the test subject takes to get to the end of the page and the number of mistakes s/he makes.” The teacher makes sure the instructions were understood, then gives the signal to start the second exercise. The scientists write down how long it took the test subjects to complete the second exercise as well as the number of mistakes in their notebooks.

The teacher then passes out Part C (folded in half) to all of the test subjects and tells the pairs: “The test subject has to say the color of the ink used to write the words on the paper as quickly as possible. Like in the previous exercise, the scientist will time how long the test subject takes to get to the end of the page and the number of mistakes s/he makes.” The teacher makes sure the instructions were understood, then gives the signal to start the third exercise. The scientists write down how long it took the test subjects to complete the third exercise as well as the number of mistakes in their notebooks.

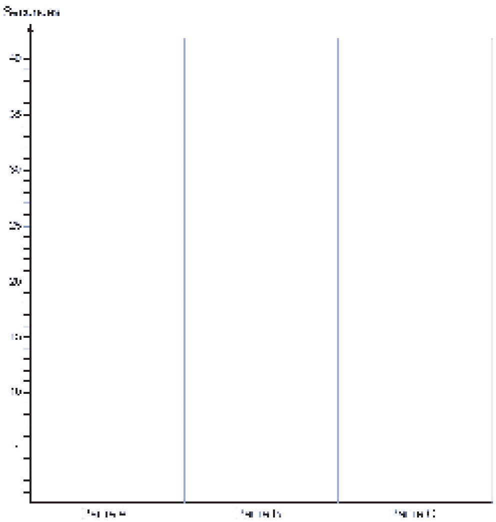
Note for teachers

– Depending on the time available for the lesson, the teacher can ask the pupils to switch roles and repeat the three exercises.
– This lesson assumes that all of the children have the same perception of colors – which is not the case for children who are colorblind. Although rare, colorblindness mainly affects boys and most often manifests as a problem perceiving red and green. In most cases, it is detected by age three and generally children are aware when they are colorblind. Teachers should explain that being colorblind is not a problem in daily life and to ensure that any children who are colorblind do not feel stigmatized.

Scientific note

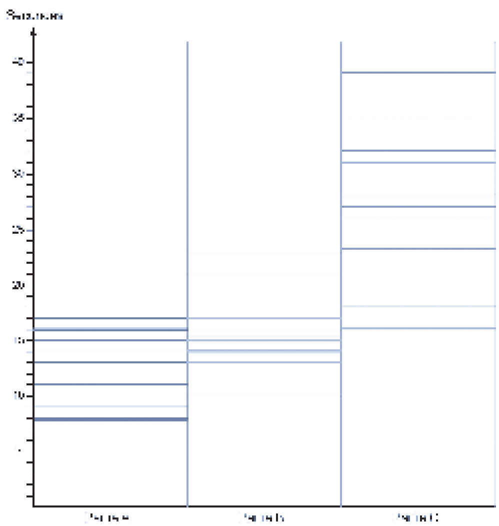
The Stroop Effect is an example of automatic processing: despite paying attention to the task of saying the colors, it is difficult to resist the automatic urge to say the word itself. The written word contaminates the correct response. The skill of reading is so strong that it is difficult for those who can read to keep themselves from reading when they see a word.

Sharing results



The teacher draws the graph outline (or displays it if already prepared) that will be used to plot the pupils' results from (Worksheet 18). For each part of the activity, s/he asks a dozen 'scientists' to say how long each test subject took to complete the task. For each answer, s/he draws a horizontal line according to the scale provided.
This graph helps the pupils quickly visualize that Part C required much more time to complete. By looking at the horizontal lines in the column, pupils can tell if the results vary a little or a lot.

The teacher asks the class to discuss the results: "Was it easy to read quickly and not make mistakes in Part A? What about for Part B? And for Part C?" The pupils will answer: "I knew I had to read the color, but I couldn't help reading the word," "When the word wasn't the right one, we read it anyways and made a mistake," "I read the word automatically," "I didn't read the words, but I had to really concentrate and go slowly."
The teacher asks the pupils to talk about what strategies they used to say the colors: "I took my time to concentrate on the color," I took off my glasses so I couldn't read the word," If I didn't know how to read, it would have been easier," "If the words were written in another language, I wouldn't have had such a hard time."
The teacher asks the pupils if they remember the process by which they learned to read: "At first, it took a long time to understand the letters and syllables, then after a lot of reading exercises, it became quick and easy – automatic."



The teacher asks the pupils if they have examples of other activities that have become so “easy” they do them automatically, or at least in part. They might cite various activities, such as multiplication tables, riding a bike, etc.
The teacher can continue the discussion about the fact that learning helps us acquire automatic behaviors, which helps us save time so we can do other things. However, sometimes automatic behaviors can also make us make mistakes. This means we have to make an effort to control automatic behaviors.

Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook. For example:
“We practice doing things until we are able to do them automatically. When we do them automatically, we can go faster until when we have to think about them, we might make mistakes. Not doing them the usual way requires more attention and a greater effort. We forget that certain actions come back automatically.”

Contribution to the “Charter for Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better.” This recommendation is then added to the poster that was hung on the classroom wall during the introductory lesson.

For example:

“Sometimes we have to resist an automatic gesture, response or habit and take the time to think to do the right action or give the right answer – both on screen and in the real world.”

Emotions

Scientific overview

Emotions are mental processes that appear through feelings and behavioral responses. The fundamental emotions are felt by all: happiness, sadness, fear, anger, surprise and disgust; often, interest and shame are included on the list. We feel a range of complex emotions that combine these basic emotions in our daily lives, such as jealousy, wonder, disappointment, enthusiasm, condescension, etc.

What happens when we feel an emotion?

Involuntary changes occur in the body when we experience an emotion. The body reacts through postures; movements; phenomena such as turning pale or red; increased breathing or heart rate; the voice changes; facial expressions change due to muscle contractions around the eyes, eyebrows and mouth. These changes differ according to the emotion.

The body reacts quickly to emotion; our response is automatic and occurs in a set order. Our mood may be affected for a longer period of time after experiencing an emotion.

Does everyone feel the same emotions for a given event?

A single event can provoke different emotions in people depending on how important each individual considers the event. For example, the fans of a winning sports team will be happy while those rooting for the losing team will not be; those who are not interested in sport will not feel anything at all.

Are emotions useful?

An emotion is a source of information. Feeling an emotion allows us to react and adapt our behavior appropriately to a change in our environment. For example, fear 'tells' us that we are in danger, which enables us to flee or fight back.

Emotions affect our attention, learning, perception of time, memorization (we generally remember an event better when a strong emotion is associated with it). Furthermore, when we have a choice or decision to make, emotion does not necessarily have a negative impact but often completes our rationality. Remembering a negative emotion keeps us from doing something again, while positive rewards associated with an event lead us to want to do it again.

Is it important to express our emotions?

People around us can observe the behavioral changes and mimicry of a person experiencing an emotion. Expressing our emotions is a method of non-verbal communication with others and is an important part of living with others.

Because the basic emotions are the same around the world, they form a sort of universal language. This language is, however, greatly influenced by the culture of each group, which allows a particular emotion to be expressed in varying degrees.

Do emotions have a trigger?

There is always a trigger behind an emotion, including other people's emotions. For instance, someone who is angry may cause the person with whom they are speaking to become afraid; someone who is afraid may cause someone else to become afraid. Various situations can also trigger emotions: fear of a dangerous animal, anger when faced with injustice, happiness when given a reward. Fictional situations, such as those in books, theater, movies or video games are often stir up intense emotions. Emotions felt through fiction are similar to those in real life.

However, those we feel in real life are different: they are not as intense and do not have the same consequences (if you feel afraid at the movies, you aren't going to run away). They allow us to experience emotions we may never feel in real life, as well as prepare ourselves in case they do occur in real life.

Where is the seat of our emotions?

The 'emotional' part of our brain includes the limbic system, the seat of multiple emotions, with the amygdalae being especially involved in fearing danger and the emotional component of memories; a circuit between the brainstem and the frontal cortex, called the pleasure or reward circuit; and the prefrontal cortex, which controls our emotions.

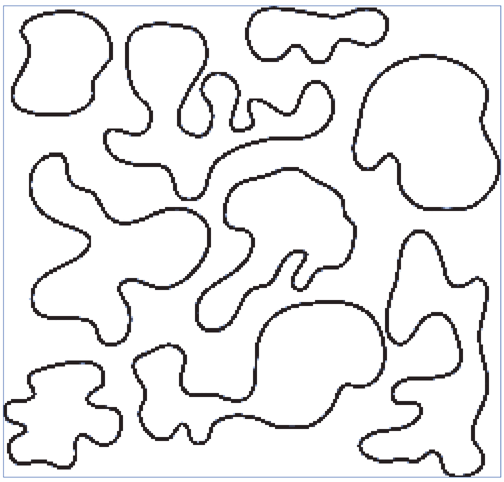
Lesson 10 – Communicating through emotion

Duration	1 hour
Material	For each student: • Worksheets 19 and 20 • Scissors
Aims	• Get pupils thinking about emotions and their functions on an individual level as well as on a group level • Have pupils practice expressing their emotions • Have pupils use and enrich their emotion-related vocabulary
Skills developed	• Investigative techniques: observing and asking questions • The ability to discuss, question and justify a point of view • Clear oral expression using appropriate language • The ability to discuss, question and justify a point of view • Critical thinking with respect to information and how it is processed • Using computers to communicate • Expressing emotions and preferences
Vocabulary	Anger, communication, disgust, emotion, happiness, fear, surprise, sadness

This lesson gets pupils thinking about the brain as an emotional organ, which may have already been mentioned during the introductory lesson. It is the brain that enables us to feel emotion, express emotion and perceive the emotion of those around us.

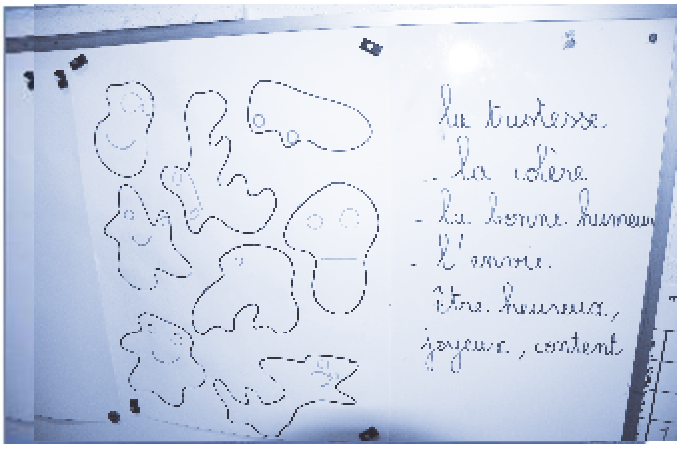
Trigger

The teacher draws 'shapes without shape' on the board. S/he gives the instruction: "Look at these shapes. What do you think we need to do to give them faces?" The pupils offer suggestions, including "draw eyes," "a mouth" and perhaps "a nose", although a nose is not necessary to perceive a face on a drawing.



The teacher asks several pupils to take turns drawing dots or circles on the shapes to create eyes and mouths. S/he explains that it does not take very much to show a face one a 'shape without a shape.' The teacher tells the pupils to draw the mouth in order to have the various faces show as many different expressions as possible.

As they draw the faces, the pupils discuss the expressions and emotions portrayed. As they name them, the teacher writes a list on the board next to the drawings. Some pupils may stay that the faces express not only emotions but moods, such as sulking or a state of health, like having a fever.



Activity: Reading and communicating emotions on faces

The teacher suggests an activity to explore the subject of emotions. S/he passes out a copy of Worksheet 19 that shows parts of people's faces. S/he asks the pupils: "Look at these eyes and mouths. "What emotion do you think each of them is expressing? Is it easy to recognize an emotion by looking only at the eyes? Or only at the mouth?" As the pupils talk, they will most likely say that it is easier to identify emotions from certain areas of the face than others.

Next, the teacher gives each student a copy of Worksheet 20, which features complete faces. S/he asks the pupils to name the emotions they see and to mimic them: anger, disgust, fear, surprise, happiness, sadness.

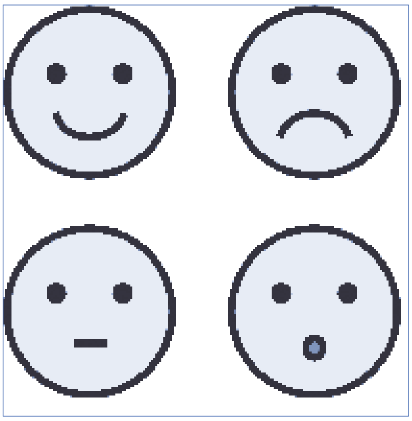
The teacher asks if, when someone expresses an emotion, their face is the only thing that changes or if their body language also changes. The pupils may answer that fear makes you run away or cover your eyes. The teacher asks the class to imitate emotions with their bodies.

Finally, the teacher asks the class to cut out the parts of the faces (eyes and mouths) from Worksheet 19 and place them over the faces on Worksheet 20 to create new combinations. S/he asks: "Do the new faces seem to express natural emotions, or are some of them strange? For the ones that are strange, have you ever seen them? Can you imitate them?"

For example, s/he can ask the class to attempt to imitate a face with sad eyes and a happy mouth – or more challenging – happy eyes with a sad mouth. The pupils will understand that while it is possible to do something on paper, it is not necessarily possible in real life.

Sharing results

Based on these ideas, the teacher begins the discussion about the role of emotions in communication. S/he can ask the class: “What do you think it is useful to express our emotions?” They may answer: “Can your family and friends know you’re sad when they see you? If so, does that help them try to make you feel better?” The idea may come up that expressing our emotions helps us communicate with others. It is a form of communicating without talking. Next, the teacher can ask if it is possible to identify someone’s emotions if we cannot see them. Some pupils may mention the phone (“The voice gives us hints, but we might be wrong”). The teacher then asks what happens when we cannot hear the person; for example, when using instant messaging or writing a text message or email. The discussion continues. If the class does not suggest it on their own, the teacher can ask “Do you know of any ways to show your emotions when you use these types of communication?”



The teacher can mention the role of emoticons that the pupils can draw in their notebooks. The teacher can then ask the pupils if the simplified faces used in messaging are sufficient to communicate all the emotions we may feel.

Cycle 3

For pupils in Cycle 3, the teacher can ask the class: “Is it easier for us to hurt someone if we can’t see the person or see their suffering? When we’re online (on a chat or social network), can we see the face of the person we are making fun of, saying mean things about or insulting?” The pupils discuss the question, possibly suggesting that “Seeing the emotions on a person’s face tells me I’m hurting their feelings and so I stop,” “It’s harder to know online how much I’m hurting someone.” This is a good opportunity to talk to the class about online harassment and bullying.

Note for teachers

Pupils with autism can have problems processing or understanding faces or expressions. This lesson may be quite difficult for them. If there is a student with autism in the class, the teacher should make sure s/he can participate in the discussion to the best of his or her ability.

Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook. For example:

“We express emotions mainly on our faces. We can understand others’ emotions on their faces. When their face is not visible, we can use other clues, such as their voice.”

“Online, we cannot see the faces of the people we are talking to and so it is difficult to know what emotions they are feeling.”

Contribution to the “Charter for Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better.” This recommendation is then added to the poster that was hung on the classroom wall during the introductory lesson. For example:

“When we communicate using screens, there is a greater chance that we might hurt someone’s feelings because we cannot see their emotions. We should think twice about how we speak to others.”

Lesson 11 – Emotions on screen

Duration	1 hour
Material	For the entire class: • Computer connected to a video projector or IWB • Video 1, which can be downloaded from the project website
Aims	• Understanding that screens portray emotions and make us feel emotions
Skills developed	• Investigative techniques: observing and asking questions • Clear oral expression using appropriate language • Expressing emotions and preferences
Vocabulary	Soundtrack, emotion, fiction, scenario

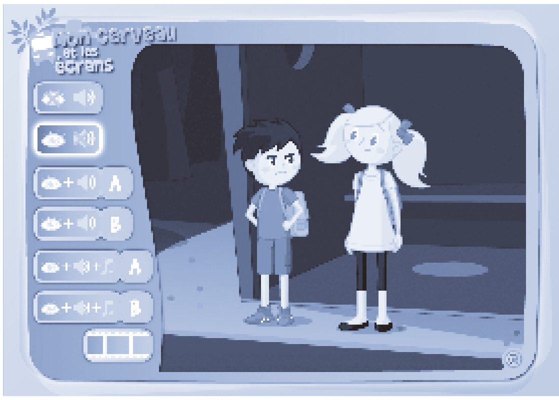
The teacher asks the class to think back to the ideas they mentioned during the introductory lesson on how screens affect the brain's functions. Here, it is the ability to feel emotion.

Initial question

The teacher asks: "How can we trigger emotion in someone?" This question is written on the board and in pupils' experiment notebooks. Pupils may offer a variety of suggestions:
"Frighten them with a scary mask," "Surprise them by popping a balloon," "Make them happy by giving them a present," "Disgust them by showing them rotten food," "Frighten them by showing them a scary movie," etc.

Observation and discussion: Emotions on screen

The teacher goes back to the idea of showing a movie and asks if watching images can trigger emotions. S/he shows Video 1 and asks the pupils to list any emotions expressed by the two characters. The pupils may recognize annoyance, surprise, fear, etc. The teacher asks them to describe the clues that helped them identify these emotions (facial expressions, body language, gestures, etc.) and the trigger that caused them. "Did you feel any emotion when you were watching the scene? The same as the characters? Or others?"



Next, the teacher tells the class they will watch the film again and plays it:

– With the "funny music" soundtrack (option View + Music + Music A)
– With the "scary music" soundtrack (option View + Music + Music B)
S/he then asks the class: "What emotions did you feel the first time you watched it? And the second? What changed?"

The class talks about it and says that screens can use not only an image but music and sounds or silence in general to create a mood and trigger emotions.

Activity: Emotions on screen

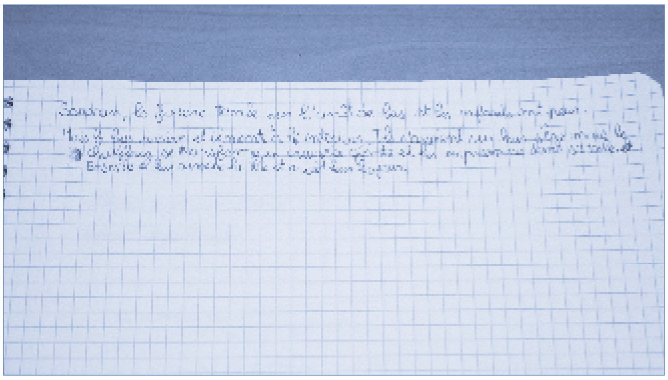
The teacher splits the class into small groups and suggests a challenge: “By groups, write a short story of about 10 lines about what happens at the end of the video. Your challenge is to choose an emotion and make the viewer feel it through the scenario you create.” The teacher can also assign each group a specific emotion.

Each group works on their scenario, then designates someone to read the story aloud. The other pupils listen, then describe the emotions they felt while listening to the scenario.

Sharing results

The teacher asks the class to compare the emotions they feel in real life with those triggered by fiction such as their stories, movies, video games or books. S/he can add to the discussion by asking: “When you go to the movies, do you call the police when you see an assassin? Do you run away when you see a monster on screen?"

The class talks about these questions: “We know it’s not real, but we’re scared anyways, although not in the same way as if it were real,” “I forget I’m at the movies, I can feel my heart beat fast,” “I was so scared when I was watching the movie that I was biting my nails,” “Sometimes when I read a sad story, I cry, and I do the same at the movies,” “We like stories or movies that scare us, or make us cry or laugh – it’s good to feel these emotions even if it’s not real.” During the discussion, some of the pupils may react differently depending on the type of scenario. The teacher can talk about movie, TV or video game stars, which correspond to the appropriate age for the movie or game.



Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook.

For example:

“On screen, the scenario, images, sounds and music trigger emotions: we cry, laugh or are afraid and we enjoy it. However, we know that it is not real.”

Contribution to the “Charter for Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better.” This recommendation is then added to the poster that was hung on the classroom wall during the introductory lesson. For example:

“Even if a story (told in a movie, video game, book, etc.) makes us feel emotions, we must not forget that it is not real.”

Living together

Scientific background

Lesson 12. Discussing and communicating

Scientific background

Social cognition refers to the mental processes that underpin our capacity to deal with others, the production and transmission of culture, understanding the rules of the society we live in; to sum up, it encompasses all the aspects of living together as a society. It includes empathy, the ability to recognize others' mental states, communication, moral judgment, stereotypes and preconceived notions, competition and cooperation.

People interact and cooperate. Together, they build tools, play games and seek to understand the world around them.

What is empathy? What is the ability to recognize others' mental states?

Empathy is an ability to identify with another person. It refers to an immediate understanding of others' feelings and their emotions through clues such as voice, language and facial expressions. We involuntarily feel what others feel – we "put ourselves in their shoes."

We can also understand that others have different intentions, beliefs and knowledge than we do and can try to adopt their point of view. This enables each person to understand what the other thinks, predict his or her reactions and interact with him or her. It is an ability to perceive others' mental states.

Various neural circuits are involved in this ability: those linked to emotional brain (the limbic system and prefrontal cortex) and those linked to higher brain functions.

What signals form the basis of communication?

Human society is organized in large part based on communication and life in a community. We send out signals to others and they send signals to us. The signals we send out communicate our intentions, emotions and feelings; in the same way, by attempting to decode and understand others' signals, we are able to interact with each other. These signals may be explicit – the most typical is language – or implicit, such as facial expressions, body language or gestures. Communication consists of a varied mix of implicit and explicit signals.

What do we perceive in the movements made by others?

Movements have an aim and offer a clue about the person's intentions. When someone sees the movements made by another person, certain areas of his or her brain are activated – the same zones as those activated in the person who is moving. The social role of this mechanism is twofold. We can imitate the person – in other words, learn by watching someone do something; by imitating the movement, we increase understanding of the other person and their intentions. However, a movement can have more than one intention. For example, if a person sitting on a bus stands up, it could mean he wants to get off the bus, or simply give up his seat. The person observing the movement interprets the intentions behind the gesture by calling on his or her knowledge and experiences.

Is recognizing faces simply about perception?

People are able to recognize hundreds of other individuals, a key quality for living in society. They can identify someone by their figure, scent, voice or face (traits, eyes, expressions). The human brain calls on specific networks to identify and recognize others, evaluate their emotional state and intentions, and understand what they are paying attention to.

A person's eyes play a very important role in human interactions. For example, the look in a person's eyes alone can indicate if someone is afraid because their eyes open wide. Eye movements can show intentions (a child looks at an object he wants and then looks at the adult who can get it for him).

When you are facing someone and they look in another direction, you will instinctively follow their eyes, where you might see a bike coming towards you. The attention you both give to an object results in a shared thought.

Does our ability to communicate develop throughout our life?

Babies have a clear preference for human signals compared to signals from the outside world. They show particular interest in their mother's voice and in language compared to any other sound. This demonstrates that the social signal of language takes root very early in the human brain. Babies are also interested in people's faces and especially the eyes, which help them understand the world adults see and learn about it through them. Babies can express emotions and are sensitive to the emotions expressed by others.

The ability to separate ourselves from others appears progressively. Around age four, children show through their behavior that they can attribute a state of mind other than their own to others. Around age seven, they are able to change their point of view.

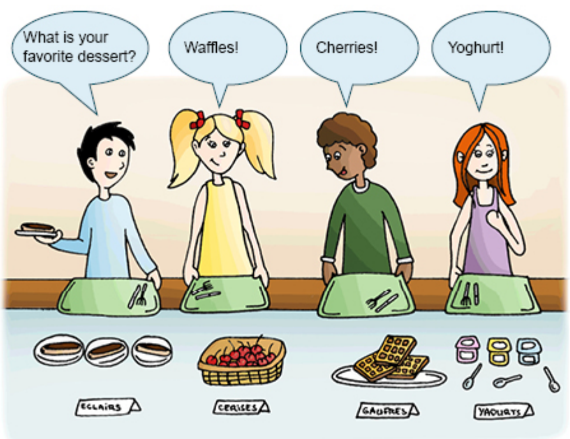
Lesson 12 – Discussing and communicating

Duration	1 hour
Material	For the entire class: • Worksheets 21 and 22 (printed on A3 paper or projected on the IWB) For each student group: • Worksheets 23 and 24 (printed in color)
Aims	• Getting pupils to understand the various means of communication that enable us to discuss with others • Getting pupils to understand the special features, advantages and risks of communicating remotely via internet
Skills developed	• Investigative techniques: observing and asking questions • The ability to discuss, question and justify a point of view • Clear oral expression using appropriate language • Expressing emotions and preferences • Respecting others and the rules of living in society • Critical thinking with respect to information and how it is processed • Using computers to learn
Vocabulary	Communication, cooperation

The teacher asks the class the class to look at the ideas raised during the first lesson regarding the way in which screens appeal to one of the brain's functions: expressing ideas, communicating (speaking and understanding what others say), and exchanging ideas.

Initial question

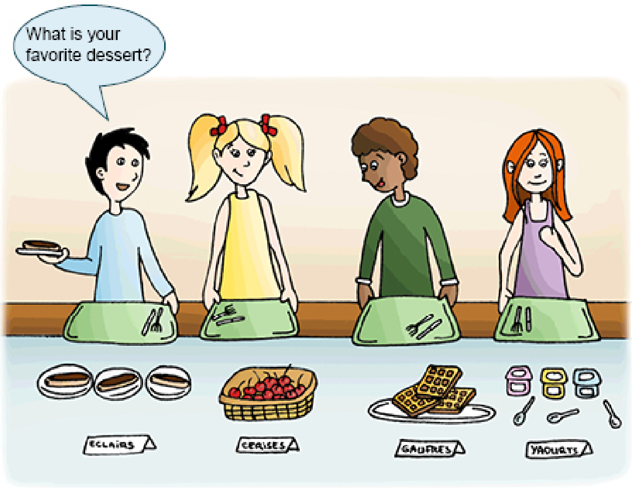
The teacher writes the initial question on the board: “How do we go about communicating our thoughts to others?” The class talks about the question and the teacher writes their suggestions on the board, such as: “We can say what we are thinking and write our thoughts down.”



Activity: Expressing your thoughts

The teacher puts up Worksheet 21 on the board and asks the class to look at it. “What kind of document is this? “It’s a drawing with speech balloons, like in a comic strip.”

The teacher asks the class to describe the image: “The scene shows four children choosing desserts in the cafeteria. The one at the left asks the others to say what their favorite dessert is. The others answer. Each has a different answer." Let's call the boy at the left Axone. The teacher asks: "What does Axon do to find out what his friends like? He listens to their answers. How do his friends communicate? By speaking. They tell him their preferences with words." The teacher puts up Worksheet 22 on the board and asks the class to look at it and then describe what is happening. The pupils give their answers, such as: "It's the same scene – Axon asks the others what their favorite desserts are, but they don't say anything."



The teacher asks: "Are there any clues Axone can use to figure out his friends preferences?" The class discusses it, suggesting for example that "They're looking at the desserts they like," "The one in green is leaning towards the cherries," etc. The pupils talk about how there are other means to communicate: "Your eyes, gestures, grimaces, facial expressions, etc." which "can be useful when someone doesn't speak our language," etc. In other words, we have a language that doesn't require words – body language for which certain movements are universally understood (e.g. pointing or leaning towards something that interests us).

Note for teachers

– Pupils with autism are unable to understand faces or expressions. This lesson may be quite difficult for them. If there is a student with autism in the class, the teacher should make sure s/he can participate in the discussion to the best of his or her ability. For example, s/he can analyze what they see in the scene.

– Sign language can also be discussed. Sign language is a completely different language with its own alphabet and grammar.

The teacher asks the class: "Can you think of any situations where we communicate with others without being able to see them?" The pupils may mention the telephone, letters and post cards, instant messaging, chats, etc. The class can then discuss the fact that when we use these types of communication we are unable to see the body language, gestures or facial expressions of the person to whom we are speaking. "To understand, we can only use what they tell us or write us." Based on their own experiences, some pupils may say that "We might not misunderstand the other person" if they are not actually present.

Note for teachers

– The teacher can bring up various types of writing (ideograms, icons, pictograms, phonetics) and various materials such as paper and screens. Other examples can be discussed, such as communicating with Morse code, which can be written or sent using signals (light, sounds, gestures, etc.).

– Pupils can give examples of computer applications for distance communication that allow you to see the other speaker.

Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook. For example:
"To express our thoughts, we can speak or use gestures and facial expressions. This helps us when we are talking to someone who isn't in front of us."

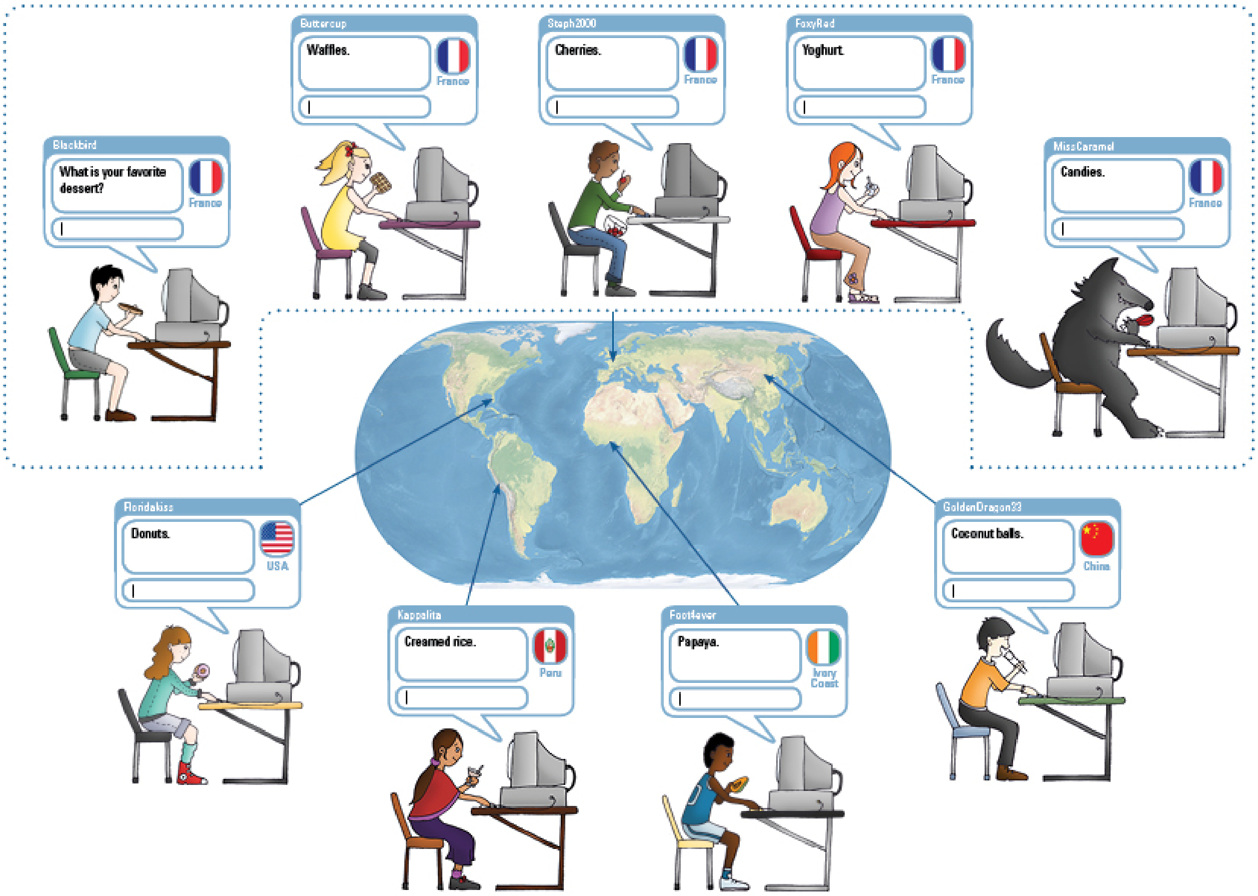
Note for teachers

For pupils in Cycle 3, the lesson continues with an activity about "on-screen" communication, i.e., online. This activity can be done with younger children if the teacher feels it could interest the class and the pupils are familiar with internet.

This activity does not require an internet connection or computer.

Activity: The "Dessert Friends" network (Cycle 3)

The teacher splits the class into groups of four or five and passes out a copy of Worksheet 23 to each.



The teacher asks each group to look at the document, pick out the different parts of it, and write a short description of what they see: "What are the characters doing?"
One person from each group writes down the ideas in his or her experiment notebook. The class then talks about the ideas together and the teacher summarizes them on the board. For example: "There are children and a wolf sitting in front of a computer. There are the French children from the cafeteria, and there are also children from other countries. They all have a dessert – it must be their favorite dessert. Above each drawing, there is a messaging bubble that shows what they are saying, their pseudonym and their country's flag. A world map shows where these countries are. Like at the cafeteria, Axone asks,

"What is your favorite dessert?" and the others send their answers by writing on the computer."

The teacher leads the discussion with questions (if the pupils do not mention the ideas on their own during the class discussion). For example:

"Are the characters really together in the same place? How are they communicating? These questions help pupils draw on the conclusions from the first activity and highlight that the characters in the drawing are communicating through a screen (here, via instant messaging) and cannot see each other.

"Which pupils see each other during the day?" This provides an opportunity to talk about how the internet lets the children from Worksheets 21 and 22 to continue their conversation and stay in touch.

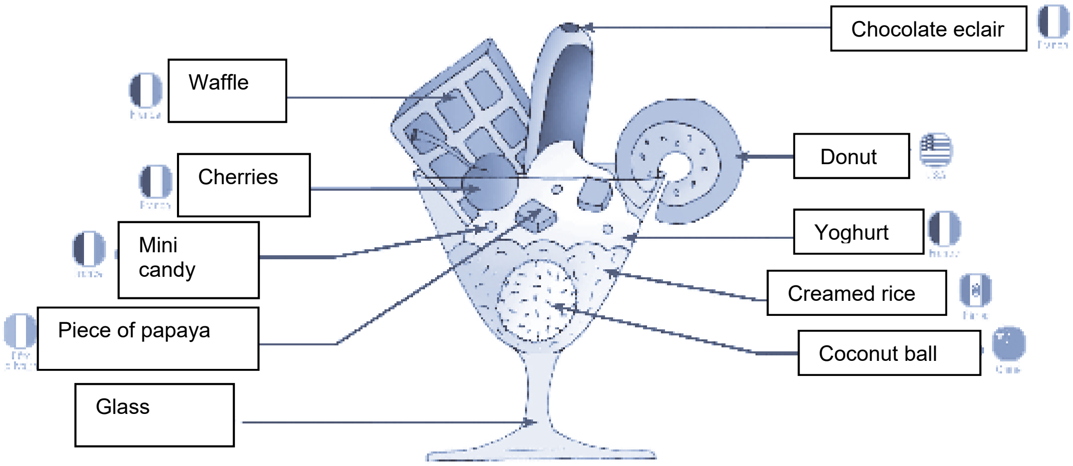
"What does the internet allow these pupils to do with the children from the other countries?" Here, the internet allows the French pupils to quickly and easily communicate with children who live far away on different continents, to learn about their culture (here, the desserts from their countries) and to share their own.

"What do you think of the pseudonyms used by the characters? Are these their real names? Why do they use pseudonyms? Can we learn something about them based on these pseudonyms?" This question deals with the issue of online identities. The pupils might say that the children chose a pseudonym to be hidden and not give their real names. Some may say that these pseudonyms still give information about themselves. For example, Steph2000 could be part of a first name (Stéphane perhaps?). "Blackbird", a pseudonym that sounds English, might give a false impression of the person's origin, but refers to the user's hair color (which the class can see is true). "Foot4ever" probably likes football (confirmed by his clothing). "Floridakiss" most likely lives in Florida, etc. Some pseudonyms have nothing to do with the user: "MissCaramel" gives the impression that the user is a cute little girl, but the pupils can see on the drawing that MissCaramel is a wolf and they can understand how the pupils on the "Dessert Friends" network would have no idea.

"What do you think the wolf is doing in the picture?" This offers an opportunity to talk about the identities of people with whom we might come into contact on the internet. Here, the network lets several children meet and make "friends." But isn't there a problem? The children say it is the wolf. But Axone and his friends may not have any idea that a wolf is hiding behind the sweet pseudonym "MissCaramel". When asked "What is your favorite dessert?" MissCaramel responds "candy." But the image the pupils see shows that the wolf is lying, because he's holding a piece of meat. The class can discuss the issue of caution that needs to be shown on the internet, as well as the ability of people to lie when they know that nobody can see them.

Lastly, the teacher passes out a copy of Worksheet 24 to each group with the "international dessert" created by the characters (next page). S/he asks: "What does this document show? How was this international dessert created?" The class offers suggestions, perhaps saying that the dessert was created "using the preferences of the children who were talking about their desserts in the picture before." The discussion explores the possibilities of cooperating online: "We can create things with people who live far away if they speak a language we understand," "It would have taken a really long time writing letters," "On the phone, they would only have been able to speak two at a time," etc.

Our “international dessert”



Un dessert conçu par :
Blackbird, Boutondor, Floridakiss, Foot4ever, GoldenDragon33 Kappalita, MissCaramel, PetitRenard, Steph2000

Note for teachers

The teacher should ensure that the discussion is not solely focused on the risks of using the internet. S/he can also discuss the advantages: being able to immediately share information (in the example, finding out about other ways of life, learning); quick communication (establishing a relationship with children living around the world, maintaining relationships with friends who have moved or with family that lives far away); and easy cooperation (like with the international dessert, but many other topics can be the focus of cooperation).

Written conclusion

The class develops a conclusion together to write on the board and in their experiment notebook. For example:
“On the internet, we can share our interests with other children, even if they live far away. It is very rewarding to learn about other countries and ways of life and to be able to cooperate, even if we live far away. However, when we can’t see the person with whom we are communicating, it is sometimes difficult to understand who that person is and what s/he really thinks. We might be misled and people with bad intentions can take advantage of our trust.”

Contribution to the “Charter for Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better.” This recommendation is then added to the poster that was hung on the classroom wall during the introductory lesson.

For example:

“It is important to take advantage of the opportunities offered by the internet while also being cautious. We must pay attention to what we share and to the people we communicate with.

Perception of time

Scientific overview

Lesson 13. Screen time

Lesson 14. As time goes by

Scientific overview

We are aware that time is a part of our lives; we notice it going by at different speeds; milliseconds, days, years... Time is a source of information and in everyday life we continuously process different lengths of time without always being aware of doing so. Am I able to cross the street even though I see a cyclist coming towards me? Will I be able to catch or avoid the ball being thrown by a friend?

How do we perceive time?

We should note that in the first place time is not a stimulus compared with physical phenomena such as sound or light and secondly, there is no sensory organ that captures time. The perception of time is located in the brain and relies on the functioning of an "internal clock" whose inner workings and counting mechanisms are not yet clearly identified. (Are certain groups of neurons specialized in the task of counting time?)

Can we perceive short periods of time?

We must accurately perceive and estimate short periods of time with precision in order to react appropriately to our surroundings. This estimation is necessary in many types of situations that take place every day, and notably in music and in sports.

Psychologists have shown that we are able to accurately estimate short periods of time (minutes to milliseconds); produce a sound for a precise length of time; reproduce the exact duration of a sound stimulus; and differentiate between the duration of two sounds. Even infants can distinguish a difference of 100 milliseconds between two phenomena.

Is the brain involved in the 24 hour period?

Cyclical changes occur in our bodies every 24 hours: internal temperatures, heart rate, appetite, awareness, hormone secretion, and of course, our sleep-wake cycle. These 24 hour cycles, called the circadian rhythm (from Latin, *circa* meaning almost and *dies* days), are linked to a cerebral mechanism involving the pineal gland which secretes melatonin. This process is essential to the sleep-wake cycle along with other brain structures such as the cerebellum which helps control movement and perception. The concept, that humans conceived, of dividing time into weeks and months requires some learning, but does not depend on a specific cerebral mechanism.

Is our perception of time constant?

Outside of controlled conditions during psychological tests, all of us have experienced the feeling that our judgment of time is relative. Sometimes hours seem to stretch, and at times they fly by. Moreover, perception of time seems to differ from person to person.

Our perception of time passing depends on multiple factors. Emotions play a role in our perception of the duration of an event. Thus, in order for us to react quickly when facing danger, our internal clock speeds up and time outside (which does not change) seems to go by much more slowly. Attention is another major factor. When there are time constraints to complete an activity there is more of a risk of making mistakes because part of our attention is focused on time management. On the other hand, when we must concentrate on a difficult task, time seems to go by more quickly.

Lesson 13 – Screen time

Duration	30 minutes
Material	For the entire class: • Computer connected to a video projector or IWB • Video 2, downloaded from the project website • Stopwatch or watch with a second hand • Seeds to grow (bean) • Jar, cotton, water
Aims	• Get pupils to think about how the duration of an event is shown on screen and to become aware of how this time can be manipulated
Skills developed	• Investigative techniques: observing and asking questions • The ability to discuss, question and justify a point of view • The ability to use standard units of measurement
Vocabulary	Chronology, duration, editing, script

This lesson explores how the concept of time appears on screen: in films and video games. It also explores the techniques used to shorten or lengthen the duration of an event shown on screen.

Initial question

The teacher asks the class: “Think about the last movie or cartoon you saw, or about the storyline of the last video game you played. Does time pass by in the same way when watching a movie, playing a video game and in real life?”
The class then discusses and comes up with suggestions such as: “Time does not pass by in the same way for characters in a movie as it does in reality.” “Sometimes, someone's entire life passes by in one short movie.” “If time passed by in the same way, it would take one year or more to find out the end of some stories.”
To feed into the discussion, the teacher could ask: “How many hours, days, or months go by in the stories on screen that you remember? Are there moments that aren’t shown passing on screen?” etc.

Activity: Screen time

To learn more, the teacher plays a short film that shows the germination and growth of a bean seed. One student is responsible for timing the length of the film.
The teacher then asks: “What is happening in the movie?” What is the storyline?” The class answers for example: “We see a plant that is growing. A seed sprouts and then becomes a plant.” “The seed sprouts and then grows taller, coming out of the ground and growing leaves.

The teacher asks the pupils if the length of the projection (1 min 30s) corresponds to the germination process shown in the film. The teacher could ask: “Would a plant be able to grow (from a seed all the way to a flowering plant) in 1 minute and 30 seconds?”
The teacher then asks the class to look for clues in the movie that show how many days have elapsed from the seed’s beginning all the way to the flowering plant. The teacher shows the short film one more time. Some pupils notice that “a few days and nights have gone by...four”. “Four days” is written below the length of the film: “1 min 30s”.

Sharing results, discussion

The teacher asks the pupils to explain time passing by and how it is projected on a screen. “The action is sped up or blurred, certain parts are skipped over and when moving from one part to another, cuts are made to the scene.” It seems possible to condense a story on screen by showing only certain parts, certain “scenes”. We can “manipulate time in order to tell a story that would have taken too long to tell if it took place in real time.”

Note for teachers

The teacher could potentially use this activity as the basis for a mathematics exercise written down in the experiment notebook by asking how many times the action is accelerated on the screen (4 days = 96 hours = 5 760 minutes). The 1 minute 30s long film (1 minute and a half or 1.5m to do the calculation) is 3 840 times faster than the actual germination process.

The teacher asks if the filmmakers could have come up with other ways of changing perception of time or other alterations to the story's chronology. “We could accelerate or slow down the scene even more. We could combine images, but there wouldn't be any logic in the order of events. We could reverse the scenes of the story, starting with the plant and ending with the seed.” The teacher could then ask the class if any of these techniques are used in movies or TV shows that they watch. The pupils might mention that a sporting event is sometimes replayed in slow motion on TV or that a scene is sped up to add a comic effect.
The teacher can draw the pupils’ attention to different techniques that filmmakers use such as cutting the script and film editing (which consists of choosing the parts of the story that they want to tell and their juxtaposition).

Activity: In real time

The teacher asks the class how they would verify if the filmmakers showed the process of the sprouting bean seed in real time. The class could suggest growing real beans in order to check. The teacher then provides the class with a jar, cotton, water and seeds. It is the children's responsibility to observe the changes every day and write the duration of the germination down in the experiment notebook. The teacher could also ask them to draw the changes that take place every day and compare them with the duration of the seed germination shown in the film. The duration of the germination is probably different from what is shown in the film (4 days). The pupils could point out this difference and come up with conclusions on the effects of “realism” represented on screen.

Written conclusion

At the end of this lesson, the class comes up with a general conclusion which is written on the board and in their experiment notebook. For example: “The time shown in a movie or a video game is not the same length of the actual event. We can manipulate time on the screen by showing stories in a short film that in reality last for several days, several months or several years.” “We can speed up or slow down a passage in a movie or even reverse the scenes as if we were going back in time.”

Contribution to the Charter on Using Screens Better

After the plant has sprouted, the pupils could add to their conclusion a recommendation for the “Charter on Using Screens Better”. For example: “We should always remember that the way time is shown in movies or video games does not necessarily correspond with reality.”

Lesson 14 – The passing of time

Duration	45 minutes to 1 hour
Material	For the entire class : • Computer connected to a video projector or IWB • Video 1, downloaded from the project website • Video 3, downloaded from the project website For each group of 3 pupils: • Worksheet 25 • Stopwatch or watch with second hand
Aims	• To make children aware of the notion of passing time, as well as the difference between estimating and accurately measuring its length
Skills developed	• Investigative techniques: observing and asking questions • The ability to handle different materials, carry out experiments, formulate and test hypotheses, and defend a point of view • The ability to discuss, question and justify a point of view • The ability to understand, interpret and develop a few simple indicators: charts and graphs • To be able to use standard units of measurement
Vocabulary	Estimation, measurement

This lesson explores the challenges we face in estimating time passing by, especially on screen. Therefore, in order to measure time on screen we must rely on objective measurements.

Trigger and initial question

The teacher has the pupils sit in front of the projector and tells them that they will watch 2 films without saying anything more: first video 1 and then video 3 (a dot flashes at regular intervals on a white backdrop).

After the class watches the videos, the teacher asks the class: “In your opinion, how long is the first film? What about the second? Which film is longer?” The class makes some suggestions and the teacher writes down a few estimations on the board (especially the ones that differ the most). The teacher asks: “Why do most of us think that the second film was actually longer?” The class discusses and will most likely suggest that” there wasn't really a storyline”; “we were easily bored”; “it was repetitious and boring”; “nothing happened and it is long and tedious when we have to wait.”

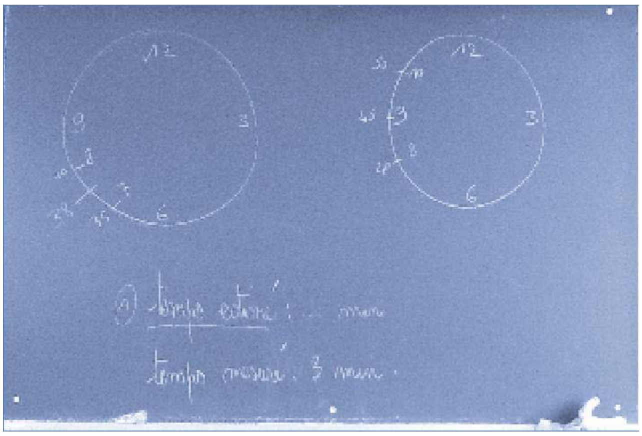
Some pupils could point out that “time goes by more quickly when we have fun or when we are interested in something instead of being bored”. The teacher then asks the class: “You know that TV shows, movies and video games are designed to entertain us and distract us. Is it easy to realize how much time we spend in front of the screen? Could we spend a lot of time without realizing it?” The class talks of their personal experiences which are usually many: “When I am playing a video game I don't notice the time passing by.” Sometimes I realize it is time to go to bed when I feel like I just started playing,” etc.

Activity: Estimating and measuring time

To learn more, the teacher challenges the class by asking them to: "Come up with an experiment to test if we are able to estimate the time spent completing an activity." The pupils, divided into groups, think of a procedure that they explain in their experiment notebooks (using sentences, a list or a diagram). Their suggestions of procedures could vary.

Sharing results

The pupils read their suggestions aloud, the teacher writes them down on the board and they are discussed by the class. The suggestion comes up to compare estimated lengths of time with measured ones. After discussing the various suggestions, the class, as a whole, agrees on one procedure to implement. For example: 1) choose an activity, 2) the first student does the activity, 3) a second student times the duration of the activity without revealing the result 4) the first student gives an estimation of how long it took him to complete the activity, and 5) the estimated time spent is compared with the actual time measured by his classmate.



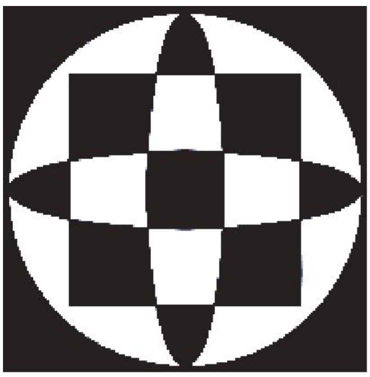
Note for teachers

– In most cases, the chosen procedure corresponds to the one suggested above, however the teacher will encourage the pupils to test other procedures if the class unanimously agrees:

– If pupils have difficulty coming up with an experiment, the teacher could suggest some ideas to lead them in the right direction.

– For example, the teacher could give pupils a list of materials to use in order to come up with an experiment. In such cases, the teacher could provide materials for an activity for which they can measure the time spent (a coloring worksheet or a photocopy of a text to read, etc.) as well as stopwatches; watches with a second hand or other tools to measure time. In this case, the teacher will give the following instructions: "Using this material, come up with an experiment to see if we are able to correctly estimate time."

Suggestions for a figure to color (Worksheet 25) and a text to read aloud

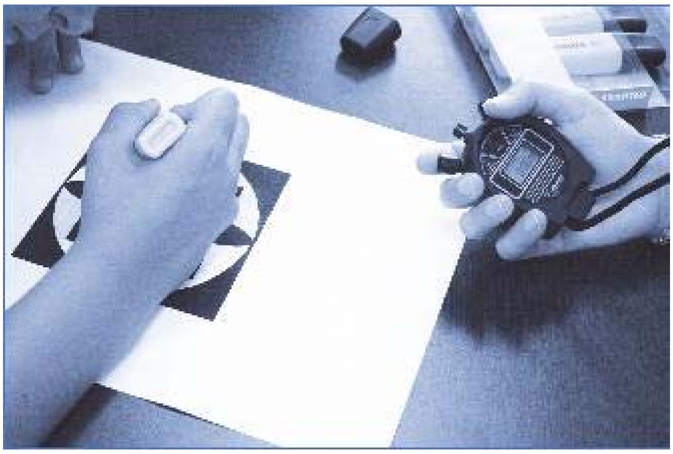


"Children, in the kitchen, time is important. Rinse fruit in clean water for two to three seconds… Knead dough thoroughly for 10 minutes…

Cook over low heat for one hour… Let sit in a cool place overnight…

Hungry kids come running and in the blink of an eye… Teacher, teacher, is the blink of an eye a measure of time?"

To carry out the experiment, each group must designate: a student who will record times using a stop watch, and a student who will complete the activity and estimate how long it took. Each group carries out the procedure and the pupils write down the estimated and measured durations in their experiment notebook for each chosen activity.



Sharing results

At the end of the experiment, the pupils share their results and the teacher writes them on the board, for example in table format (see example below):

Activity	Estimated time	Measured time	Estimation error
Coloring in			
Student 1	2 min	1 min 30 s	(–) 30 s
Student 2	1 min	1 min 30 s	(+) 30 s
Student 3	…	…	…
…			
Reading the text			
Student 1	1 min	20 s	(–) 40 s
Student 2	10 s	30 s	(+) 20 s
Student 3	…	…	…
…			

The teacher could ask the class to describe the direction and the magnitude of the estimation error: "Have we estimated spending more or less time on completing the activity? Were we mistaken in our estimation by a lot or a little?"etc.

Note for teachers

– The teacher can ask the pupils to suggest methods to express different lengths of time between activities. Some pupils could suggest using greater than or less than symbols, others by putting the durations in order (starting with the longest length of time or the other way around); and others might even suggest drawing a scale. The teacher could ask the pupils to use these methods in their notebooks or to write them on the board. This classification has no particular purpose, but it does give pupils an opportunity to deal with different ways of measuring.
– For 3rd year pupils, this could be the opportunity to work on calculating averages if multiple pupils estimate the same amount of time to complete an activity.

The class then discusses the results. "It isn't easy to estimate time spent doing an activity." "We actually thought we had spent more or less time." "If we really want to know how much time we spend doing something, we have to measure using a stopwatch or a watch." The discussion could go on to include the need to be organized or to make a schedule for the day or even half a day.

Written conclusion

The class comes up with a general conclusion that is written on the board and in the experiment notebook. For example:

"When we estimate the duration of an activity using a rough guess, we may make a mistake. When we are doing something we like, we don't think of time elapsing. On the other hand, something really boring goes by slowly. We have fun when doing activities on a screen and usually we don't realize the time going by."

Contribution to the "Charter on Using Screens Better"

At the end of this lesson, the class writes a general recommendation for the "Charter on Using Screens Better". This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson.

For example: If we want to know how much time we spend in front of a screen, we have to use an instrument to measure it."

Further study: How much time do I spend in front of a screen?

The teacher could ask each student to share how much time he or she spends in front of a screen during one week. Each student can draw a time table with hours spent from beginning to end in front of a screen and then calculate the total. Pupils will be surprised to find out how much time they actually spend in front of a TV screen or a computer.

Further study: measuring time another way

As an extension, the teacher could suggest that pupils work with different tools to measure time (such as counting, using an hourglass, a stopwatch, a clock, an alarm or a timer). The teacher could challenge the class to measure a given duration (preferably brief), by creating an instrument used to measure time with materials that are at hand: funnel, salt packet, paper filter, a bottle, and a scale (one set for each group). This way the pupils can build an instrument "to weigh time": the salt trickles through the bottle by passing through the funnel (a paper filter can be used to slow down the salt) – based on the hourglass model – then the salt is removed and weighed. The weight of the salt is proportional to the duration measured. Once again, comparing the measurements of different groups in the class can feed into using mathematical tools, conversions, etc.

Sleep

Scientific overview

Lesson 15. Sleep time

Scientific overview

Sleep is a natural part of life and essential for good health. It has always been a fascinating topic for humans and features in fairy tales (such as Sleeping Beauty) and mythology. In Greek myths, the goddess of night was the mother of the twin brothers Thanatos (god of death) and Hypnos (god of sleep), and the grandmother of Morpheus (god of dreams).
When we sleep, the body is active, but in a different way than when we are awake. The brain is also active; however, our awareness of the outside world and of ourselves is considerably reduced. The brain coordinates sleep-wake cycles, which determine how long we sleep, the alternation of sleep phases and the quality of sleep. Humans are diurnal. In other words, they are active during the day and sleep at night.

Managing sleep-wake cycles

Sleep-wake cycles are controlled by our biological clock, which is located in the brain. This clock automatically operates on an approximately 24-hour rhythm (and is therefore called the circadian clock). Adjustments (or synchronizations) to this rhythm are made based on light. Specific retina cells that are sensitive to variations in light send information to the pineal gland in the brain, which secretes the hormone melatonin. Melatonin is released in the body when night falls, letting the body know that it is time to sleep. Melatonin secretion is influenced by seasonal variations in daylight: in our part of the world, more melatonin is released in winter and less in summer. Light from screens may be a factor disrupting sleep.

Sleep patterns

Adults sleep once a day at night. However, this sleep is made up of several alternating stages. Immediately after falling asleep, we experience light NREM (non-rapid eye movement) sleep, which is followed by deeper NREM sleep. We then enter REM (rapid eye movement) sleep, during which the eyes move but the rest of the body is completely relaxed. Each night we experience between three and five cycles of NREM and REM sleep.
Sleepwalking (when a sleeping person gets up and walks) is not an illness. It is a motor activity that takes place during the deep NREM sleep phase.

Dreams

We dream during all phases of sleep. We all dream, even if we do not remember what we dreamt of. Most dreams go over the day’s events, no matter how ordinary or insignificant they were. Sometimes dreams feature real plots and give rise to emotions and sensations. Dreams are proof that the brain is active during sleep. There is nothing magical or premonitory about dreams. Nightmares are frightening dreams that are unpleasant enough to wake the sleeper, but nothing more.

The purpose of sleep

Sleep is a natural part of life and crucial for good health and mental stability. In children, it is also essential for growth. Sleep plays a key role in learning and long-term memorization. During sleep, the brain “relives” things we did or learned throughout the day, consolidating information memorized the day before and confirming decisions to forget irrelevant or useless information.

Sleeping well is extremely important. Activities that reduce the time available for sleep affect learning and may have negative consequences on health and mental stability, causing fatigue, shorter attention spans, memory issues, mood problems and daytime sleepiness.

Sleep in animals

All animals need to sleep. Some sleep at night and others during the day. Sleep duration and quality (whether sleep is deep or not) vary from species to species. Some animals are able to enter states of "half-sleep", which allow them to register the presence of a predator and escape in just a few milliseconds.

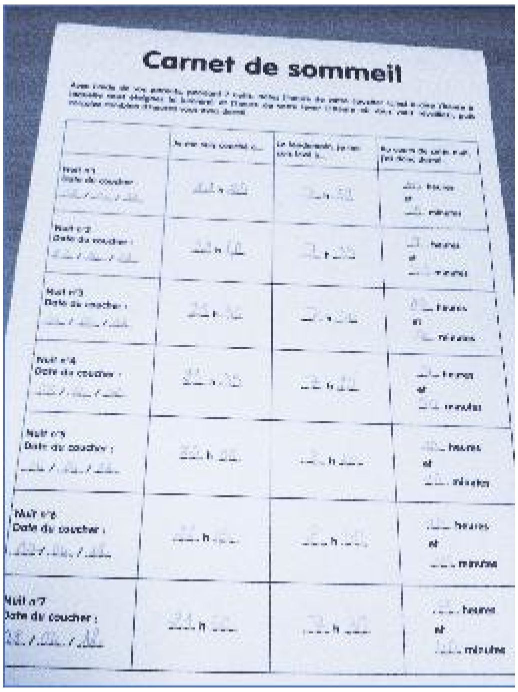
Lesson 15 – Sleep times

Duration	1 hour 15 minutes (15 minutes one week and 1 hour the following week)
Material	For each pupil: • Worksheets 26 (completed by each pupil over the course of a week), 27 and 28
Aims	• Show how humans need sleep • Get pupils thinking about the importance of sleep, things that have a negative impact on sleep, the signs someone has not had enough sleep and the effects of not having enough sleep
Skills developed	• The ability to read, interpret and develop simple representations: tables, graphs • The ability to discuss and use the results of measurements or research using scientific vocabulary
Vocabulary	Wellbeing

This lesson deals with the importance of sleep, for wellbeing and learning in particular. It raises children's awareness of the need to protect sleep and why this protection is necessary.

One week before the lesson: initial question and preparation

One week before the lesson (for example, at the end of the preceding lesson), the teacher asks the class, "How long do we sleep each night?"

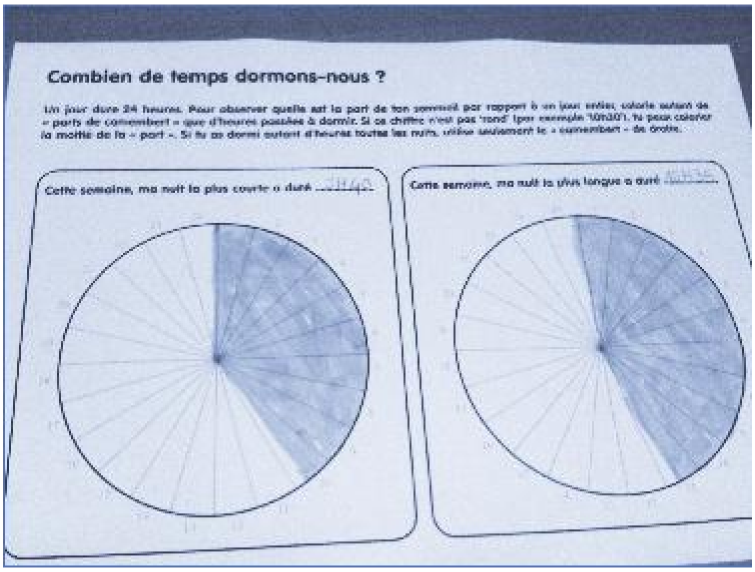


The class briefly discusses this question, suggesting different times (9 hours, 10 hours, 11 hours or more depending on the individual and circumstances concerned). Some pupils will say they "go to bed and wake up at the same time every day". Others will claim to "get up early", "go to bed late" or "go to bed when their parents tell them to". Still others will say, "It depends".

The teacher then asks, "How could you work out how much time you spend sleeping each night over the course of a week?" The class discusses different options. If the pupils do not raise the possibility themselves, the teacher can suggest keeping a "sleep diary".

The teacher hands out a copy of worksheet 26 to each student. He/she tells the class, "Your mission for the next seven nights is to keep a sleep diary with your parents' help. Every night, fill in when you go to sleep (the time you turn the light off) and when you wake up (the time you get out of bed). Then calculate how many hours you slept. We will work on your sleep diaries at the next lesson."

Activity: how long did you sleep each night last week?



On the day of the lesson, the teacher asks pupils to remember what they were asked to do each day of the preceding week and has them take out their completed "sleep diaries". If some pupils were unable to calculate the number of hours they slept each night, the teacher can take a few minutes to help them.

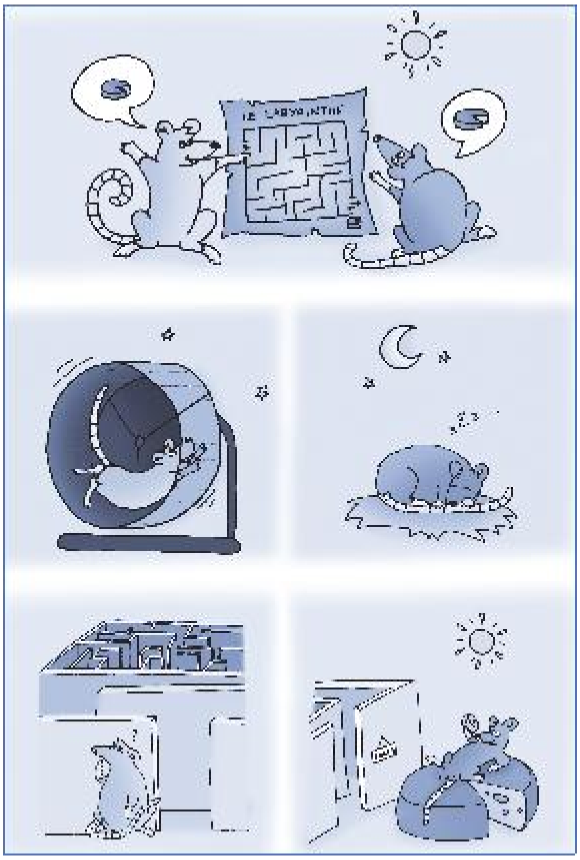
He/she then asks, "Did you sleep the same number of hours each night?" While some pupils may have slept the same number of hours, this is not necessarily the case for others.

To illustrate how much each pupil slept, he/she hands out copies of worksheet 27. He/she asks one child to read out the instructions and pupils work on their own for a few minutes.

Sharing results

The teacher asks, "What do you think about these 'pie charts'? Do we spend much of the day sleeping?" The class discusses this question and realizes (often with surprise) that we sleep from 25% to 50% of each day.

Document study: the importance of sleep



The teacher next asks, "Do your parents sleep more or less than you? If you have baby brothers or sisters, do they sleep more or less than you?"

The class discusses these questions and may say things like: "parents sleep less, because they go to bed later and are always awake to get us up"; "babies sleep during the day"; "when you're very small, you take naps" etc. They come to the conclusion that people of different ages sleep different lengths of time – but we all sleep. Why?

The teacher writes the question "Why is sleep important?" up on the board. He/she hands out copies of worksheet 28 to each pupil or, if he/she prefers, reads out loud the text below. He/she then asks the class to read the document in silence for a few minutes.

The maze of Ratinopolis

There is no point in running. Getting a good night's sleep is more important. Why? Read on...

All the rats in the land had made their way to Ratinopolis to try and find their way through the famous maze. The prize was a large morsel of yellow cheddar cheese. All tried their luck.

Finally, the only rats left in the competition were Topolino and Ratounet. It was the last race of the day. They took seven steps straight ahead, two steps to the left, one step backwards, eight steps to the right and ten steps to the left. Quickly, quickly! The cheese was just around the next corner. However, just then, night fell. The race was postponed until the next day.

Ratounet spent the night celebrating the day's wins with his supporters. He thought it was more important to have fun than it was to sleep. What a night of capers and larks he had!

Meanwhile, Topolino took himself far from their frolics and slept soundly.

When the sun rose, the door to the maze opened. Ratounet was off like a shot: seven steps straight ahead, two steps to the left, three steps backwards, five steps to the right… Oh no! A dead end! All his efforts were in vain.

Topolino made it to the end in record time: seven steps straight ahead, two steps to the left, one step backwards – he knew the route by heart. He shouted to Ratounet, "I was right to sleep – see where your late night has got you!"

Moral of the story: Sleeping soundly helps improve memory

Last minute

Scientists have shown that the hippocampus, a tiny part of the brain shaped like a sea horse, is very active when we sleep the night after we learn something. The brain replays at night the lesson we learned during the day.

Sharing results

The teacher asks the class what kind of document this is and what information it contains. Answers may include: "It's like a fable, with a moral, it shows that the rat who slept well won the race, and there is a scientific explanation"; "It's a short story told in images: the brown rat sleeps at night and the next day he can remember the way to the cheese, but the grey rat played all night and the next day can't remember the way through the maze."

The class discusses our need for sleep and may say things like "sleep helps the brain to rest at the end of the day" or "sleep helps us learn".

The teacher asks, "What happens when we don't get enough sleep?" Pupils give answers based on their own experiences: "We feel tired and yawn all the next day"; "We're in a bad mood"; "We have red eyes and bags under our eyes"; "We can't concentrate on our lessons" etc.

By asking questions, the teacher encourages the class to express its ideas on the things that make it difficult to fall sleep. For example: "Drinking orange juice before going to bed makes it hard to sleep"; "Watching scary films makes me sleep badly"; "Noises or too much light can stop us from sleeping" etc. Some may add that playing, reading or watching television late at night can make it difficult to fall asleep, or that, generally speaking, "When we are too worked up when we go to bed, it is difficult to get to sleep."

Note for teachers

Pupils often know about the importance of sleep because of the many messages raising awareness of this issue. The debate may reflect this, and pupils' answers may be what they think is expected of them. In this case, the teacher can ask the class to think about what it is saying by saying, "Is that your own idea or not?"

Conclusion and written record

As a class, pupils come up with a conclusion that the teacher writes on the board and they copy into their experiment notebook. For example: “We all need to sleep. If we do not sleep enough, we are tired the next day and cannot concentrate.”

Contribution to the “Charter on Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better”. This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: “We must make sure we sleep properly. Screens are one of the things that can stop us from falling asleep and make us sleep badly.”

Memory

Scientific overview

Memory is a fundamental aspect of learning, imagination, reasoning and reflection. Memorization is a mental process by which we record, store and retrieve new information. Without us being aware of it, our memories constantly retain information based on our personal experiences, forget other information and allow us to look into the future.

How much information does the memory store and for how long?

Scientists differentiate between the short-term and long-term memory. In the long-term memory, information is retained for a long time – days, months, years or lifetimes. Large amounts of information can be stored. The long-term memory is what allows people to develop their inner self, because it combines sensory memories (images of people, places, music, sounds, tastes, etc.), individual memories and the emotions connected with them (an “episodic memory” unique to each person and part of his/her identity), skills (which are remembered for long periods of time) and general knowledge (a “semantic memory” generally independent of emotions). The short-term or working memory retains small quantities of information (7 items ± 2) for short periods of time (10 to 15 seconds). We constantly use our short-term memory without even being aware of it. New information quickly displaces old information, which is either transferred to the long-term memory or forgotten. The short-term memory is easily distracted.

The short-and long-term memories work together. The short-term memory must consult what we already know – information that is stored in the long-term memory. Basic training in any one field (whether it be football or neuroscience) makes it easier to memorize new information on this field.

We create new memories all the time using our knowledge, past experiences, emotions and attention. For this reason, our memories are unique, even when we take part in the same event with others.

How do we memorize?

The acquisition of a piece of information is consolidated by repetition. Frequently remembering an item of knowledge is the same as relearning it. The brain finds regularly recalled information more quickly. Other memorization strategies include in-depth analysis of information, the association of ideas, hierarchical organization and mental imagery. Children aged between 7 and 12 naturally use these strategies to improve their learning abilities. The memory also records information without us realizing.

Sleep is necessary for memorization.

How do we remember or recall information?

Memorized information is recalled in different ways. Sometimes memories surface unexpectedly. However, sometimes remembering things takes time – strategies, efforts or clues may be needed to access the information we want to recall. When remembering skills, recall is often subconscious. Emotionally charged information is generally easier to locate. Information organized in a rational or logical way is also easier to find.

Are memories accurate?

Memories are generally accurate and that is sufficient for everyday life. However, a memory is not a fixed recording that is simply stocked in part of the brain. Each time we remember something, we reconstruct the event, transforming our memory of it. This explains why memories are sometimes incorrect and testimonies cannot always be relied on.

How do memories last in time and space?

With the invention of writing, it became much easier to access what other people learned during their lifetimes. These external memories are part of a collective memory that humans have always sought to improve and build on: through the printed press, photography, audio recordings, film and, today, digital media.

Where is the memory located?

Memories are not kept in one part of the brain. They are spread across a wide area, which includes the hippocampus, the gateway for information being memorized; posterior regions, where the information making up memories is stored; frontal and parietal regions, home to the working memory; the amygdala, the centre for emotions; and the thalamus and the parietal cortex, essential for remembering skills.

Lesson 16 – Memory and screens

Duration	1 hour
Material	For each pupil: • Worksheet 29
Aims	• Show pupils that some memories are personal and others are shared with a group • Show pupils that screens can replace the memory, and that this has advantages and drawbacks
Skills developed	• Investigative techniques: observing and asking questions • The ability to read, interpret and develop simple representations: tables, graphs
Vocabulary	Memory, collective memory, memory devices

The teacher asks the class to use the ideas that were formulated during the introductory lesson on the ways in which screens stimulate one of the brain's functions: the ability to remember things.

Initial question

The teacher starts by asking the class, "Are there things we remember for a long time?" The class will give examples like holidays, birthday parties, etc., but also things like the multiplication tables, verb conjugation and skills (such as swimming or riding a bike).

The teacher then asks, "Are some memories or knowledge shared and others that are unique to us?" He/she gets pupils to talk about an event the whole class took part in – a museum excursion, play, sports event or art lesson. This is an opportunity to talk about collective memory. Each person remembers things slightly differently even when he/she takes part in an event with others. Sharing different memories creates a wider picture of the event. Some pupils may mention that they have better memories of events that gave rise to strong emotions: "I'll always remember the play the class performed for parents."

Note for teachers

Collective memory is a concept that pupils can easily come to grips with: they share some knowledge, even with children they have never met – for example, cartoons, films or popular books.

Activity: memory devices

The teacher asks pupils to make a list of the devices they could use to help "keep a long-term record of things they do together". He/she underlines that he/she would like them to think first and foremost (but not only) about devices using screens. Pupils put forward their suggestions, which are written on the board.

Examples include: taking photos, making videos, making audio recordings, putting information or images on websites, keeping blogs, writing things down, keeping travel journals, keeping diaries, keeping flower collections, keeping shell collections, etc.

Next, the teacher hands out a copy of worksheet 29. Pupils will use this table to classify memory devices. They paste the table into their experiment notebooks. The teacher also copies the table onto the board or a piece of paper and gives the class the following instructions: “In the left-hand column, write down the different memory devices we have mentioned. For each device, put a cross in the corresponding column.” He/she could use one of the pupil’s suggestions as an example to ensure the class has understood.

Memory devices from our list (examples)	I can record:				I can make a copy		I can delete or destroy content		Who can access the information?	
	Sounds	Images	Text	Objects	Yes	No	Yes	No	Me and whoever I share it with	Anyone
Photos		X			X		X		X	
Videos	X	X	X		X		X		X	
Stories		X	X		X		X		X	
Audio recordings	X				X		X		X	
Publications on social networks		X	X		X		To be discussed		To be discussed	
Blog articles		X	X		X		To be discussed		To be discussed	
Travel journals		X	X	X	X		X		X	
Diaries		X	X	X	X		X		X	
Flower collections			X	X		X	X		X	
Shell collections				X		X	X		X	

Note for teachers

– When pupils fill in the table, the aim is not to get them to come up with a “correct answer”. The aim is to get them thinking about the topic in order to encourage debate when sharing results.

– Depending on pupils’ ages and their awareness of social networks (they may not have accounts themselves, but older brothers and sisters who do), the teacher may choose to add these networks as a memory device, if the class has not already mentioned them. For pupils aged 5 to 7, it is enough to compare the different types of content recorded using each device.

– For some devices (for example, publications on social networks), pupils will hesitate as to whether it is possible to make a copy, delete content or restrict access to content. These hesitations are a good opportunity to raise awareness of the dangers of putting personal information online.

After pupils have worked alone on their tables, they share their work by making suggestions for the table the teacher put on the board. They discuss the different characteristics of each memory device, debating their advantages and disadvantages. It may become clear from their comments that none of these devices can record a smell, taste or an emotion. Furthermore, all of these devices can be damaged or lost.

For older pupils

For pupils aged 8 to 11, this debate may be an opportunity to discuss the future of personal data they put on the Internet, and the difference between a “private” photo album (that is shown to just a few friends and can be deleted) and a “public” album that anyone can see.

To highlight the differences between the two, the teacher could use the following situation as an example: “Imagine you are asked to put up private photos, videos and stories about you, your family, your holidays and your house in the playground at school. Would you say yes? Do you think the other people in these photos, videos and stories would also say yes?” Pupils’ responses may include the following: “No, because they’re personal”; “it depends if other people can touch them or draw on them”; “it depends on the photo – if it’s a photo I don’t like, then no. But if it’s a nice photo, then I don’t mind sharing it”.

Note for teachers

The aim of this discussion is not to discourage pupils from using the Internet to share memories, but to encourage them to think about the advantages and disadvantages of the devices they use. It aims to help them choose the best device for what they want to do with their data.

Written conclusion

As a class, pupils write a conclusion that is written on the board and in their experiment notebook. For example: “Screens and other devices can help us remember and share some events. They do not replace our memories.”

Contribution to the “Charter on Using Screens Better”

At the end of this lesson, the class works as a group to write a recommendation for the “Charter on Using Screens Better”. This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: “Screens help us remember and share some memories, but there are risks involved. Our memories may be used by other people without us realizing, saved instead of deleted, or lost.”

Lesson 17 – Memorization strategies

Duration	1 hour
Material	For each pupil: • A slip of paper with a word from a poem written on it for each pupil • Worksheet 30
Aims	• Demonstrate the difference between the short-term and long-term memories • Increase pupils' awareness of a few memorization strategies
Skills developed	• The ability to memorize a few short texts • The ability to discuss, question and justify a point of view
Vocabulary	Memory, strategy

Trigger

The teacher asks the class to go over the ideas that were discussed during lesson 16 on memory devices. These devices have disadvantages: they may be unavailable, incomplete (lacking information) or lost. Alternatively, we may need to recall information immediately from the memory without looking at the computer (or other device).

The teacher gives each pupil a slip of paper upon which he/she has written a different noun from a poem such as You Are Old, Father William by Lewis Carroll.

Father – man – hair – head – age – youth – son – brain – back-somersault – door – reason – sage – locks – limbs – ointment – box – couple – suet – goose – bones – beak – law – wife – jaw – life – eye – eel – nose – airs – downstairs.

The teacher gets the class to sit in a circle. Each pupil reads the word on his/her piece of paper out loud and repeats the words of the pupils before him/her. The more words there are to remember, the more difficult this gets. If necessary, the teacher can ask: "Where can we get to in the circle? What is the biggest number of words you can remember?" He/she then asks pupils what brain function they are using during this exercise. Most will agree that they are using the memory.

Debate and activity: memorization strategies

The teacher asks the class, "What could we do to get further around the circle? What strategies could we use to help us remember the list of words?" The class discusses these questions. Some pupils may suggest writing the words down, but the teacher will remind them that this time they must use strategies that do not depend on "external devices". Others may suggest repeating or grouping words that relate to each other (for example: father, son, man, wife), words that sound similar (for example: law, jaw, airs and downstairs), words that can be made into a sentence (for example: "the man has hair on his head"), words that can be made into a song, etc.

These strategies are noted on the board. The teacher suggests that the class test a few of them.

Pupils split into small groups and are given the complete list of words (30 in the example above). The challenge for each group is to use one of these strategies to remember more words than they could when they were sitting in a circle.

Note for teachers

If pupils struggle to come up with memorization strategies, the teacher can suggest a few that they can test:
– Repeating words
– Finding words that rhyme or sound similar
– Putting words into categories (for example: body parts, animals, objects, etc.)
– If the nouns are concrete, using visualization
– Paying close attention to the text and its rhythm
One of the oldest and most efficient memorization strategies is building a "memory palace". This involves putting items to remember (words, a speech, etc.) into a place you already know well (for example, places in your house). When you want to remember the list of words, you walk through your house to find all the words you put into different places.

Sharing results

Each group chooses a speaker who recites the list of words – by telling a story, repeating words that rhyme, singing a few of the words, creating groups of words from the same family, etc. After discussing these methods quickly, pupils will realize that there are several possibilities and that each person has their own preference or method that works best for him/her. The teacher may ask pupils whether they see any advantages in learning things by heart. Answers could include: "I want to be an actor when I grow up"; "It's easy to remember things you've learned by heart"; It's quicker than searching on the Internet, and sometimes you can't look things up on the Internet"; "But you can't know everything"; "I can make calculations more easily if I know my times tables", etc.

Written conclusion

As a class, pupils write a conclusion that is written on the board and in their experiment notebook. For example: "There are different strategies we can use to remember things more easily."

Contribution to the "Charter on Using Screens Better"

At the end of this lesson, the class works as a group to write a recommendation for the "Charter on Using Screens Better". This recommendation is then added to the poster that was attached to the classroom wall during the introductory lesson. For example: "Screens are useful to help remember things but we do not need them all the time."

Further study: poetry

The teacher hands out copies of the poem from which the words were taken. Depending on the pupils' ages, he/she can ask the class to memorize the entire poem or just a few verses. When the children are called on to recite the poem, the teacher may wish to underline that learning poetry by heart is hard work – it is a way of remember these 30 words, and many more besides!

"You are old, *Father* William," the young *man* said,
"And your *hair* has become very white;
And yet you incessantly stand on your *head* –
Do you think, at your *age*, it is right?"

"In my *youth*," Father William replied to his *son*,
"I feared it might injure the *brain*;
But, now that I'm perfectly sure I have none,
Why, I do it again and again."

"You are old," said the youth, "as I mentioned before,
And have grown most uncommonly fat;
Yet you turned a *back-somersault* in at the *door* –
Pray, what is the *reason* of that?"

"In my youth," said the *sage*, as he shook his grey *locks*,
"I kept all my *limbs* very supple
By the use of this *ointment* – one shilling the *box* –
Allow me to sell you a *couple*?"

"You are old," said the youth, "and your jaws are too weak
For anything tougher than *suet*;
Yet you finished the *goose*, with the *bones* and the *beak* –
Pray how did you manage to do it?"

"In my youth," said his father, "I took to the *law*,
And argued each case with my *wife*;
And the muscular strength, which it gave to my *jaw*,
Has lasted the rest of my *life*."

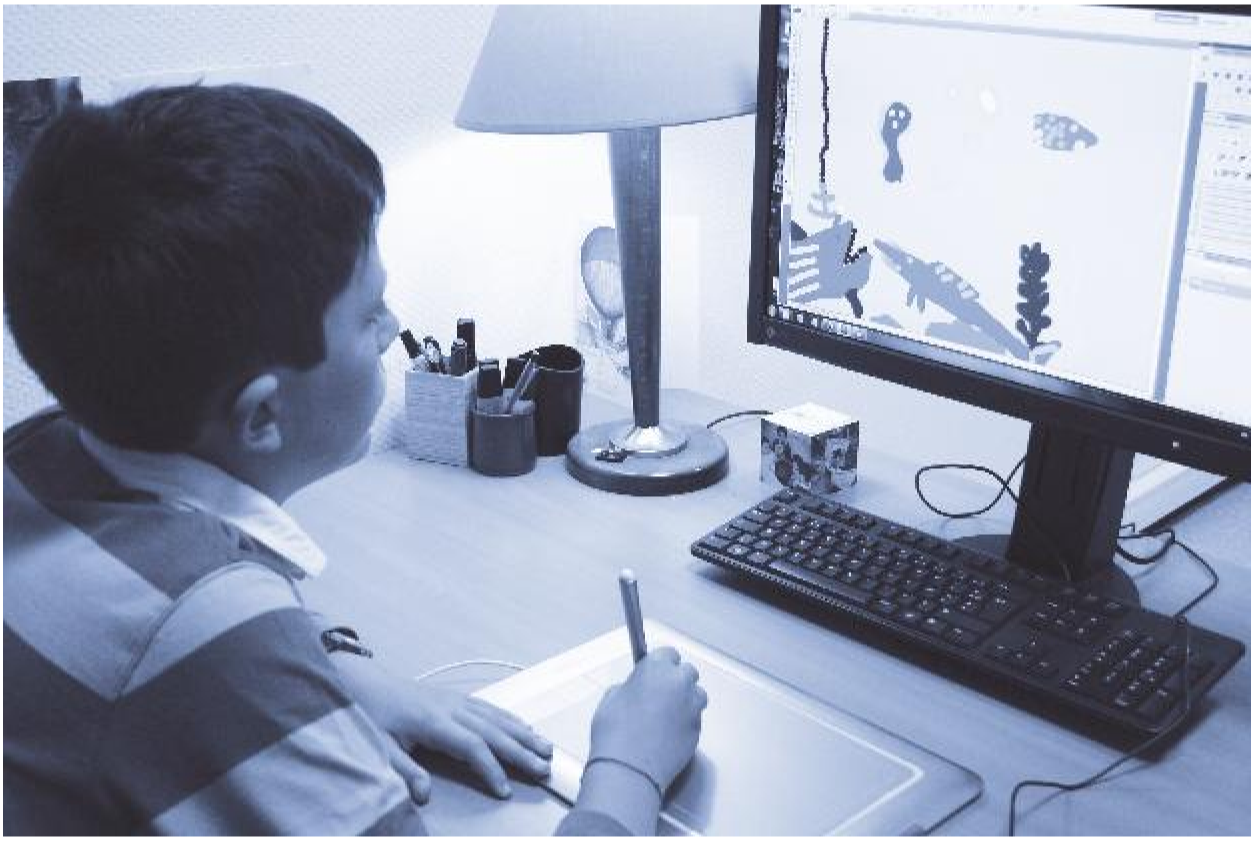
"You are old," said the youth, "one would hardly suppose
That your *eye* was as steady as ever;
Yet you balanced an *eel* on the end of your *nose* –
What made you so awfully clever?"

"I have answered three questions, and that is enough,"
Said his father; "don't give yourself *airs*!
Do you think I can listen all day to such stuff?
Be off, or I'll kick you *downstairs*!"

You Are Old, Father William
Lewis Carroll

The imagination

Scientific overview Lesson 18. The imagination



Scientific overview

Imagination is a mental process that we regularly use in our daily life, though we don't always realize it. The brain is constantly active, even "when we're not thinking of anything". Our mental activity is mostly something that takes place unconsciously, and a part of this unconscious activity is imagination.

The human capacity to create imaginary worlds is universal. It starts early in childhood – proprietarily with games based on "make-believe" – and continues in adulthood with daydreams, fantasies, creation and projects. It is practiced differently in every culture. Anyone can enter an imaginary world invented by others, be they fictional worlds in books, films, theatre or role-playing in games. Even everyday objects are forms of reservoirs for the imagination of their inventors.

What is imagination?

One definition of imagination is the ability to form mental images of absent objects. The production of mental images is a common phenomenon that everyone can easily experience. Take the following classical example: if we are asked to describe the difference between a kitten's ears and a teddy-bear's ears, we instantly create a precise mental image of the head of these two animals and can "see" the round ears of a bear and the pointed ears of a kitten.

We can control a mental object, create an image from different aspects, turn it over, concentrate on the details, transform it, and combine it with others all the while escaping the laws of the real world. These constraints are not absent, however: we have seen that it takes time to mentally travel through an imaginary maze, and this time is proportional to the maze's complexity, just like in reality.

What do we know about mental images?

Psychologists and neurobiologists have shown that when we produce visual mental images, the zones of the brain that are activated are more or less the same as those involved in the visual perception of the real world, including the zones involved in emotions. The brain functions as if visual imagination was a simulated perception, although there is no message from the retina for the brain.

Brain imaging techniques have also helped scientists study the mental processes that precede the execution of an action, known as motor imagery. Exactly like when we execute a real movement, mental motor images activate the motor cortex. These images, in particular used by athletes and musicians, are part of their training.

What is the imagination's function?

We generally use our imagination to mentally examine the world, in particular before acting, in order to consider the various options and mentally simulate their potential consequences. The imagination helps us experience things through thoughts (dealing with a moral dilemma, for example) while the real world is experienced differently: novels and films show us situations, both temporal and spatial, emotional or psychological, that we would not discover otherwise; they provide stimulation that would be impossible in the real world; they introduce us to "models" (the heroes in literature or film).

Most of the time, we do not believe that what our imagination proposes is real (even if can sometimes be practically impossible to distinguish fiction from documentary). The distinction between the real and the imaginary is already established, albeit in embryonic form, in small children. From before the age of four, children can distinguish real situations and objects from their mental images (game situation, drawing). This capacity becomes more refined with age and experience.

Even when we are consciously aware that something is a work of fiction, a part of our brain reacts as it would if it were faced with a similar situation arising in reality: we feel fear, joy, sadness, disgust, hope. In other words, while one part of our brain correctly registers the information concerning the imaginary nature of the experience, another part reacts as if it were “true”. This explains the feelings we experience when reading a novel, watching a film or playing a video game.

Lesson 18 – The imagination

Duration	1-2 hours (depending on the decision to produce a class film or not)
Material	For the whole class: • Computer connected to video projector or interactive blackboard • Video 4, which is available for download on the project website • Video camera or camera with recording and pausing functions • A4 or A3 sheets to create storyboards • Markers
Aims	• Get pupils thinking about notions of what is real and what is imaginary • Show pupils how special effects can bring an imaginary idea to life
Skills developed	• Investigative techniques: observing and asking questions • Adjusting and experimenting, forming ideas and testing them, setting out an argument • Clear oral expression with suitable language • Exchanging ideas, raising questions, justifying a point of view • Showing the capacity to think critically when presented with information and processing it • Using computers to present work completed
Vocabulary	Special effects, fantasy, fiction, imagination, reality, storyboard

Initial question

The teacher asks "does everything we see on a screen exist in reality?" and the class discusses. Generally, pupils have lots of ideas on aspects related to imagination and what is real, from their personal experience with media (films, video games, etc. that present objects or events that are not "possible" in reality). Some may mention "magic", "dragons" or "stories or films that show things that didn't exist but could have happened".

The teacher asks the pupils where these ideas of things that don't exist come from: "my imagination", "a story I read", or "a film I saw". They can then return to the ideas expressed in the introductory lesson on thought as a function of the brain.

Activity and discussion: "The sorcerer's apprentice"

The teacher shows the class video 4, where a child makes objects appear and disappear "as if by magic". After watching the film, the teacher asks the pupils to describe the film and list the elements or events that could exist in reality and those that are "fantasy". To help structure their ideas, the teacher may draw a table with two columns on the board. For example:

Elements possible in the real world	*Elements of fantasy*
Children set the table *Everyday items: plates, silverware, water*	*The "magical" appearance of objects* *The magical "disappearance" of objects*

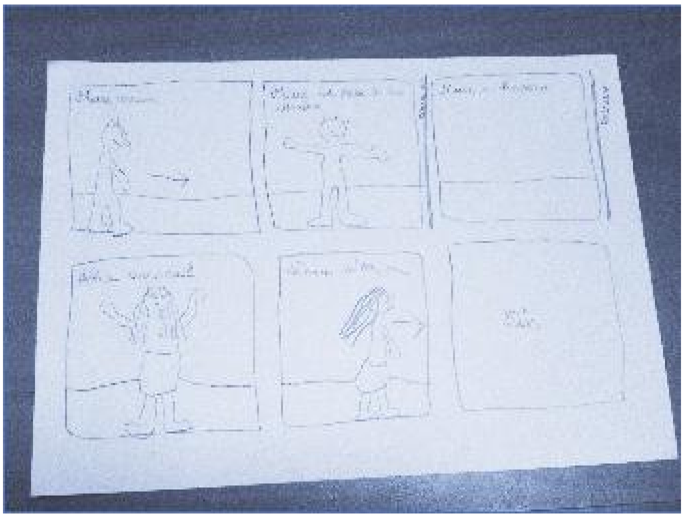
The teacher may help them explore further by asking them, for example, what the difference is between dinosaurs (which existed – there are traces, even if their appearance and behavior is often fantasized in books, films, objects) and dragons (which have never existed and are fantasy).
This may be a good opportunity for the teacher to get pupils thinking about fictional situations that can happen, but that should not be reproduced in reality because they are too dangerous for us and others (acts of violence, risky behavior, etc.).
The teacher asks the pupils to explain how, in their opinion, the author of the film made objects appear and disappear. The class discusses, suggesting for example: “he stopped recording, then started again after he moved the object”, “they’re special effects like the ones we see in films on T.V. or in the cinema”. The teacher reveals that the filmmaker did cut the filming, then start filming again.

Note for teachers

The pupils may evoke magicians who also make objects appear and disappear. Certain pupils may themselves declare that “it’s not the same thing”: the magician is trained to act quickly and distract our attention “to make something disappear up his sleeve”. The teacher can point out that the technical processes used by filmmakers and magicians are not the same, although the imagination reacts similarly.

Activity: creating a storyboard for a film (senior cycle)

The teacher then asks the pupils: “by using similar effects, can we make a person, rather than an object, disappear from the screen and have another person appear in his/her place?” The teacher divides the pupils into groups and challenges them to produce a group storyboard on an A4 or A3 page that sets the scene for the disappearance of one person and the reappearance of another. Pupils may add the technical instructions necessary to produce the film to their storyboard.



Note for teachers

A storyboard is an illustrated representation of a film preceding its production. It is a document that sets out the film’s scenes in order to plan the filming. Character movements can be indicated with arrows. Each square on the storyboard shows a shot to be filmed. By drawing a red line between the squares, the pupils can show when the filming should be paused and restarted.

Sharing results

After completing their group work, the storyboards are displayed at the front of the classroom and each group chooses a person who will give a brief description of the suggested action and the effects used. The pupils may suggest “cuts”, for example by pausing the camera, but other idea may also have emerged.

Going further: producing the film

If the class or teacher have a video camera or a regular camera with recording function that can be paused, the class can choose one of the storyboards and produce the film following the pupils' instructions.

Note for teachers

Cameras that do not have a "pause" function while recording will need to be edited on the computer. Cameras that do have a "pause" function can be watched immediately afterwards by the class.

Generally, producing the film has a strong impact on the pupils.

Conclusion and written record

The class draws up a group conclusion which is written on the blackboard and in their experiment notebook. For example:

"When we see events on screen, some things actually happen or could happen, others do not but we can imagine them happening. Special effects help us show these things on a screen."

Contribution to the "Charter on Using Screens Better"

At the end of this lesson, the class works together to write a recommendation to be added to the "Charter on Using Screens Better" and adds it to the poster hung on the classroom wall during the introductory lesson.

For example:

"What we see on screens is not always real. We should not try it out in the real world, as it is dangerous for us and for others."

Voluntary movement

Scientific overview

Lesson 19. Movement

Scientific overview

We move with the help of our brains: the brain organizes all our voluntary movements in accordance with our muscles, information received from our surrounding environment and the goal to be reached.

How does the brain command a movement?

Grasping an object appears simple, to us. However, this voluntary movement engages a large part of the brain.

It involves planning the action, assessing the overall context in which the action takes place, producing a mental image, estimating its timescale and only executing the relative movements while inhibiting others.

The object is also subject to our perception (analysis of its position in space in relation to other objects and our own body, assessing its shape and identity, possibly its speed, as well as its potential recognition) and we must prepare the intention to move as well as the ideal trajectory of the movement.

The parietal cortex, the frontal cortex and the cerebral zones involved in perception are all engaged.

These regions of the brain send instructions to the primary motor cortex (located behind the frontal cortex) which then sends motor commands to the muscles to carry out the movement. These regions are interconnected on a large scale and their functioning, which is unconscious, ensures the fluidity and rapidity of the actions.

Other cerebral structures (such as the cerebellum) and the brain stem work together to coordinate the sequence of muscles to be activated (for example, the coordination of eye, head and hand movements) and more generally posture, balance and locomotion.

Meanwhile, the sensory system of the skin, tendons, joints and muscles send information to the brain to adjust the movement. The visual system also plays a significant role in executing movement.

What happens next?

The neurons that leave the primary motor cortex travel down the spinal cord, where the message is picked up by neurons called motor neurons. The projections (axons) of these motor neurons are connected to the target muscles at the neuromuscular junction where muscular activity is activated.

Are there other cerebral functions involved in movement?

We must not forget that learning and action are related. The neurons in the parietal cortex that prepare the movement (picking up an object for example) are capable of learning: when we repeat a movement often, these neurons retain the configuration of the hand as it grasps and during the use of the object, which results in a form of automatic reflex behavior.

Does physical activity affect the brain's functioning?

The need to walk, move and run is vital for our health. Moderate, regular physical activity has a direct impact on our body as well as our brain. It increases blood flow to the brain and studies have shown that it improves memory and learning.

Lesson 19 – Movement

Duration	1 hour
Material	For the whole class: • Access to a computer (or computer room)
Aims	• Become aware of the variety of our movements • Realize that we are not motionless in front of a computer but we only execute small movements
Skills developed	• Practicing an investigative approach: observing and raising questions • Tweak and experiment, form a hypothesis and test it, defend a point of view
Vocabulary	Action, movement

The teacher invites the class to think back to the ideas expressed during the introductory lesson concerning one of the brain's functions: executing actions and movements.

Initial question

The teacher invites the class to reflect on the following: "What movements do we perform with our bodies throughout an ordinary day?"

The class discusses, perhaps reflecting on the previous day, suggesting for example that "we walk to school or to move from one room to another", "we run in the yard at lunchtime", "we jump while playing elastics". Some pupils may mention that we also perform lots of "little movements", such as "we swing our legs under our chairs", "we move our hand to write with our pen", "we turn our heads right and left to see our classmates", etc.

The teacher writes the class suggestions on the board.

S/he then asks: "How could we class these movements? Do they have anything in common?"

Working as a class or in small groups, the pupils think about this and then offer suggestions, for example "certain movements are slow, others fast", "some of them only move one part of the body: hands, head, legs...others move the whole body", "some are tiring, others not", "make us sweat or not", "some of them happen without thinking, for others we make an effort", etc. The children affirm that many different movements are performed in one day.

The categories suggested by the pupils are kept on the board for the next part of the lesson.

The teacher then asks: "When we are in front of a screen: does our body move? How?" The pupils discuss among themselves and the teacher writes their ideas on the board. Some may declare that "no, we don't move", others object that "yes, sometimes we change position when we're watching the television", "we stand up to shout at the referee of a match", "we curl up in our seat when there is suspense". Some may say that "we move our fingers to use a keyboard and a mouse on a computer or the controls of a video game".

Others might mention "kinetic video games" (which are movement sensitive), etc. The question of "how do we move in front of screens?" is written on the board and in each pupil's experiment notebook.

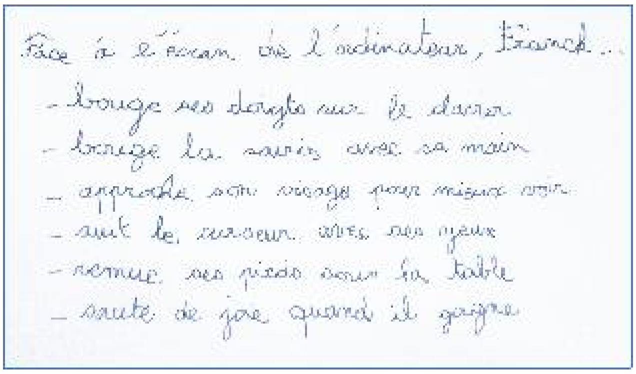
Activity: "How do we move in front of a computer?"

To find out more, the teacher asks the class: "How can we study how a person moves, for example when using a computer?" Together, the pupils think of a method of observation, suggesting for example: "we have to observe someone who is really using a computer", "pay attention to everything s/he does with his/her body", "observe the person carefully to write a list", etc. They may suggest "we could film ourselves while using computers, then watch the videos and write down everything we do".

On the class computer or in the computer room, the teacher suggests that the pupils carry out this observation work. If the class has only one computer station, one pupil is selected to use it (operating a word processing program, browsing a web page, playing a game of Solitaire, etc.) and the rest of the class observe and note his/her movements. If several stations are available, the teacher might ask the pupils to work in pairs, with one pupil at the computer and the other noting his/her movements. If the class has a video camera or camera with recording function, this might be considered.

Sharing results

When they have finished observing, the class shares the observations listed in a table or on a poster. For example "when we are in front of a computer screen, we move our head to look at every corner of the screen, our fingers to type on the keyboard, our hand to use the mouse, we bring our nose close to the screen, cross and uncross our legs under the table", etc. This observation exercise may reveal to pupils movements that they would not have imagined performing in front of a screen.
This is also a good opportunity to notice the movements that are essential for the computer to function and produce the result we expect.


Face à l'écran de l'ordinateur, Franck...
- bouge ses doigts sur le clavier
- bouge la souris avec sa main
- approche son visage pour mieux voir
- suit le curseur avec ses yeux
- remue ses pieds sous la table
- saute de joie quand il gagne

The teacher then asks the class to class these movements in the categories defined at the beginning of the lesson and left on the board. “In which category do they belong? Do these movements involve the whole body, or one part of the body? Are they tiring or not?” The class discusses these questions, and it appears that – even if we are not motionless in front of a computer – the movements are generally very small and are mainly in the fingers and hands. They are a lot less intense than the movements performed in P.E. class or gym.
During the discussion, the class might consider what would happen if our movements were limited to “tiny movements performed sitting in the same place all the time”.

Conclusion and written record

The class prepares a group conclusion which is written on the board and in the experiment notebooks. For example:

“We are not motionless in front of screens: we perform small movements. These movements are essential to use the machine (we give it orders by moving the mouse or typing on the keyboard).”

Contribution to the “Charter for Using Screens Better”

At the end of this lesson, the class writes a recommendation together to add to the “Charter for Using Screens Better” and add it to the poster that was hung on the classroom wall during the introductory lesson.

For example:

“We should do physical exercise and sport every day: this helps us use energy and relaxes us after sitting in front of a screen.”

A look at the brain

Scientific overview

Lesson 20. The brain seen on a screen

A. Van der Stegen/ Laboratory of psychology of development and education of the child (LaPsyDÉ) - CNRS

Scientific overview

From Antiquity, the brain was designated the organ of reason by Hippocrates (c. 460-375 B.C.). Research in medicine as well as philosophy was pursued for centuries, stirring many passionate debates. From the 19th century on, the brain sciences flourished spectacularly.

In 1861, neurologist Paul Broca, while performing an autopsy on the brain of a victim of aphasia, explained the loss of speech by this man by a lesion in the frontal cortex of the left hemisphere. This demonstration shed new light on the brain's functioning, showing that it is not homogenous and that each region is more or less specialized in one function. This opened the door to research that continues today with brain imaging techniques. Following his discovery, a number of observations showed that we can distinguish specific regions in the brain which are dedicated to specific functions. The study of highly unusual malfunctions (such as the inability to recognize faces, for example) resulted in the first maps of the brain's regions at the beginning of the 20th century. Techniques for analyzing brain activity by electroencephalography – which explores the "living" brain of healthy or diseased subjects - were also developed at this time, and allowed great progress to be made. The work of Ramon y Cajal (Nobel Prize 1906) revealed that neurons form discontinuous networks, connected by synapses.

In the mid-20th century, methods of experimental psychology (tests performed in laboratories on subjects performing specific tasks) paired with linguistics and artificial intelligence gave new impetus to the study of cognitive functions. They involved elucidating the sequences of the mental operations of memory, reasoning, decision-making, perception, language, calculation and reading. The meeting place between these "cognitive sciences" with the neurosciences gave rise to cognitive neuroscience, defined as the study of the neural bases of mental functions. Our knowledge of the the adult and the child's minds were entirely upended. Modern progress in neurosciences owe much to functional neuroimaging, which shows the activity of the different structures of the brain and allow us to follow the mental process at the moment they are produced.

Functional magnetic resonance imaging (fMRI) shows us the different networks of neurons and the neural processes involved in language, memory, emotions, facial recognition, learning, reading, etc.

Functional MRI is based on the fact that active cerebral zones, participating in a task, momentarily consume more energy (and therefore oxygen). They make use of the magnetic properties of the blood's hemoglobin, which varies according to the presence of oxygen. The signals received by the machine (changes in the oxygen concentration levels related to changes in blood flow) correspond to the localized and transitory increases in blood flow, and not directly to neuron activity. The result of the fMRI is presented as an image, constructed from these signals by extremely powerful calculators and shows the cerebral zones where the blood flow changed between the control state and the execution of the task. The deduction made is that those zones, which are indicated in color on the brain map, are involved in performing the task. fMRI images, which today are widespread in the media, are not a photography of neural activity.

Increasingly efficient technology continues to be developed, but the brain, an organ with exceptional properties, still retains a large part of its mystery.

Lesson 20 – The brain seen on a screen

Duration	1 hour
Material	For each group of pupils: • Brain of a sheep or pig • Worksheets 31, 32, 33
Aims	• Pupils discover how new technologies allow the brain and its functioning to be studied
Skills developed	• Practicing an investigative approach: observing and raising questions • Express and use the results of the experiment using scientific vocabulary
Vocabulary	Brain, cerebral cortex, brain lobe

Initial question

The teacher reminds the pupils of their response to the question "What do you know about the brain?" during the introductory lesson. "It is an organ found in the skull, it's grey, it's soft", etc. If the teacher had asked the pupils to draw a brain or the nervous system, these images can be looked at in this lesson, and the teacher might suggest comparing their drawings and prior ideas with a sheep or pig brain and images taken from an anatomy book.

Activity: observing an animal brain

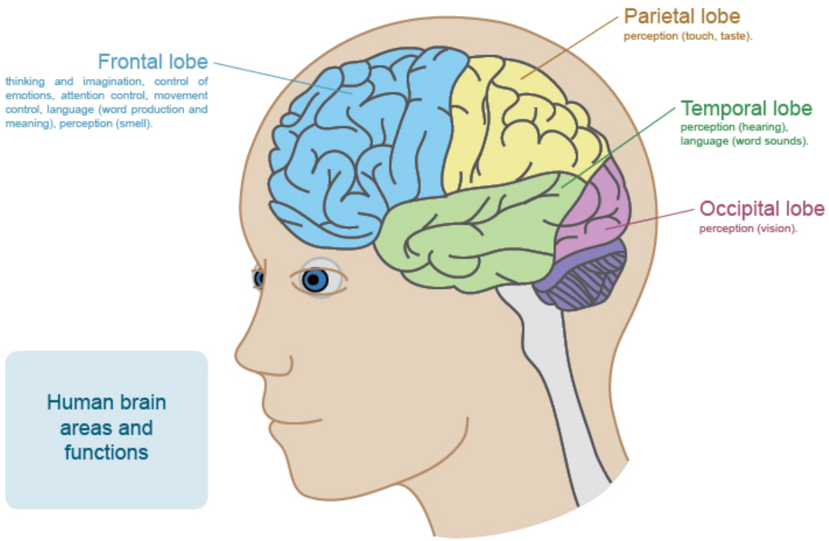
The pupils are divided into groups and each group is given a brain (pig or sheep). The teacher asks each group to observe its size, shape, color, appearance (smooth or wrinkled, the different folds, if they are deep or shallow, and – using a disposable plastic spoon or glove – its consistency (mostly soft, but not too delicate). The teacher can then begin the dissection, showing the pupils that the brain is formed of an outer gray layer (the cerebral cortex) and a deep, white interior (white matter).

The teacher may point out that no blood flows when the brain is cut, whereas in a living animal the brain contains a lot of blood.

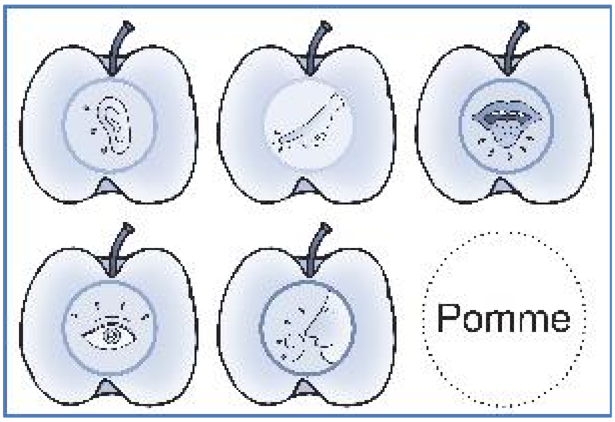
The observations are written down in the experiment notebook and then shared for all by writing them on the board.

Activity: Human brain functions

After direct observation of an animal brain, the teacher gives each group a copy of worksheet no. 31 which shows a diagram of a human brain in profile, where the 4 lobes are visible in different colors. The pupils read the text which describes certain functions attributed to each lobe:



- the frontal lobe: thinking and imagination, control of emotions, attention control, movement control, language (word production and meaning), perception (smell);
- the parietal lobe: perception (touch, taste);
- the occipital lobe: perception (vision);
- the temporal lobe: perception (hearing), language (word sounds).



The teacher distributes a copy of worksheet no. 32 to each group and asks them to cut out each of the 6 images, and place them on the corresponding lobes of the brain. Each apple illustrates one or more brain functions:

– one image represents hearing, Apple und of the apple as we bite it; the second represents the feel; the third taste; the fourth vision and another represents the smell of the apple;

– one label has the word "apple": this calls on language for the meaning of the word and vision in order to read it.

Each group completes worksheet no. 31 by applying the labels. The worksheets are hung on the board and the answers from each group are compared and discussed.

Note to teachers

Various answers may emerge from the discussion. Certain pupils may place the apple label on the occipital lobe and others on the frontal lobe: both are correct. Others may suggest that we can think of an apple without seeing or touching it, etc.

Discussion

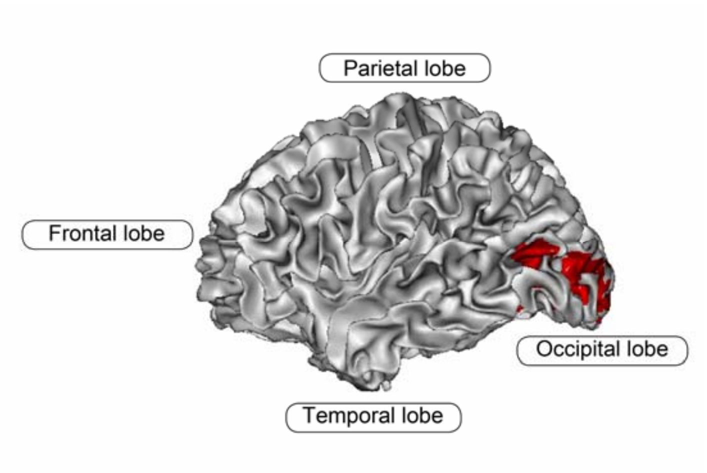
The teacher asks: "Do you have any ideas on how to observe what happens in the brain, on how the scientists managed to map the brain's lobes and functions?" The pupils discuss this, suggesting for example that we might "do a kind of x-ray" or "operate on the brain". Some might make suggestions from personal or family experiences. To find out more, the teacher distributes or shows worksheet no. 33 on the board.

The teacher explains that the brain can be studied by machines connected to computers: we can see a child being examined in the machine. S/he then invites them to observe the image obtained, projected.

on the computer screen. This is the MRI (magnetic resonance imaging). On worksheet no. 34, which the teacher distributes or shows on the board, we see the occipital lobe is active when the child looks at an object. In the image, the active zone is shown in red.

Note for teachers

The teacher should make sure that the pupils don't think that only the colored zones are active: the entire brain is active, even during sleep and when we do nothing and think of nothing.



Conclusion, written record

The class come to a conclusion together and writes it on the board and in their experiment notebooks. For example:

"Highly complex machines help us know the brain better. Some zones of the brain are used for seeing, others for touching, others for hearing. Computers help carry out scientific research."

Final lesson – Beyond the classroom walls

At the end of the unit and depending on the class schedule, the teacher can suggest a scientific mediation activity so that the pupils can value the work completed during the year and share the knowledge they have gained. For the pupils, it is a creative activity that highlights the value of their work, helping to look back on all of the concepts discovered throughout the unit.
Such a project might be included in the school fair, or science forum.

To do so, the teacher asks the class: “How might we share (with friends in other classes who haven’t done the project, with parents, etc.) what we learned about the brain and what happens when we use screens?”

Suggestions may be varied:

– displaying or handing out the “Charter for Using Screens Better”;

– writing a journal or blog;

– creating a booklet as a group;

– designing an exhibit where the pupils in the class invite pupils from other classes to attend their presentation of what interested them most, using various means: a quiz, interactive experiments (Stroop test, illusions, etc.), showing films on the computer, displaying themed posters and individual and group worksheets collected throughout the unit, commenting on the charter, etc. This presentation, including the texts, drawings and photos, could also be displayed in the computer room and outside the classroom;

–the exhibit and all of the pupils’ worksheets can be shared with other classes enrolled for the unit on the project’s dedicated website (www.fondation-lamap.org/ cerveau).

Glossary

Allocentric representation: Knowing our location in our environment is a function that is essential to our survival and requires cerebral mechanisms. One of the two spatial representations is allocentric representation. This is independent of the observer's position. It enables us to define the direct relationship between objects. Distances and directions are not defined in relation to the observer's position. The location of an object with an allocentric reference point does not change when the subject moves in his/her environment. An example of this is when we use road maps.

Attention: Attention is a cognitive function that is essential for conscious human activities. It enables us to concentrate on a detail or an activity while controlling the force of habit and without becoming distracted by a constantly changing environment.

Augmented reality: Technological tools enable virtual elements to be superimposed on the real world, giving the user the possibility of being immersed in a mixed environment. Augmented reality is currently rapidly growing, with a number of uses in games as well as professional environments: geolocalisation, marketing and e-commerce

Autism: Autism, or autism spectrum disorders, are pervasive developmental disorders causing behaviour impairments. It is particularly difficult for autistic children to communicate and interact with others.

Avatar: in video games, Internet forums, etc., and "avatar" is the appearance that a player or web user takes. In the Hindu religion, each successive incarnation of a god is an avatar.

Cerebral cortex: made up of the cell bodies of neurons, the cerebral cortex is the outer layer of the cerebral hemispheres (cortex means "covering" in Latin).

Cerebral plasticity: This is the brain's ability to organize and reorganize the neuron circuits according to experiences and acquired knowledge. This fundamental property goes against the naive idea that the brain is a rigidly wired robot.

Cognitive science: Cognitive cerebral functions are those which enable us to acquire, maintain, transform or use our knowledge. Their study is a meeting point for neurobiologists, psychologists, neurologists, psychiatrists, philosophers, linguists, sociologists, anthropologists, computer scientists, etc. A recently introduced term to refer to this discipline is the cognitive neurosciences. Better understanding of human cognition can be a source of reflection on learning and teaching methods.

Cyberbullying: Information and communication technology can be used by schoolchildren and middle and high-school students to tease another classmate, repeatedly over time. Cyberbullying takes place via mobile phones, instant messaging, email and social networks. It may consist in intimidation, insults, online threats, spreading rumors, account hacking and online identity theft; the publishing online of a photo or video of the victim in a delicate situation, etc.

Egocentric representation: Knowing our location in our environment is a function that is essential to our survival and requires cerebral mechanisms. One of the two spatial representations is egocentric representation. This is when the location of an object is represented in relation to our own location. When we move, the egocentric space changes.

Functional magnetic resonance imaging (fMRI): Neuro-imaging using fMRI combines elements of physics, instrumentation and engineering, computer software and sophisticated calculations. It makes use of the fact that there is increased blood flow in the vessels supplying an active cerebral region. This increased blood flow is accompanied by increased oxygen consumption. An fMRI shows a live view of the variation in blood oxygen levels in the brain when it is working, and connects consumption peaks with a specific cerebral activity. It reveals which region is specifically active when the brain is applied to functions such as watching, talking, reading, counting and even thinking.

Immersion (such as in a virtual reality system): Technological tools can engulf the user in a virtual world. This immersion is essential for the user exploring the virtual world to be able to react naturally, so that nothing leads him to think that this world doesn't exist.

Internet: Computers – machines capable of processing vast quantities of varied information (images, videos, sounds, text, etc.) – when in binary form (0 or 1) can exchange information when they are connected by cable or by radio. These connections are called computer networks. They can vary in size. Internet is a network, or a network of networks, of vast size, that connects several billion computers. In the early 1960s, two American researchers came up with a way of connecting research centres using computers.

Long-term memory: long-term memory concerns four systems that interact and contribute to the long-term storage of information:
– episodic memory, which stores memories of personal experience, or specific episodes of our own lives;
– semantic memory, composed of general knowledge about the world (Paris is the capital of France) and about ourselves (civil status);
– procedural memory, which stores particular gestures and skills (driving a car, cycling);
– perceptive memory, our memory of sounds and images (we recognize a shape easier if we have already seen it).

Mental image: our brain contains a multitude of images which come to mind either subtly and often irrepressibly, or by reconstruction. The cerebral networks of mental images are connected to those of visual perception.

Neuron: Neurons are nerve cells which are information processing units. In the central nervous system, the brain is made up of a hundred billion neurons. Each neuron is made up of a gray body and white projections which are the axon and the dendrites. Neurons communicate between themselves through these projections which form liaisons between them. The information perceived by our sense organs, for example, activates the neurons which transmit electric impulses (nerve impulses) along their axons to the synapses.

Neuro science: Fundamental neurosciences study the organization of the nervous system from the structural and functional macroscopic scale to the microscopic scale, at the genetic, cellular, molecular, physiological, electrophysiological, developmental, anthropological, etc. levels. Clinical neurosciences aim to understand, predict, diagnose and cure neurological disorders, psychiatric disorders and sense organ pathologies.

Neurotransmitters: The nerve impulse is the electrical signal transmitted by the neuron's axon. At the synapse (the space separating two neurons where they communicate), the arrival of nerve impulses causes biochemical molecules to be released, which cross the synaptic cleft and stimulate (or inhibit) the next neuron (post-synaptic), causing the next nerve impulse to be transmitted. Dopamine, serotonin and acetylcholine are all neurotransmitters.

Perception: Perception is our window to the outside world. Seeing, listening, tasting, smelling and feeling cost us no effort and nothing appears simpler. The sensory systems are, however, extremely complex, involving the sense organs first, followed by a number of cerebral processes to select, decipher and interpret.

Social cognition: the mental processes we use as social beings, including understanding others, language, culture and types of social organization. Why are we more attracted to one face over another? How are stereotypes and pre-conceived notions formed? Are we really free when we make a choice? What processes are involved in empathy, altruism, moral judgement, competition and cooperation? There are some of the questions studied.

Social networks: at the end of the 1990s, social networks (a group of people connected by a social link) appeared on the Internet? Facebook, created in 2004, is the best known and the most commonly used today. These networks, which bring together millions of users, can be excellent communication tools for internet users. However, they raise complex issues in terms of data protection. Many questions have been raised, in particular about personal data, the use of this data by third parties, the default settings of the tools for managing privacy as well as the possibility of definitively leaving the network by closing an account. 48% of young people aged 8-17 in France are members of a social network (CNIL 2011 poll).

Synapse: A synapse is located between two connected neurons. It is a tiny gap between the axon terminal of one neuron and the dendrite or cell body of another neuron. It is in the synapse that the arrival of nerve impulses releases neurotransmitters, enabling the transmission of information from one neuron to another.

Virtual reality: In a virtual reality, all objects – the highly realistic along with pure fantasy – appear as computer-generated images that we can interact with. Interactivity allows us not only to be spectators that are entirely immersed in a virtual world, but also and most importantly to be actors.

Web: the launch of the Internet enabled the World Wide Web to be created in 1989 at the CERN (European Organization for Nuclear Research). The web is a system built on hypertext documents: electronic links, created and saved between documents, enable us to "surf" from one document to another or lead us to images, music and videos. The web functions on the Internet (the two are often confused), which enables hypertext links to span computer networks and connect documents on several machines, thus forming a "web" that is constantly renewed, making the Internet a global communication tool.

Working memory (or short-term memory): As its name suggests, this is a workspace where small quantities of useful information is stored for a limited period (the time necessary to process the information for immediate use): remembering a phone number long enough to dial it, remembering figures to multiply when calculating, etc. This memory is essential for reasoning and planning an activity. There is interaction between the long-term and short-term memory. Memories intended to leave a long-term imprint pass through the working memory; inversely, any event can activate long-term memories that are then accessed by the working memory.

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Appendix

Example of informative letter for parents

Dear Parent,

Your child's class is about to begin a new project entitled "Screens, the brain and the child", proposed by the La main à la pâte foundation[1] and which is in line with the educational board's curricula.

La main à la pâte was established in 1996 at the initiative of Nobel Prize laureate Georges Charpak, Pierre Léna and Yves Quéré with the support of the Academy of Sciences, to promote experimental science teaching in elementary school. The teaching approach it recommends is based on observation, scientific questioning, investigation and experimentation, with a significant focus on group work, discussion, comparing and contrasting ideas and proficiency in language, both spoken and written. It requests parental approval as well as their cooperation.

"Screens, the brain and the child" is a teaching unit for the teacher to implement in class. The aim when it was created was twofold: teach pupils about the brain functions affected by the numerous screens that now are a part of their daily lives and help them realize that they are capable of using them correctly and in a self-regulatory manner. Pupils will thereby become aware of the impact on their cerebral functions when they are using screens, helping them better understand what they can do and what they cannot do with screens. They will understand that they must think critically about certain content, and be careful when using these tools to communicate and inform themselves; they will develop their thoughts on civic behaviour, moral judgement and health. This will encourage them to develop their own rules for moderate and self-regulated use of these tools.

The teacher will need your support in stressing the importance of the correct use of screens, the rules for which your child will have developed him/herself at school.

We would like to express our gratitude in advance for your support and we remain at your disposition if you have questions or suggestions that you would like to put forward.

Yours Sincerely,

1. Fondation *La main à la pâte*
43, rue de Rennes,
75006 Paris
http://www.fondation-lamap.org/

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We would especially like to thank the teachers who accepted to test the project in their classes; it is thanks to their precise observations that this unit was completed: Christine Blaisot (Le Mesnil, 76), Lydie Bordacarre (Mondeville, 14), Anne Clémenson (Chambéry, 74), Gaëlle Cornu (Mondeville, 14), Laetitia Frassetto (Caen, 14), Corinne Hervé (Mondeville, 14), Agnès Lamiday (Mondeville, 14), Anne-Marie Lebrun (Bourg-la-Reine, 92), Virginie Ligère (Antony, 92), Lydia de Lise (Aubervilliers, 93), Mme Maleplate (Merville-Franceville, 14), Florent Mécène (Aubervilliers, 93), Marie Mellet (Paris), Tiphanie Nadaud (Caen, 14), Marion Olivier (Paris), Jean-Michel Peres (Caen, 14), Mme Peres (Colleville-Montgomery, 14), Bruno Plaut (Nonancourt, 27), M. Vannier (Merville-Franceville, 14).

Warm thanks to Arlette Pineau, honorary professor at the University of Caen, and Céline Lanoë, Amélie Lubin, Sandrine Rossi, teacher-researchers in cognitive sciences also working at this university, for their assistance and judicious comments throughout the testing phases.

We would also like to thank all those – scientists, teacher trainers and education specialists who proofread this text and enhanced it with their helpful comments, in particular Anne Clémenson, Odile Macchi, Manuela Piazza and Édith Saltiel, Andrea Formica, Clémence Bernard, Mathieu Hirtzig, Clémentine Jung, Brice Goineau, Antoine and Blandine Descamps, Marzio and Corinna Formica.

Afterword

The brain: a delicate treasure

La main à la pâte was founded in 1996 at the initiative of Georges Charpak. After receiving the Nobel Prize in Physics in 1992, G. Charpak decided to put the prestige and audience that this exceptional distinction earned him to good use, to help the children of France and the world. He then, with the firm support of the Académie des sciences, launched this programme unlike any other and which rapidly began to be known as *La main à la pâte.* The aim was to practice science in primary schools and to make pupils happy to discover it, based on the Ten Principles which would, in the years that followed, lay the foundations for complete revolution in elementary school science teaching in France. This afterword does not aim to recount the details of that adventure, which was done elsewhere and continues in France and abroad, nor those of science or the curiosity of children which knows no bounds.

Nonetheless, it is useful to know that from 2004 on, the *La main à la pâte* team focused on making a tie between education and health, which is taught through science class in primary school, for the simple reason that children, like adults, pay more attention to their health when they understand the reasoning behind the recommendations. The main biological functions that are breathing, blood circulation and digestion are already present in the science basics that form the school curricula. Creating links between science and health was a new step and several units for teachers were published, offering lesson plans for the class that followed the curricula. Success was encountered, and this provided the encouragement to continue in this vein.

The intense frequency with which children use screens, in all the forms that the digital revolution has provided – games, computers, mobile phones, tablets, etc. – raises questions for parents and teachers, who are both admiring of the dexterity and understanding that children show of these tools, and concerned by excessive use and the consequences. But how could we develop a meaningful teaching project? While other organs (lungs for breathing, the stomach for digestion, the heart for circulation) are easily illustrated and ideal for the scientific observation and reflection necessary for the inquiry-based approach recommended by *La main à la pâte*, the task appeared much more arduous when it came to the brain. An organ so complex that modern science is far from understanding it completely, the brain is also invisible and inaccessible for direct experimentation; it is also the organ for thinking and self-awareness, more than all others making us human. The challenge was great, but we decided to take it on and attempt this new adventure: based on screen use, children could discover that they each possess a precious treasure, nestled within their heads, with multiple functions that screens stimulate or stultify, awaken or send to sleep.

A team from *La main à la pâte* got to work with passion, respecting our basic principles: construct an inquiry-based teaching unit on the chosen theme – and without a moralizing overtone, teach pupils about the treasure that is the brain and its fragile nature -; provide school teachers with a tool that unites scientific knowledge with pedagogy; test each step with teachers and pupils.

It was an undertaking that required great daring, and without the encouragement of Stanislas Dehaene, an eminent neuroscience specialist passionate about educational issues, we would most certainly never have done it. We also needed the support of the National Education board's general inspectorate, in charge of school curricula, and their respect: the sudden boom in popularity of the brain and cognitive sciences in our primary schools, alongside the more traditional bodies mentioned above, did not cause undue worry to Dean Philippe Claus, who encouraged us to move forward. The unit was therefore published to great acclaim, and it is likely that it is unique worldwide.

But this publication, intended to be implemented in our schools, is not unaccompanied. While we were drafting and testing the teaching units it contains, the Académie des sciences was reflecting intensely on how to provide parents, health professionals and educators with a Guide for screen use in children. This Guide is based on the most up-to-date research in neurosciences, cognitive sciences and experimental psychology, as well as medical practice by doctors who listen and treat: it is published as an accompaniment to this text and they each contain elements that can be found in the other.

Two revolutions provide the setting for these two publications, revolutions that have marked our era: the first, silent and profound, is that of the cognitive sciences which are gradually revealing the brain's mysteries and will change the act of teaching; the other, striking and pervasive, fills our lives with screens and computer devices. Teachers have the difficult but fascinating task of preparing our children to live well in this new world.

Pierre Léna

Worksheets

Worksheet 1

Tools that have screens / In this column, write down the functions of the brain, and then check those which – in your opinion – are activated when we use each of these tools.	 Television	 Computer	 Mobile phone	 Video game console

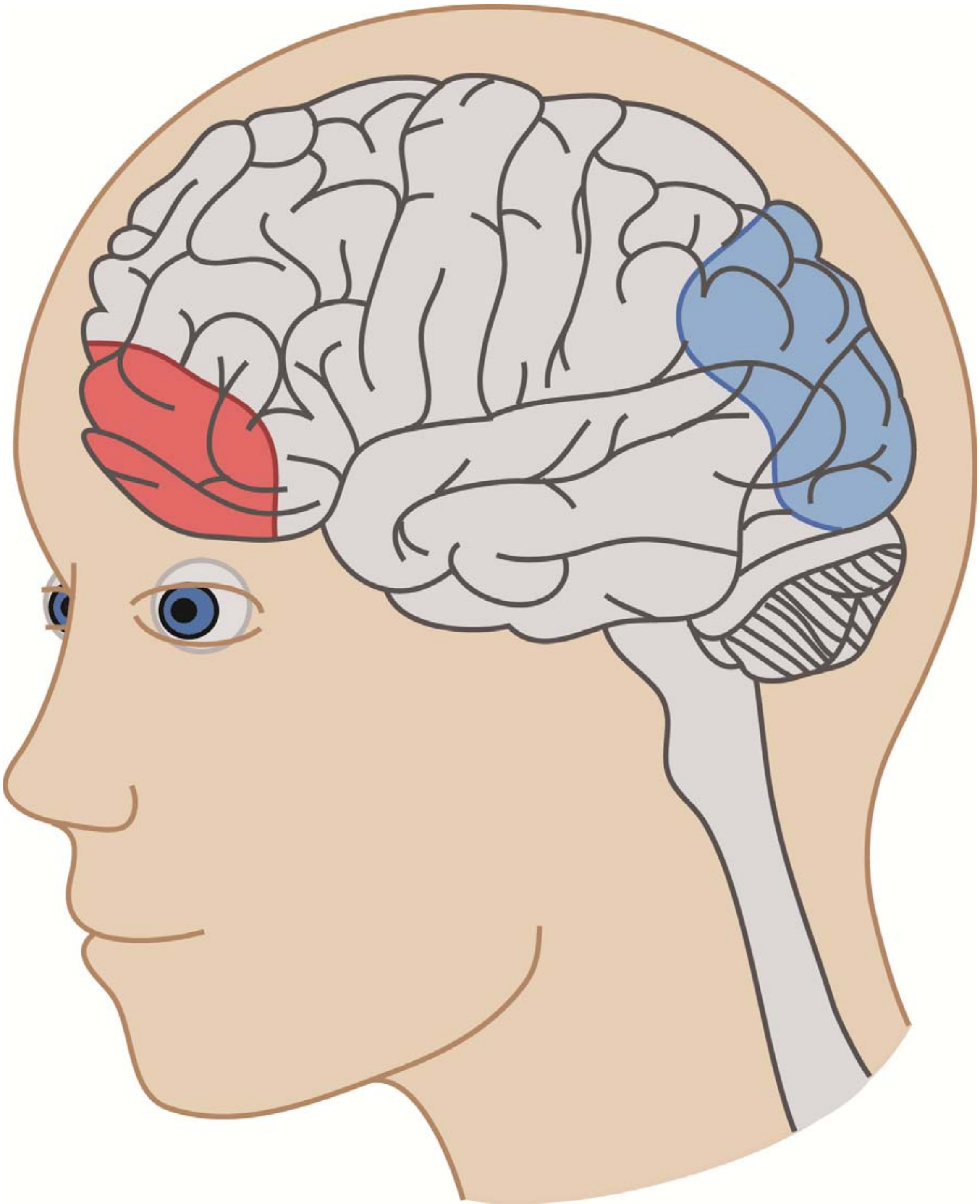
Worksheet 2

Worksheet 3

Worksheet 4

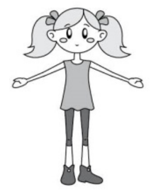
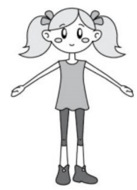
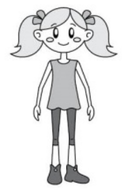
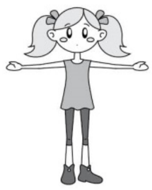
Colors / Flavors	GREEN	RED	YELLOW
MINT	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐
STRAW-BERRY	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐
LEMON	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐	Mixture number (write on jar): ☐ Flavor recognized by "control" pupil: YES ☐ - NO ☐

Worksheet 5



Worksheet 6

Worksheet 7

1 	6 	11 	16 
2 	7 	12 	17 
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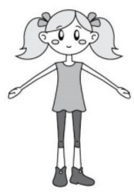
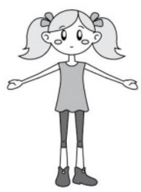
5 	10 	15 	20 

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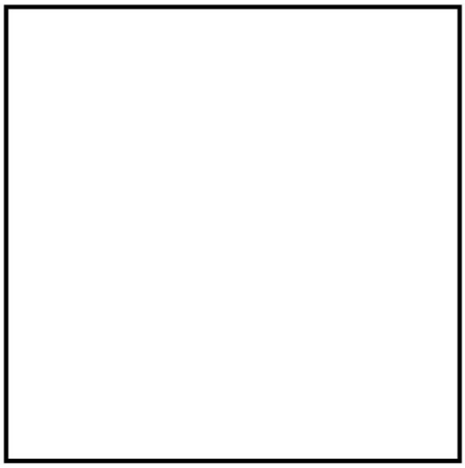

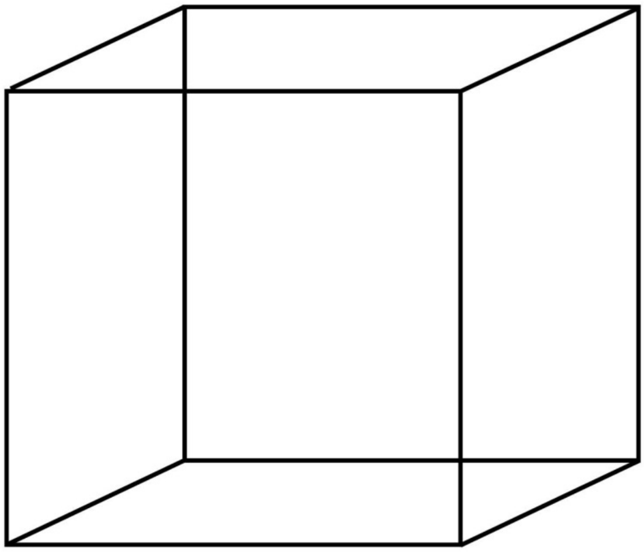

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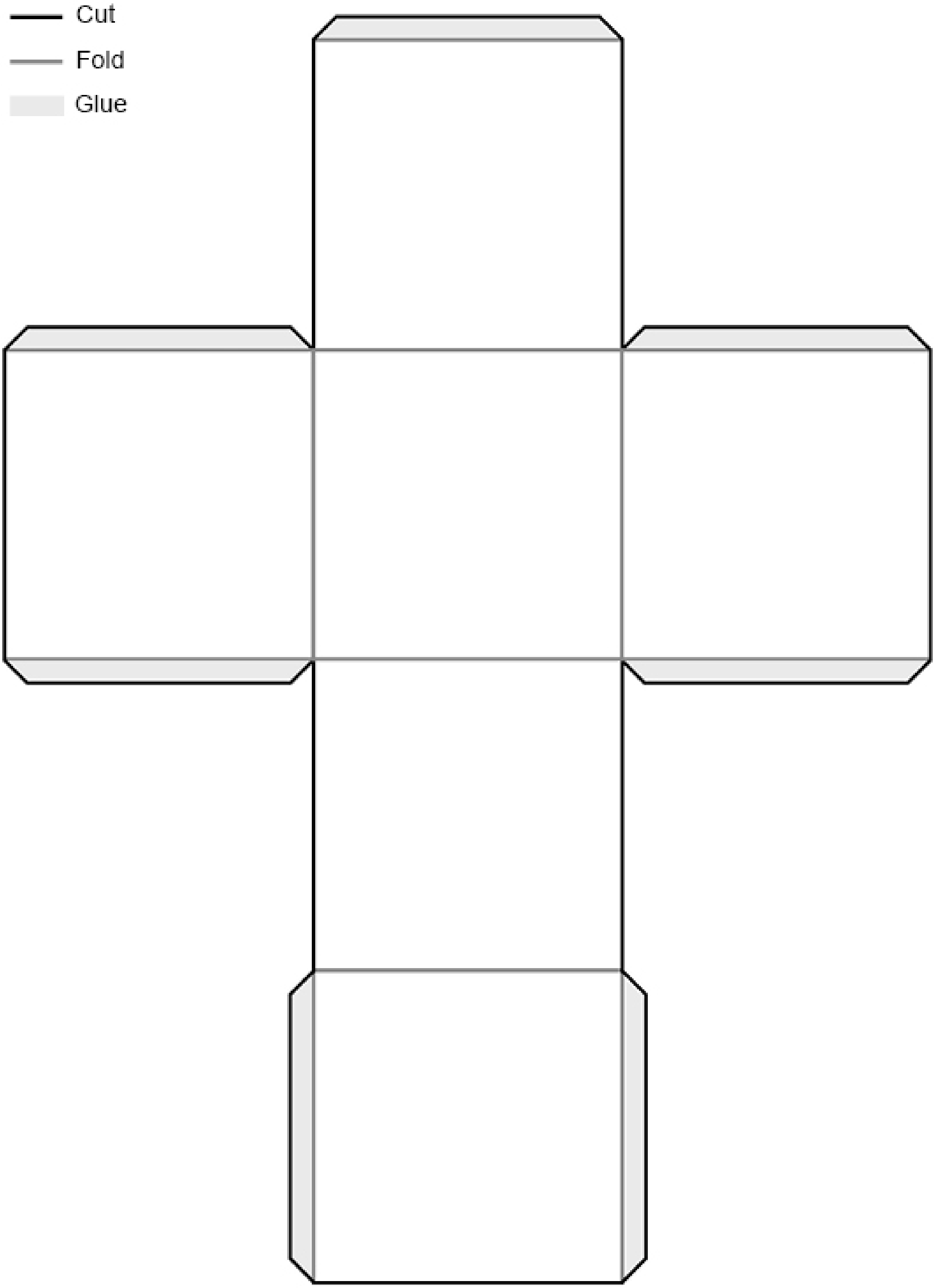

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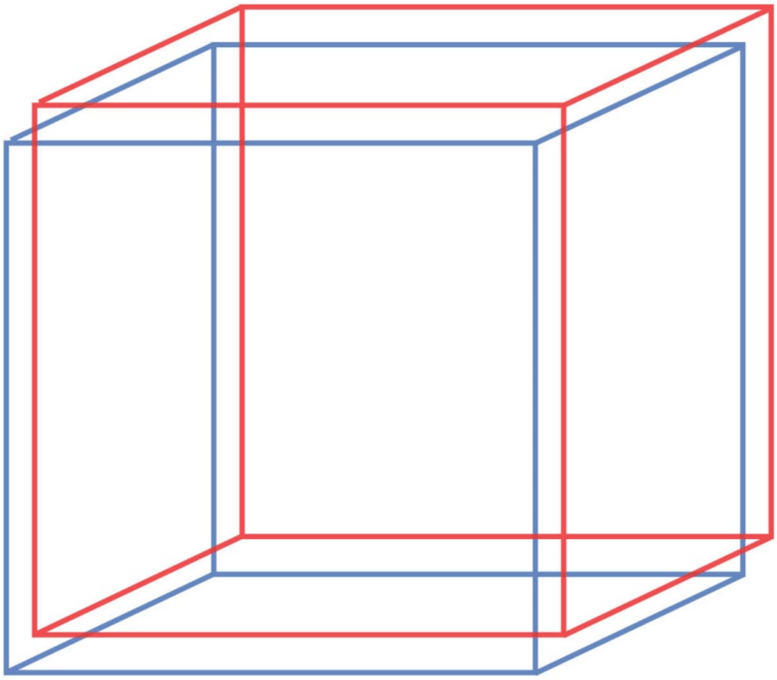
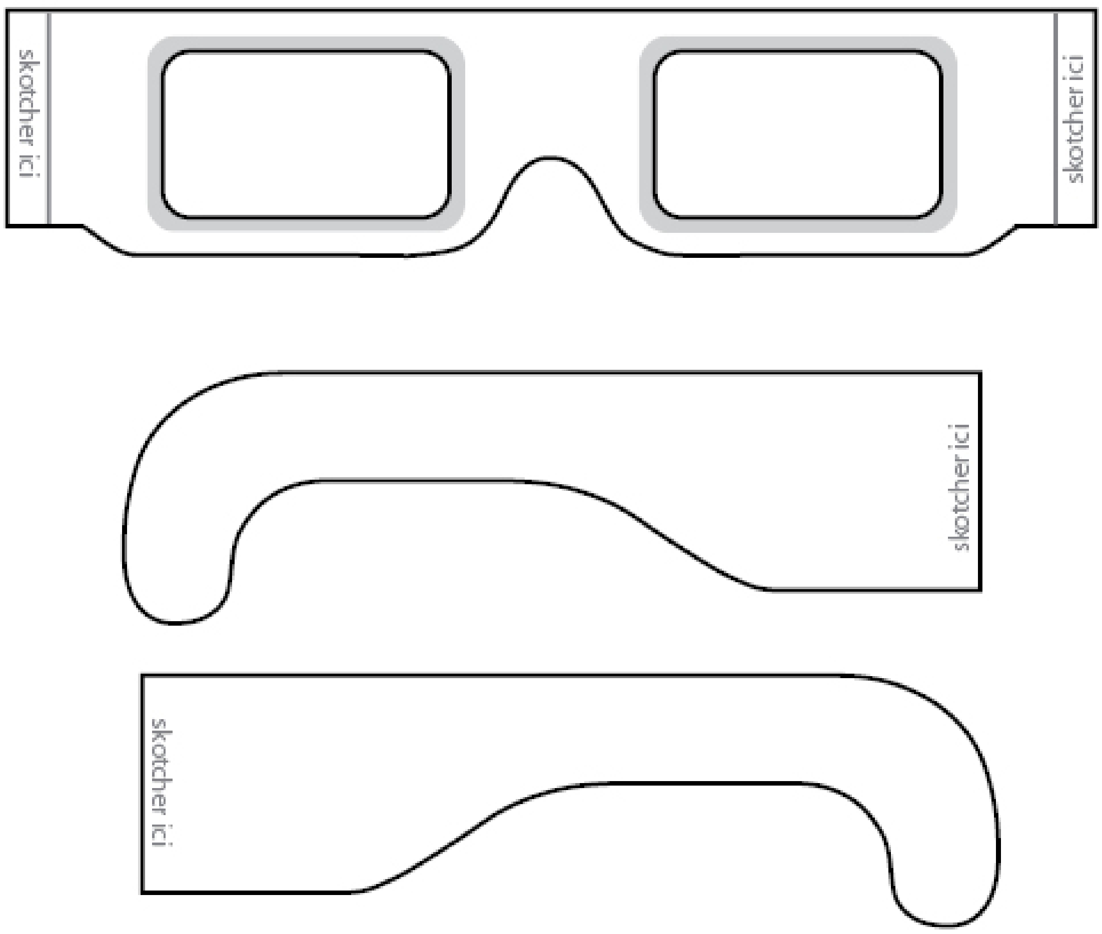


Worksheet 11

Template for 3D glasses

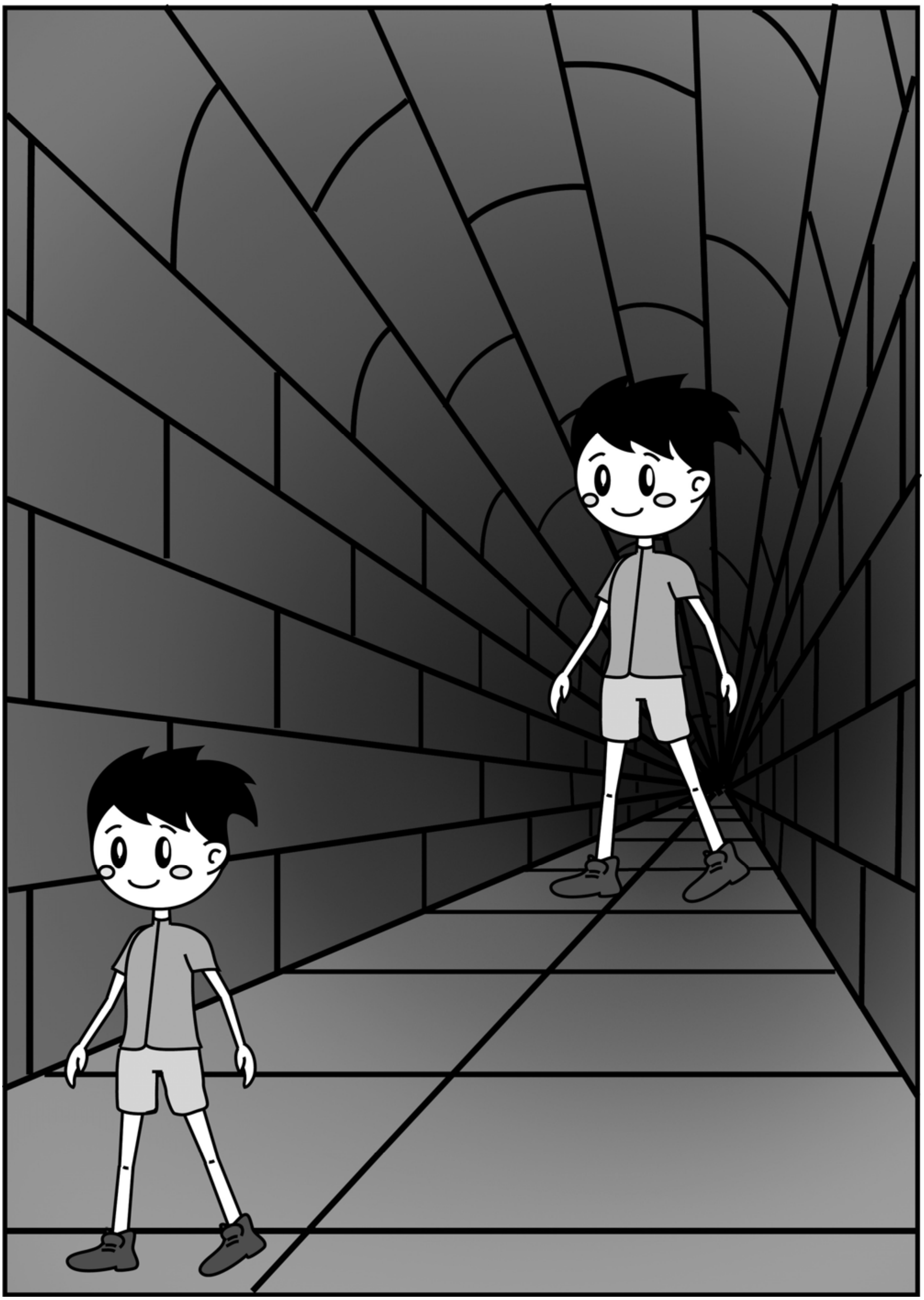
Material : template below, printed on an A4 page ; plastic sheet (such as projector slide) : two permanent markers (red and blue) ; scissors ; glue ; sticky tape.

1) Cut out the three parts along the black lines
2) Fold along the grey lines and tape the arms to the main frame of the glasses, where indicated.
3) Cut out two rectangles, slightly larger than the eyeholes, from the plastic slide. With the permanent marker, colour one in red and the other in blue.
4) Apply glue to the grey areas and stick these colored transparent rectangles (red on the left, blue on the right).



Worksheet 12

Worksheet 13



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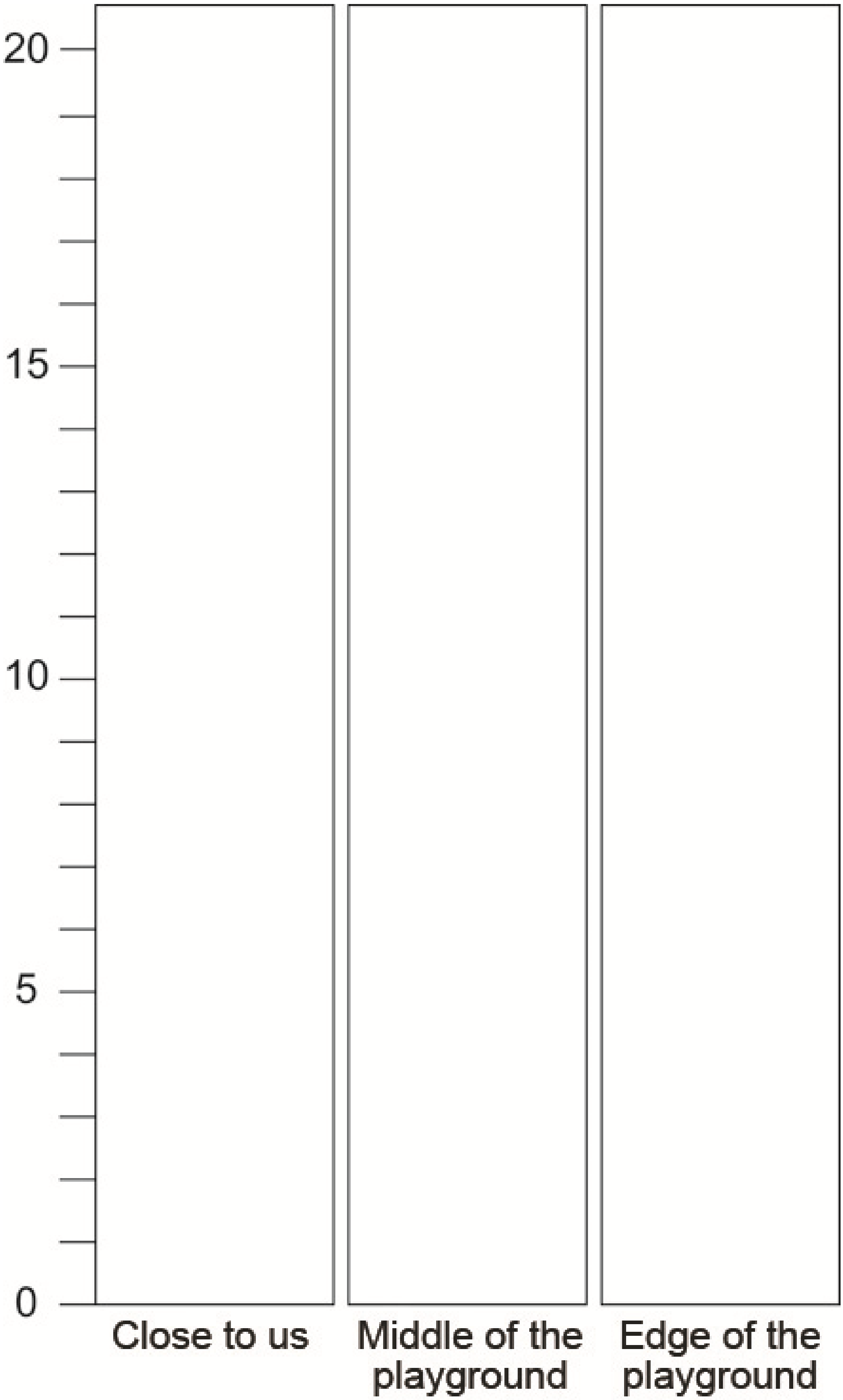

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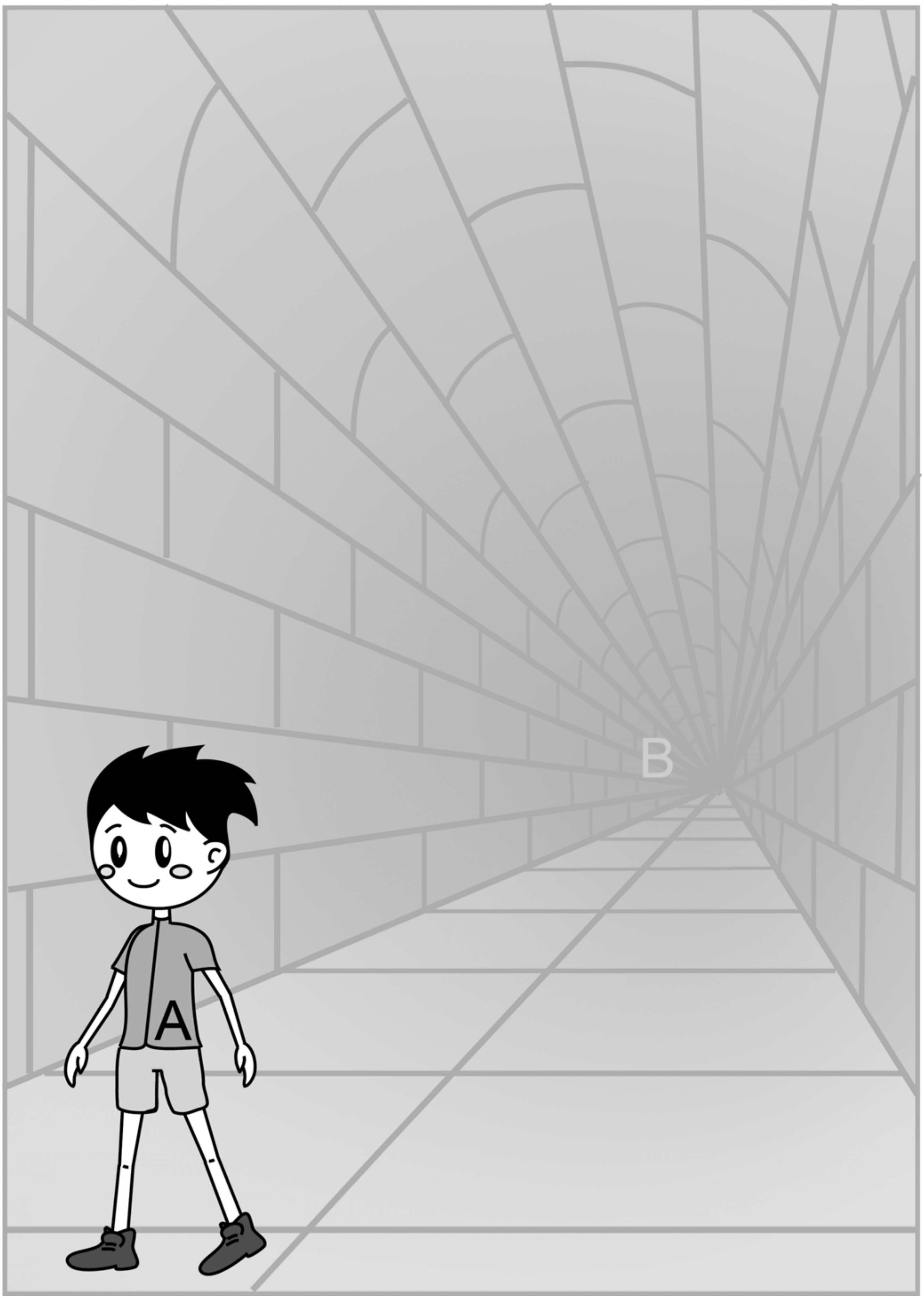

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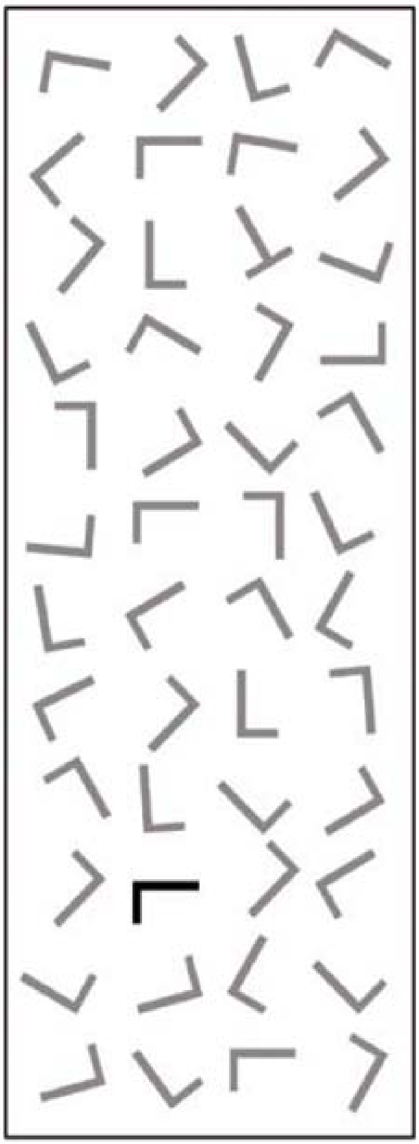

Worksheet 17

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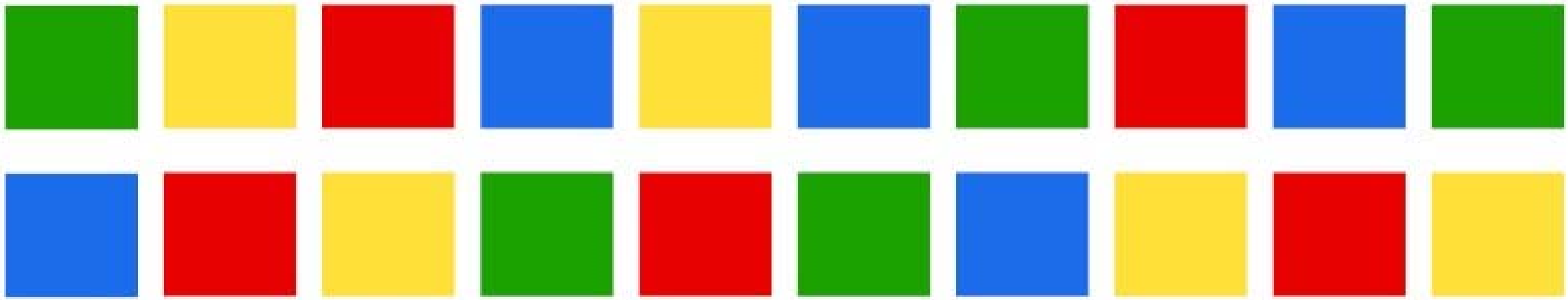


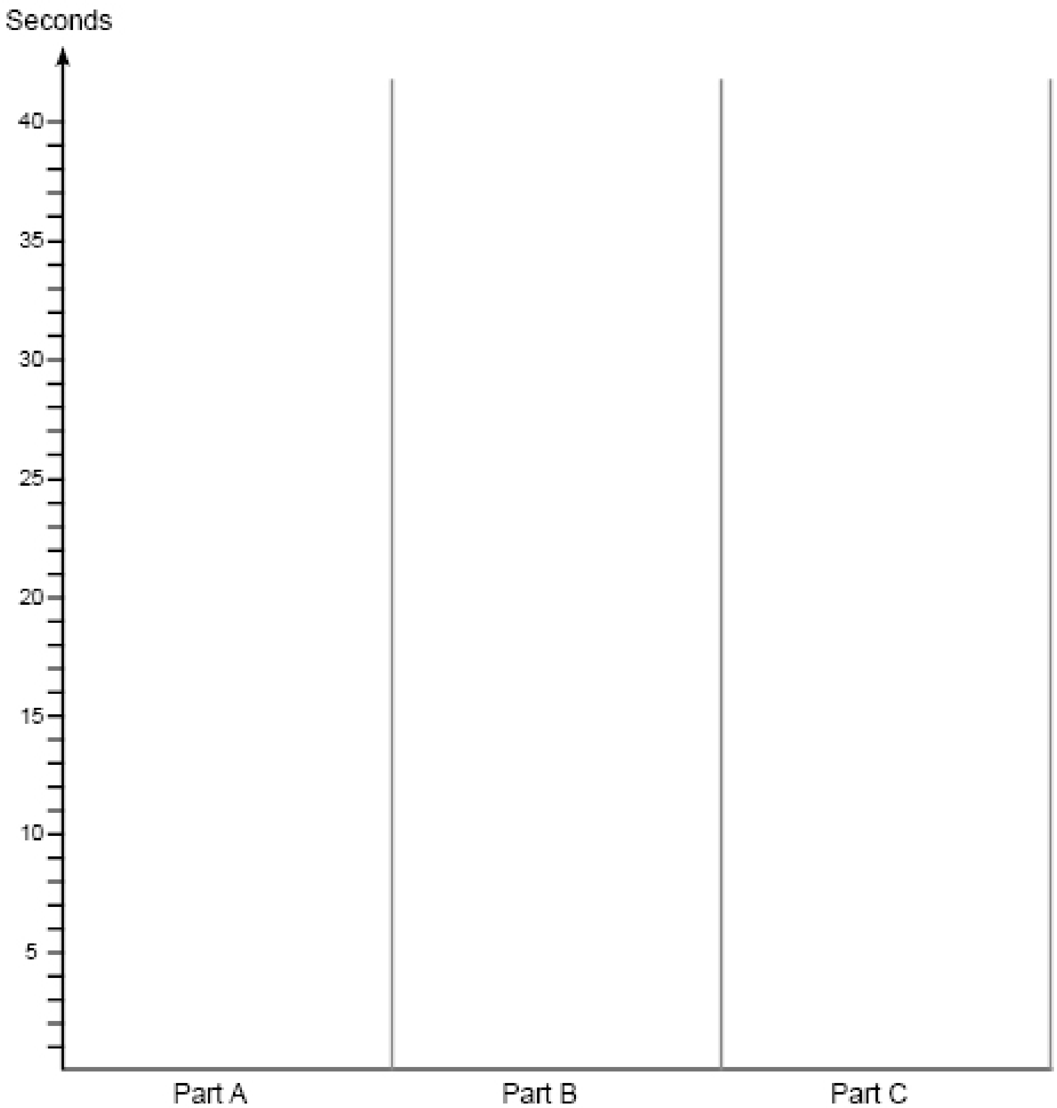
Ⓑ

green	yellow	red	blue	yellow	blue	green	red	blue	green
blue	red	yellow	green	red	green	blue	yellow	red	yellow

Ⓒ

green	blue	yellow	red	green	yellow	red	yellow	green	blue
red	green	yellow	green	blue	red	blue	green	yellow	blue

Worksheet 18



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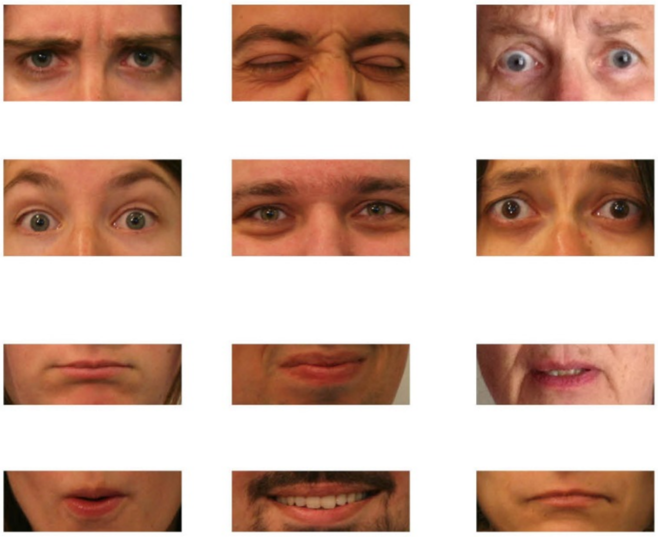
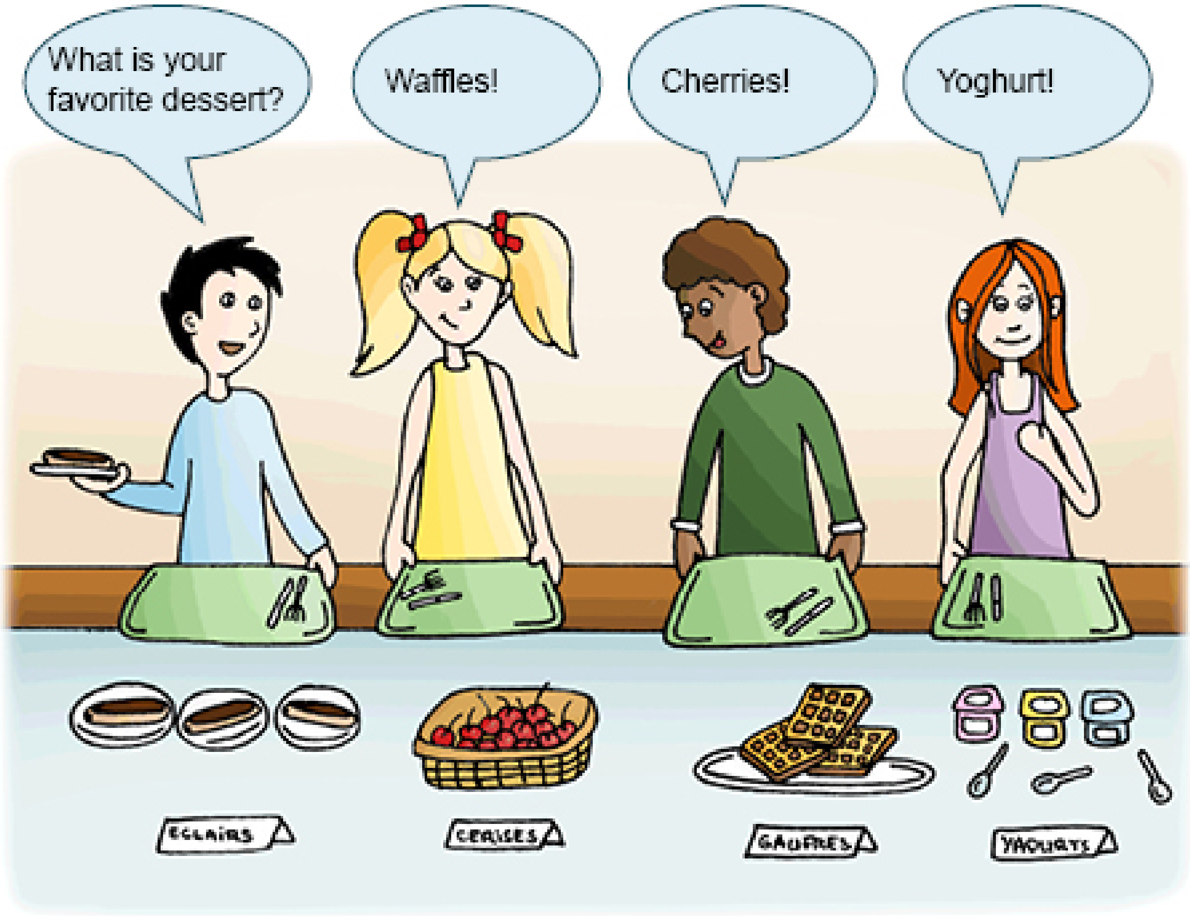


Worksheet 20

Worksheet 21



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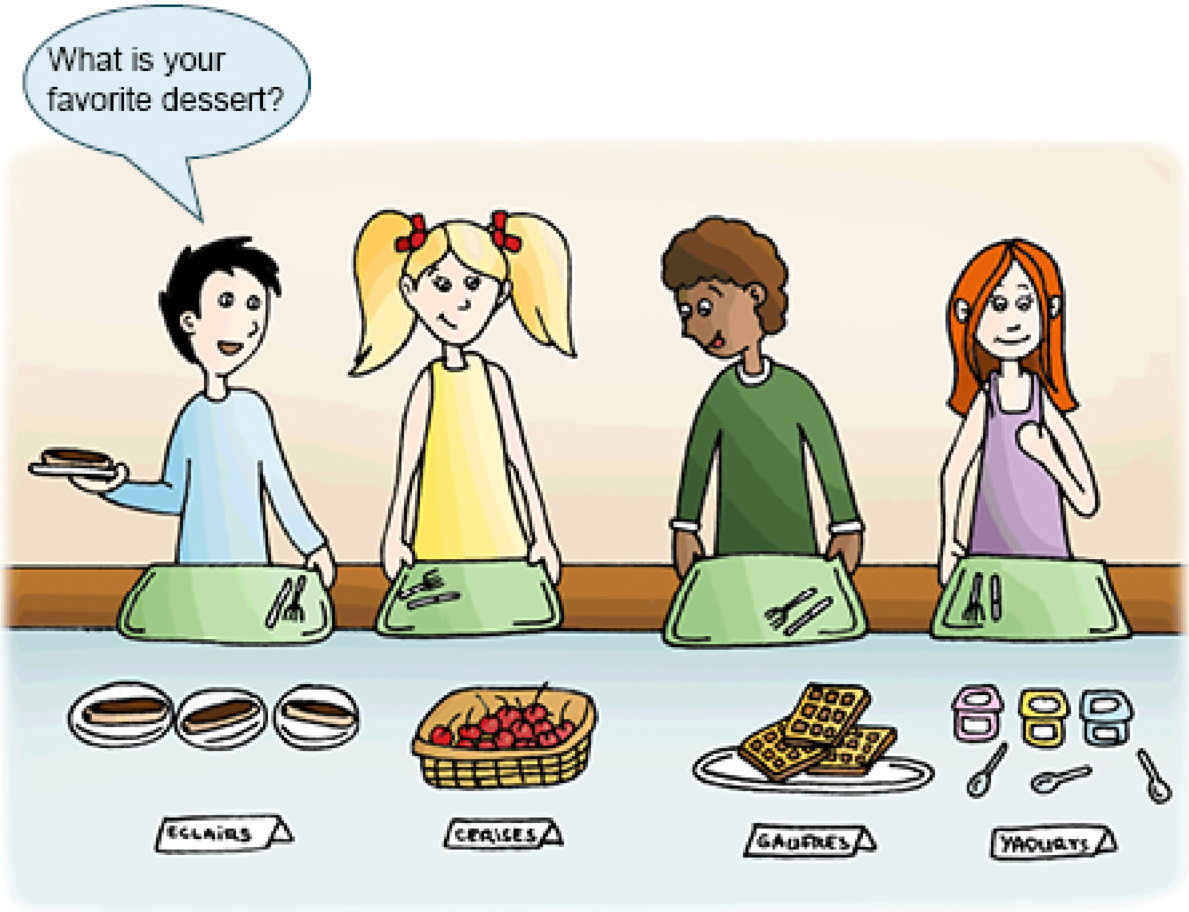

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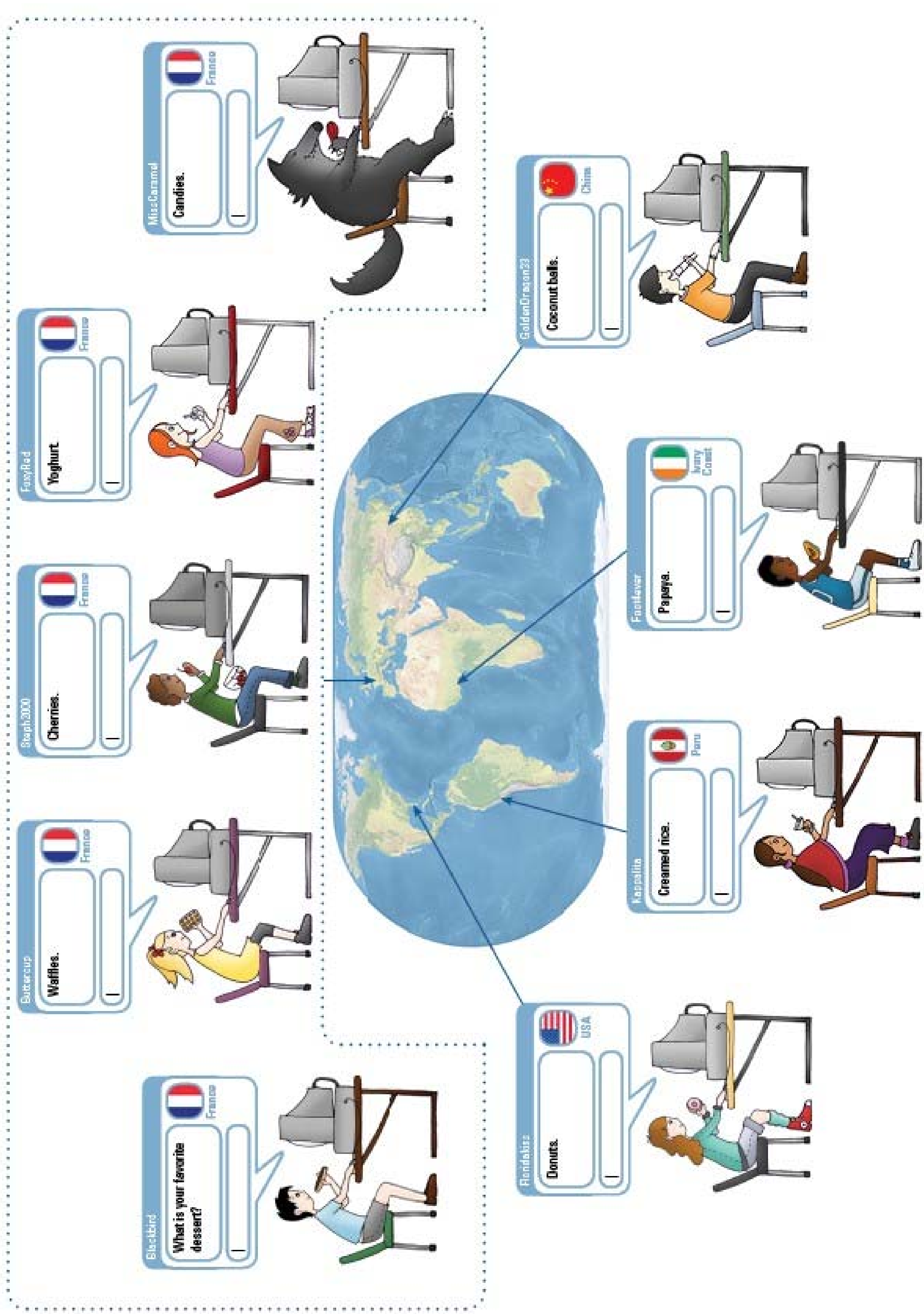
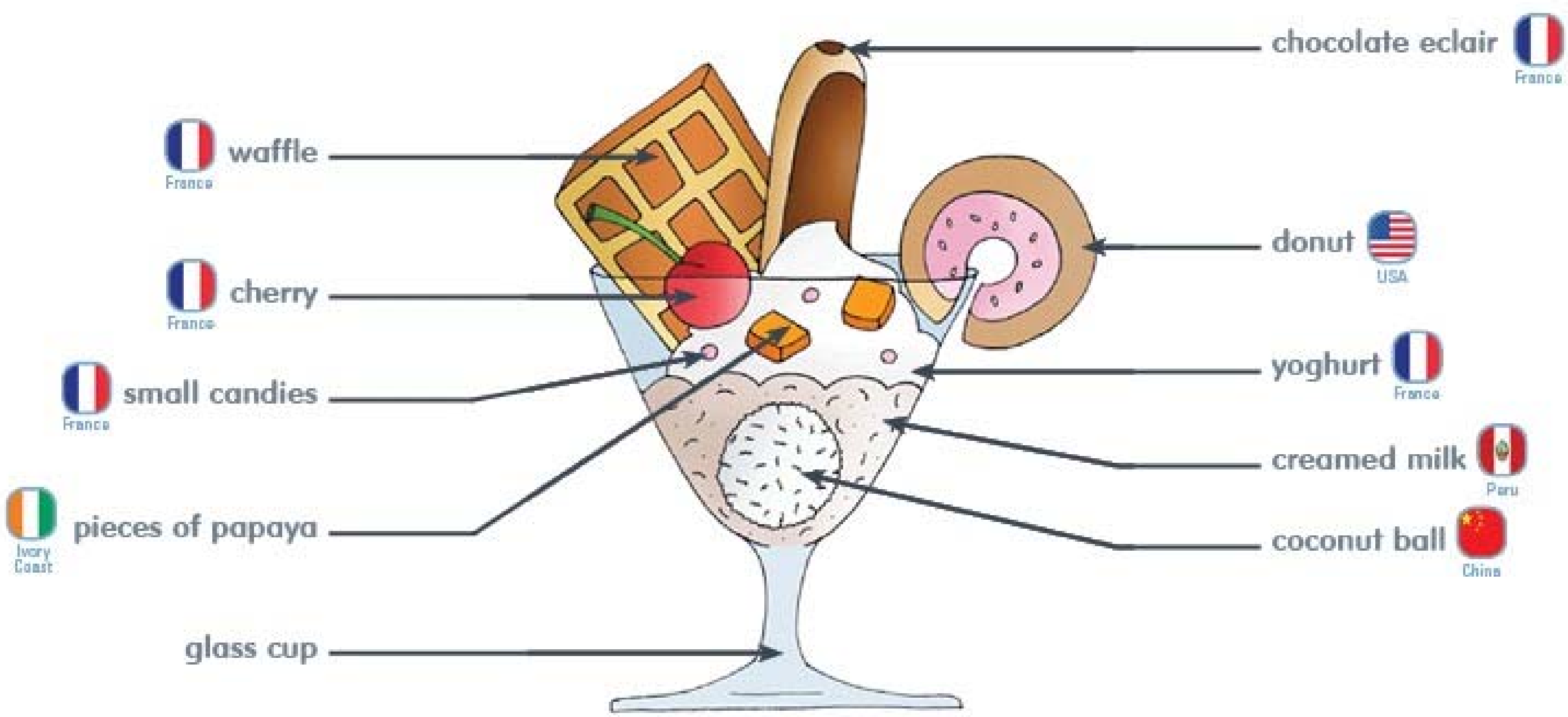
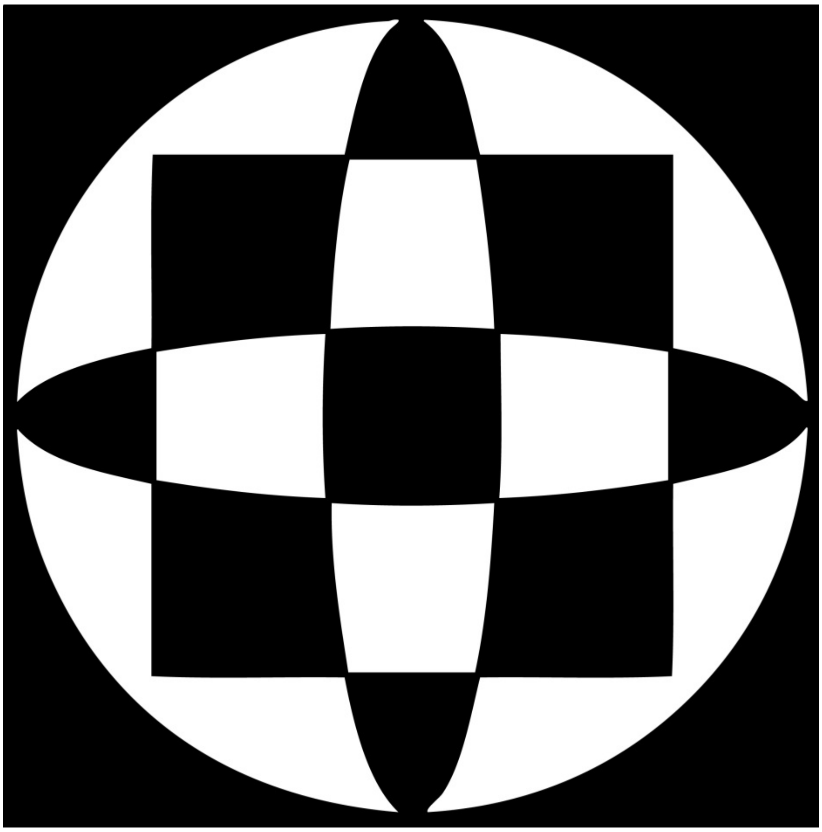


Our « international dessert »



This dessert has been designed by:
Blackbird, Buttercup, Floridakiss, Foot4ever, GoldenDragon33 Kappalita, MissCaramel, FoxyRed, Steph2000

Worksheet 25



"Children, in the kitchen, time is important.
Rinse fruit in clean water for two to three seconds…
Knead dough thoroughly for 10 minutes…
Cook over low heat for one hour…
Let sit in a cool place overnight…
Hungry kids come running and in the blink of an eye…
Teacher, teacher, is the blink of an eye a measure of time?"

Worksheet 26

Sleep log

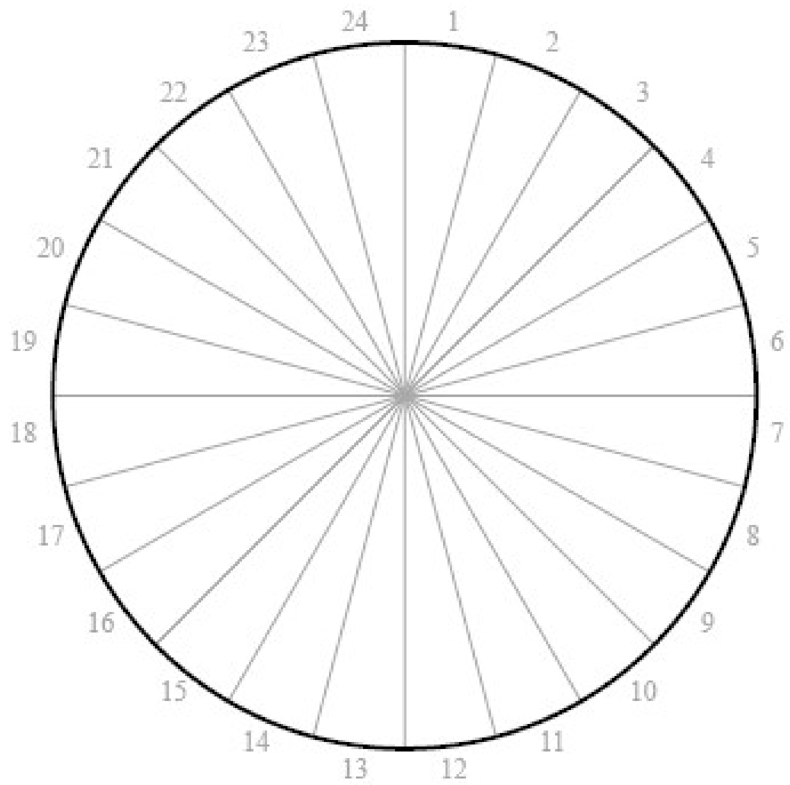
With the help of your parents, for 7 nights write down what time you go to sleep (the time you turn out the light) and what time you wake up. Calculate how many hours you slept.

	I went to bed at...	The next day, I woke up at...	That night, I slept for...
Night n°1 Date: .... / .... /	.... h	.... h	.... hours and .... minutes
Night n°2 Date: .... / .... /	.... h	.... h	.... hours and .... minutes
Night n°3 Date: .... / .... /	.... h	.... h	.... hours and .... minutes
Night n°4 Date: .... / .... /	.... h	.... h	.... hours and .... minutes
Night n°5 Date: .... / .... /	.... h	.... h	.... hours and .... minutes
Night n°6 Date: .... / .... /	.... h	.... h	.... hours and .... minutes
Night n°7 Date: .... / .... /	.... h	.... h	.... hours and .... minutes

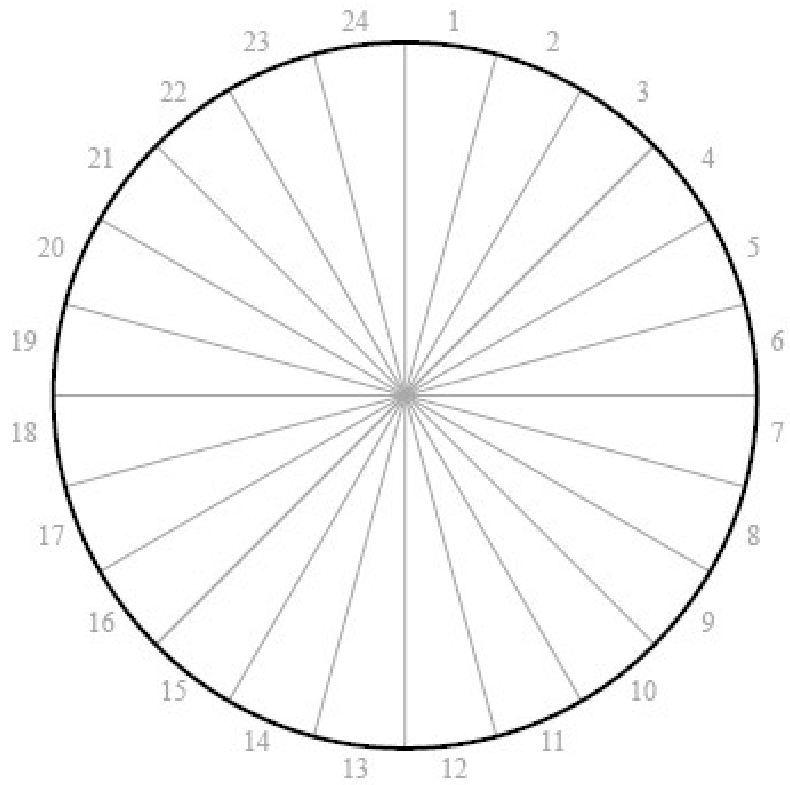
How long do we sleep for?

A day is **24** hours long. To calculate the proportion of time you sleep in a whole day, color in the number of segments that you slept for. If you did not sleep for an «even» amount of hours (e.g. **10 1/2** hours) then color in half a segment. If you slept the same amount of hours every night, use the right-hand pie-chart only.

This week, my shortest night was .... hours of sleep.



This week, my longest night was .... hours of sleep.



Worksheet 28

Worksheet 29

Memory storage in our list (examples)	I can store… Sound/Image/Text/Objects	I can make a copy Yes/No	I can delete or destroy the content Yes/No	Who can see it? Me and people I share it with/ Everyone
Photos				
Videos				
Stories				
Audio recordings				
Items shared on social networks				
Blog articles				
Travel log				
Diary				
Herbarium				
Shell collection				

Worksheet 30

You Are Old, Father William by Lewis Carroll

"You are old, *Father* William," the young *man* said,
"And your *hair* has become very white;
And yet you incessantly stand on your *head* –
Do you think, at your *age*, it is right?"

"In my *youth*," Father William replied to his *son*,
"I feared it might injure the *brain*;
But, now that I'm perfectly sure I have none,
Why, I do it again and again."

"You are old," said the youth, "as I mentioned before,
And have grown most uncommonly fat;
Yet you turned a *back-somersault* in at the *door* –
Pray, what is the *reason* of that?"

"In my youth," said the *sage*, as he shook his grey *locks*,
"I kept all my *limbs* very supple
By the use of this *ointment* – one shilling the *box* –
Allow me to sell you a *couple*?"

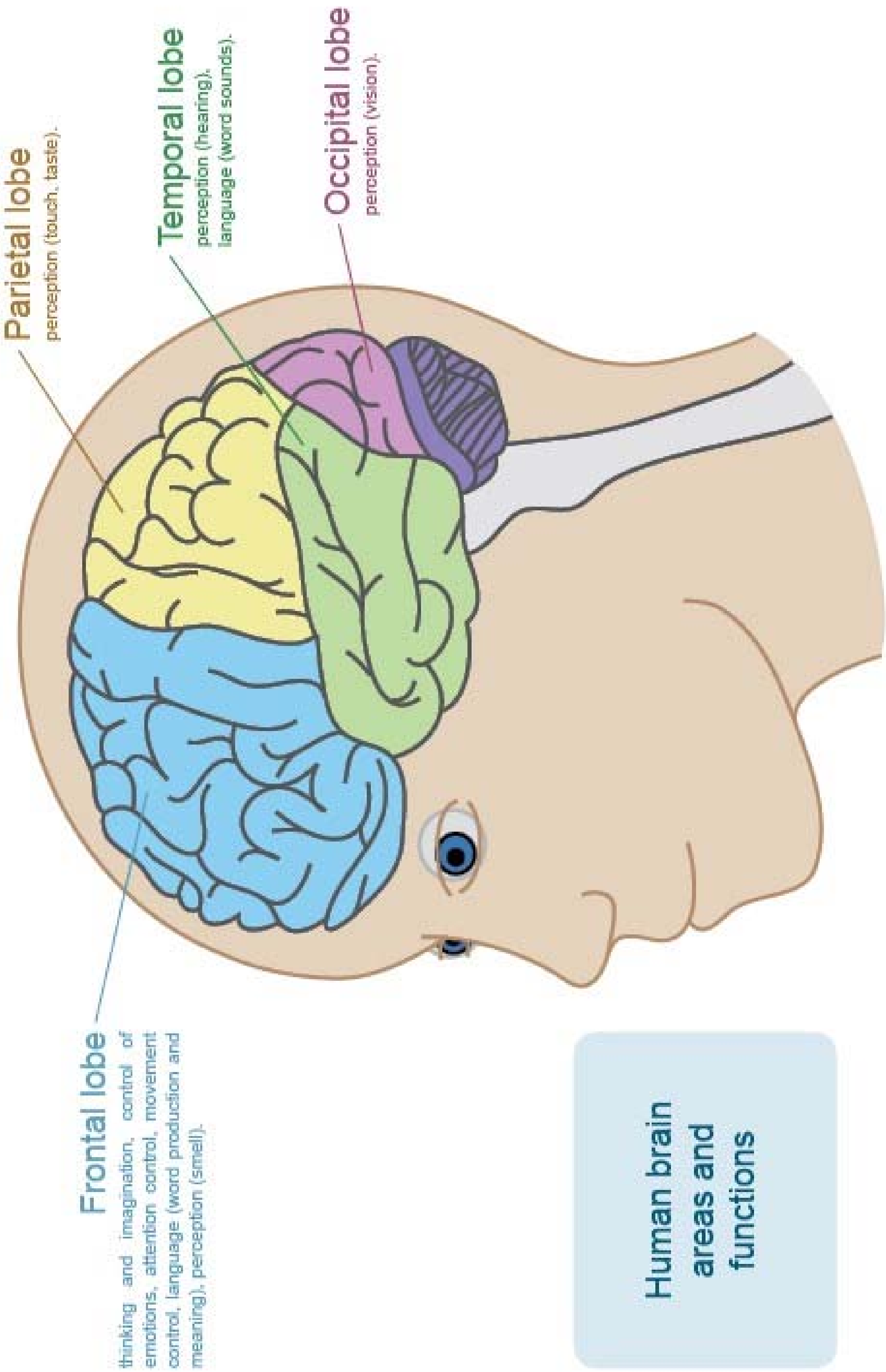
"You are old," said the youth, "and your jaws are too weak
For anything tougher than *suet*;
Yet you finished the *goose*, with the *bones* and the *beak* –
Pray how did you manage to do it?"

In my youth," said his father, "I took to the *law*,
And argued each case with my *wife*;
And the muscular strength, which it gave to my *jaw*,
Has lasted the rest of my *life*."

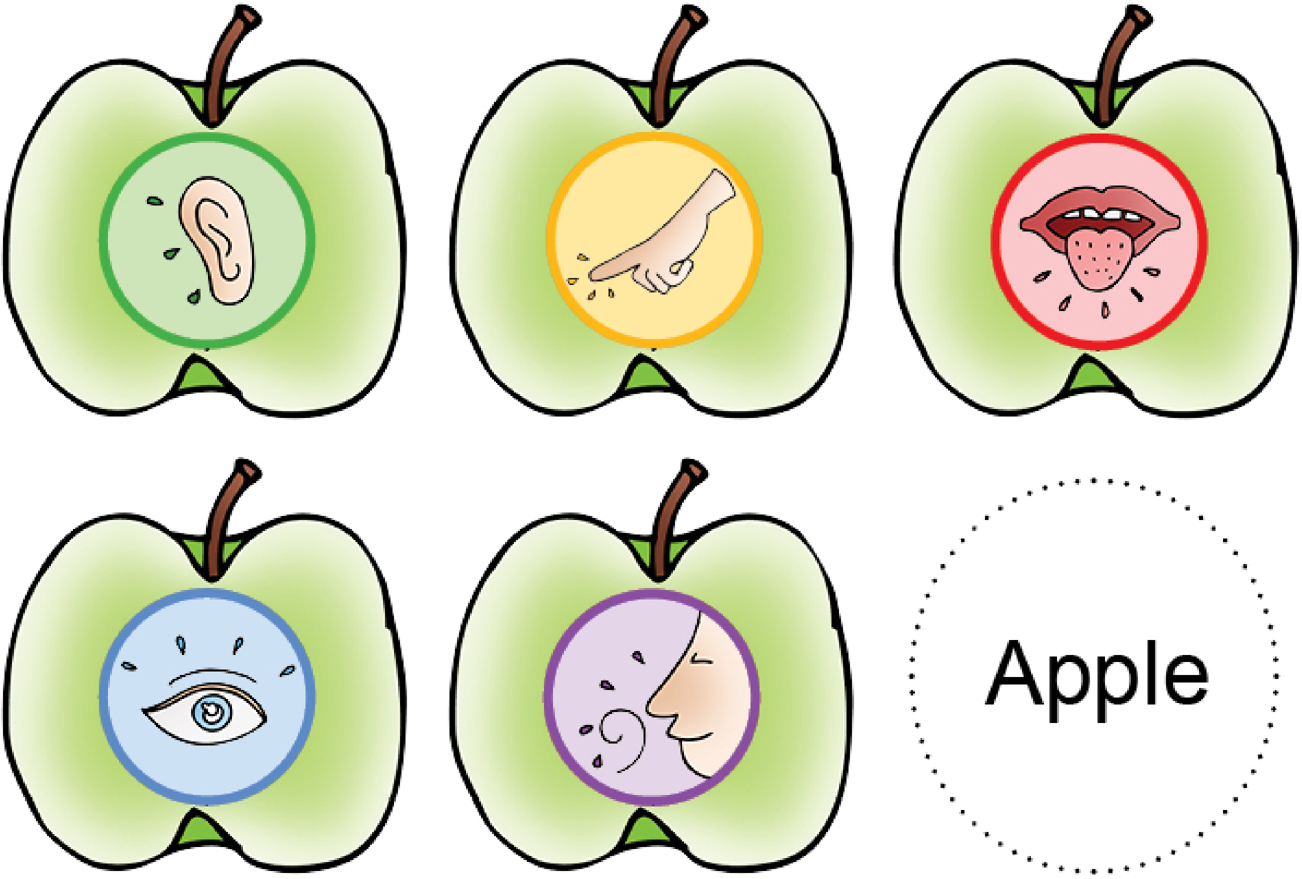
"You are old," said the youth, "one would hardly suppose
That your *eye* was as steady as ever;
Yet you balanced an *eel* on the end of your *nose* –
What made you so awfully clever?"

"I have answered three questions, and that is enough,"
Said his father; "don't give yourself *airs!*
Do you think I can listen all day to such stuff?
Be off, or I'll kick you *downstairs!*"

Worksheet 31



Worksheet 32



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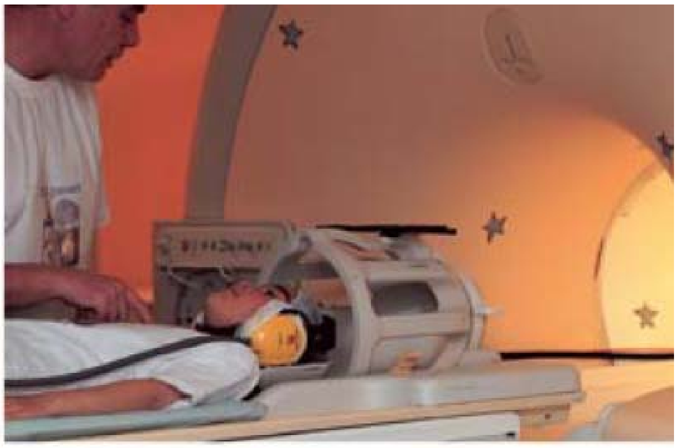

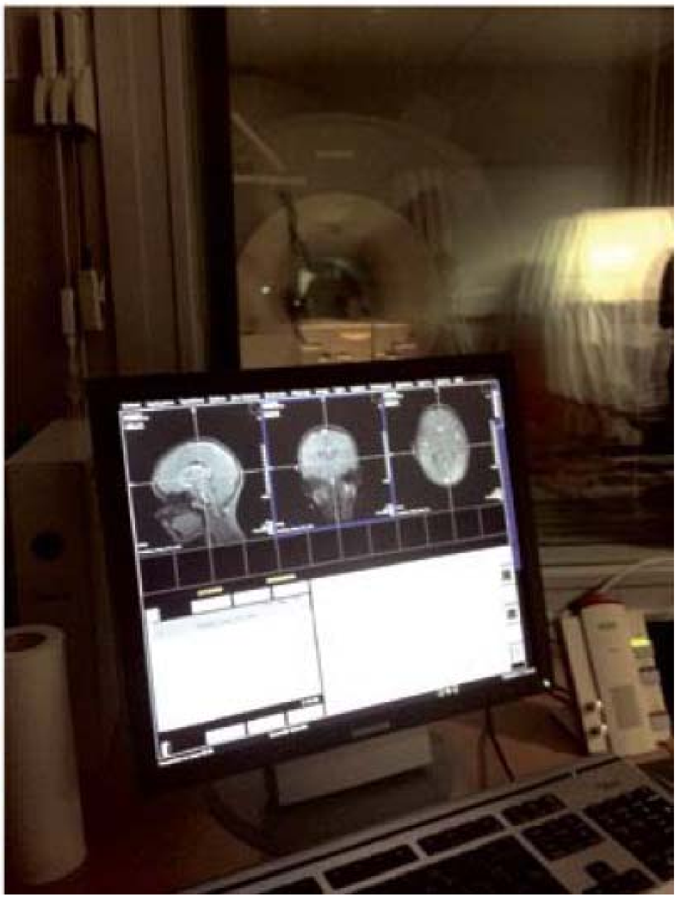

Worksheet 34

A human brain MRI picture.
The child looks at an object: le occipital lobe is active.