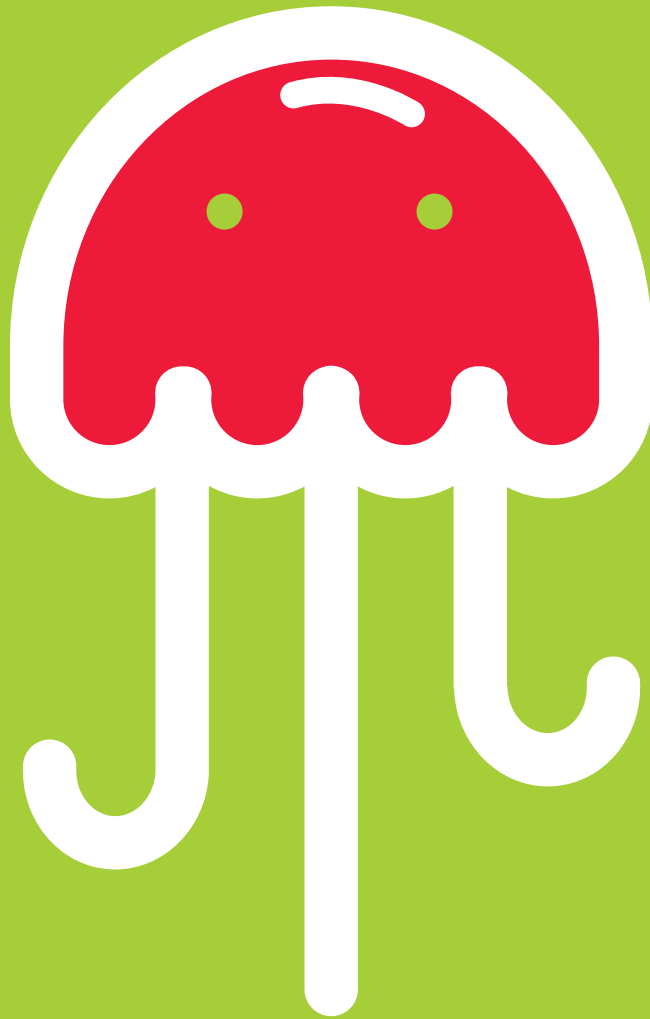


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BIOLOGY & GEOLOGY CONSOLIDATION

1
SECONDARY



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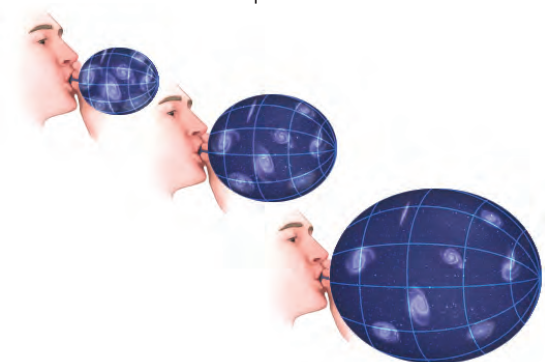
BIOLOGY
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CONSOLIDATION

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SECONDARY

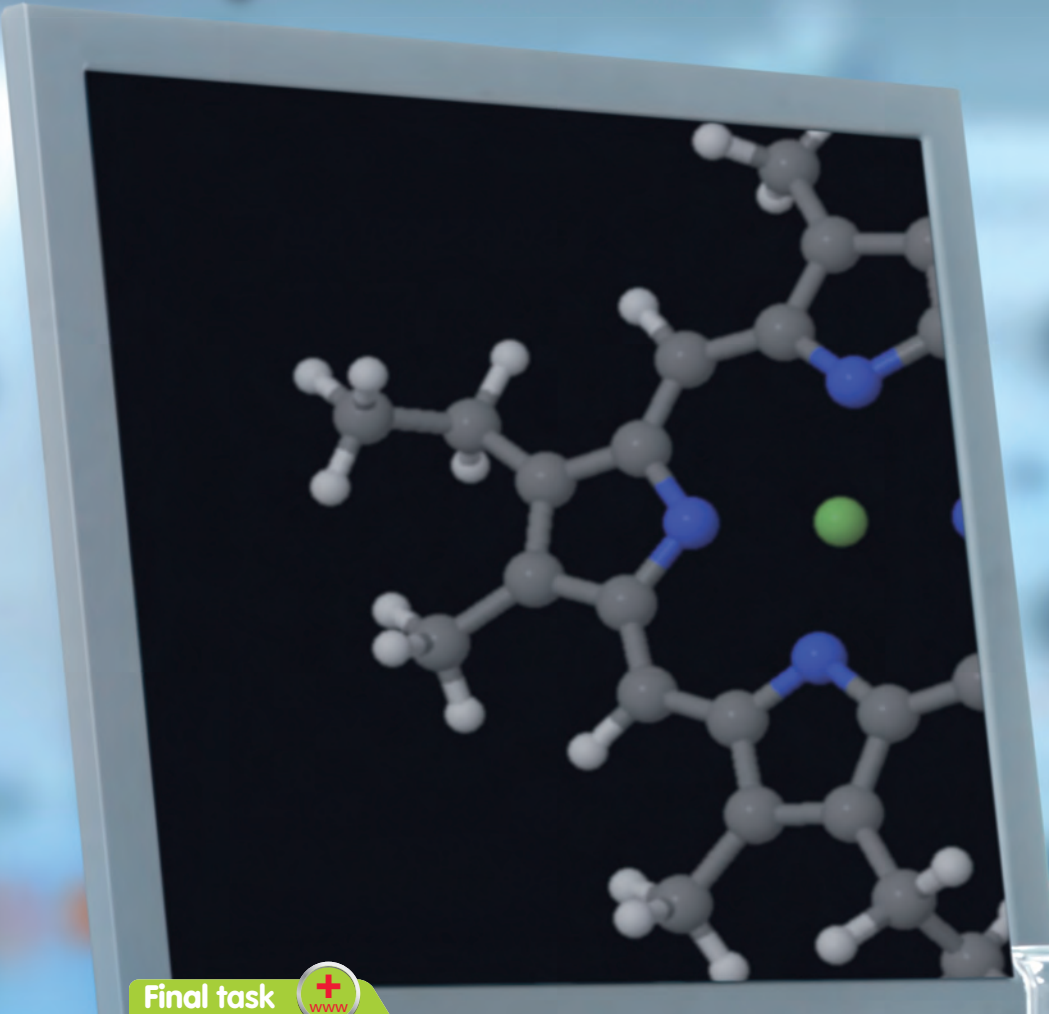
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1

THE SCIENTIFIC METHOD



Final task



Are beans alive?

Beans, like other pulses, are seeds. We keep them in sealed containers in the kitchen.

You have probably experimented with beans in a glass with cotton wool and seen how they germinate. However, the beans stored in the kitchen don't germinate.

You are going to write a research paper to explain why beans do not germinate when they are kept in sealed containers, but they do outside.



Science

Science is based on the continuous search for reasoned, objective answers to questions about natural phenomena. This search for answers follows a process of investigation called the scientific method. Pseudoscience includes all the disciplines that try to answer questions about natural phenomena or processes, using scientific language, but not based on objective experiments.

The Scientific method

The scientific method establishes rules and scientific theories to explain natural phenomenon. There are four steps: Question, Hypothesis, Experiment, and finally, Analysis of results and confirmation of hypothesis. Scientific laws are made from the hypothesis that have been proved. A collection of scientific laws that explain various natural phenomena form a theory. Scientific theories allow us to make predictions.



Scientific work

Scientific work consists of designing and carrying out experiments that recreate phenomena we want to study in order to confirm or reject a hypothesis. In experiments, the variables that can influence the result are controlled. Before carrying out research we should plan the materials and the steps. Sometimes scientists carry out experiments in the natural environment. This is called fieldwork. Fieldwork allows scientists to observe and measure events in their natural state. Other times they conduct experiments in laboratories. A laboratory is a room or building that has the equipment and instruments needed to conduct experiments. Before carrying out research we should plan the materials and the steps. In laboratory work we have to follow safety rules.

The research project

A research project follows the scientific method to investigate a phenomenon. We need to follow these steps of the scientific method: ask a question; formulate a hypothesis; design and carry out experiments; analyse results and confirm the hypothesis. Scientists use tables and graphs to help them interpret the results of their experiments. A data table allows us to relate and compare the variables we are investigating. The results of a research project are presented using posters, oral presentations with slides, scientific articles or fact sheets. Presentations of results allow scientists to share the conclusions of their experiments with the rest of the scientific community.

Research paper

A research paper is a scientific report explaining the work and conclusions of the research project.

It allows other researchers to know about the research. A research paper must be both objective (truthful, without manipulating the results) and precise (the methods used and the results obtained have to be explained clearly so that the same results are obtained when the work is repeated). A research paper has the following sections: title page, content page, summary, introduction, methodology, results, conclusion and bibliography.

Science

1. What is the name of the method used to research something that occurs in nature?
2. What is the difference between science and pseudoscience?

The scientific method

3. Put the following steps of the scientific method in order:
 - a) Experiment
 - b) Conclusion: compare with hypothesis
 - c) Make a question
 - d) Observe
 - e) Analysis of the results
 - f) Make a hypothesis
4. Design an experiment to prove the following hypothesis: 'Fungus, such as mould on bread or fruit, grows better when the temperature and humidity are high'.

Scientific work

5. What two instruments are fundamental when planning a scientific experiment? Justify your answer.
6. True or false? Explain your answers.
 - a) When working in a laboratory, you should get the material you need as you do the experiment.
 - b) After an experiment, the work station should be the same as before starting.
 - c) Put your school bag on the laboratory table so that you don't trip on it as you walk around.
 - d) Return any leftover material to the container you got it from in order not to waste it.
 - e) If you aren't sure of the chemical composition, smell it to check what it is.

7. In the laboratory, look for a chemical product that has the following symbols on its label. Then answer the questions:



Irritant



Explosive



Corrosive



Flammable



Toxic



Environmentally unsafe

- a) What product is it? What is it used for?
 - b) Why is that symbol used?
8. What advantages and disadvantages does fieldwork have?
 9. For what sort of fieldwork would you need a compass? And a camera?

The research project

10. Make a data table with the following information. Use a graph to explain why you have chosen that kind of graph
 A teacher observed that the number of students passing his subject during the year depended on the units taught. In the first unit, 10 students passed; in the second, 12; in the third, 11; in the fourth, 18; in the fifth, 15; and in the sixth, 20.
11. Briefly explain the rules and basic advice for making a scientific poster.
12. Make a poster of the local flora. Collect samples and information for between four and six varieties.
13. Make a slideshow presentation with at least six to eight slides about dogs and their breeds.
14. Make a data table, a pie chart or a bar graph to illustrate the following:
 Of the total fresh water on our planet, 79% is in glaciers, 20% in groundwater, and 1% in rivers, lakes and surface water.

READ AND UNDERSTAND SCIENCE

What do we owe who the Ancient Greeks in the field of science?

The Greeks developed philosophy as a way of understanding the world around them. Early Greek philosophers were also scientists who studied the known world, the Earth, seas, and mountains, the Solar System, planetary motion, and astral phenomena.

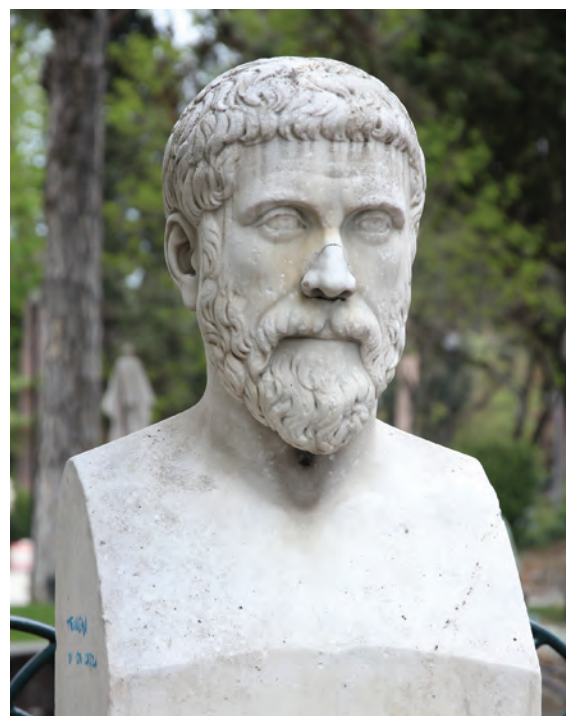
Astronomy, which began with the organisation of the stars into constellations, was used for practical purposes, to fix the calendar. The Greeks estimated the size of the Earth, they figured out how a pulley and levers work, they studied refracted and reflected light, as well as sound. In medicine, they looked at how the organs worked and how diseases progress. They learned to make inferences from observations. They made contributions to the field of mathematics.

Many of the Ancient Greeks' discoveries and inventions are still used today, although some of their ideas have been overturned. At least one, the discovery that the Sun is the centre of the Solar System, was ignored and then rediscovered.

Pythagoras, Hypocrates, Aristotle, Euclid and Archimedes are just some of the names of Greek thinkers that were the early scientists.

N.S.Gill, (n.d.), *What We Owe to the Ancient Greeks in the Field of Science* [web article]. Retrieved from:

<http://ancienthistory.about.com/od/sciencemedicine/tp/042810GreekScientificInventions.htm> (Adapted)



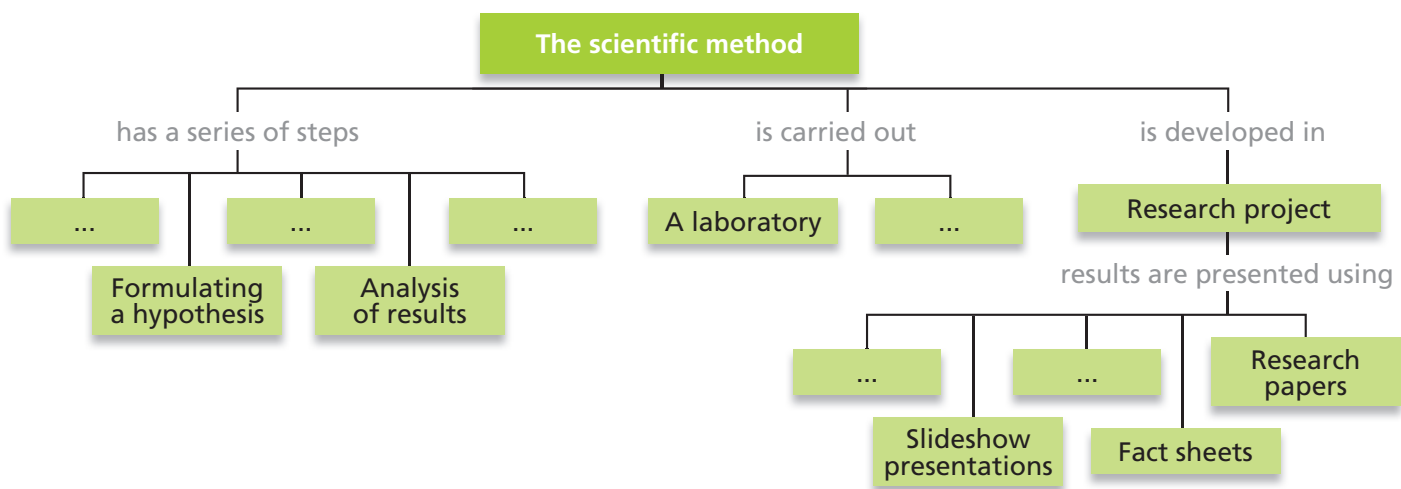
Pythagoros

- a) What is the text about?
- b) What did the early Greek philosophers do?
- c) What did they study?
- d) Find out what discoveries the philosophers mentioned in the text made.

STUDY SKILLS

- Create your own summary of the unit using the Key concepts. Add other important information.
- Copy the following structure and add the missing information to create a concept map of the unit.

You can record your summary and listen to it as many times as you like to revise.



- Create your own scientific glossary. Include the following terms: *bibliography, factor, search engine, science, slide, experiment, variable, graph, hypotheses, laboratory, scientific law, poster, web page, data table, theory and variable*. Add other terms you consider important.



Density of matter



In this science experiment you will learn basic facts about density and practise using different laboratory instruments.

Procedure



1. Use a felt tip pen to number three of the 100 mL measuring cylinders.
2. Weigh the measuring cylinders individually and record the mass of each one in your notebook.
3. Add 50 mL of water to measuring cylinder 1 and weigh it again. Record the result and calculate the mass of the 50 mL of water.
4. Add 50 ml of alcohol to cylinder 2 and weigh it. Record the result and calculate the mass of the 50 ml of alcohol.
5. Add 50 ml of oil to cylinder 3 and weigh again. Record the result and calculate the mass of the 50 mL of oil.
6. Calculate the density of the water, alcohol and oil using the following formula:

$$\text{density (g/L)} = \frac{\text{mass (g)}}{\text{volume (L)}}$$

In order to express density in grams per litre (g/L), convert the millilitres to litres first.

7. Slowly add the water, alcohol and oil in that order, to the 250 mL measuring cylinder. Pour the liquids down the side of the cylinder. Let the mixture settle and observe what happens.
8. Weigh the cork and the stone separately and make a note of their masses in your notebook.
9. Add 50mL of water to the 100 mL measuring cylinder. Place the cork and the stone in it and observe what happens.

Materials



- felt tip pen
- scales
- 4 measuring cylinders (100 mL)
- 1 measuring cylinders (250 mL)
- 50 mL of water
- 50 mL of alcohol
- 50 mL of oil
- cork
- a stone (with a smaller mass than the cork)



1. Which of the liquids is heavier? Which of them is lighter?
2. In steps 7 and 8:
 - a) Which order did the liquids settle in?
 - b) Is there a relationship between the density of the three liquids and the order that they settled in?
 - c) If we mix 100 mL of oil, 75 mL of water and 50 mL of alcohol, would the liquids settle in the same order?
3. Did the cork or the stone float? Why?
4. Based on the experiments, explain in your own words the difference between mass and density.



Are beans alive?



The objective of this task is to put into practice what you have learnt in this unit about the scientific method and how to do research. You will complete your experiment about bean germination and present your results in a research paper.



1. Research

- Are beans dead seeds or are they alive?
- Why don't beans germinate in a packet or jar?
- What do seeds need to germinate?
- digestive system?

2. Presentation

To present the findings of your research you need to write a research paper.

- Revise the structure of a research paper in the unit.
- Organise the information you are going to include in your paper. Make an outline.
- Make a note of key words (germination, seed, etc.).
- Write each section and choose appropriate images, graphs, tables or charts.
- In the conclusion section include an evaluation of the hypothesis.
- Read and check your research paper carefully.
- Don't forget to include a bibliography at the end.

Procedure

Steps to follow for research:

Search for information

- Find out which conditions and times of the year are best for seed germination.
- Consult various sources of information.
- Make sure you include all your sources in the bibliography.

Organise the information

- Design and plan your experiment before carrying it out.
- Make graphs and tables to help you interpret the results.
- Answer the questions in the *Research* section.

Draw conclusions and check your research

- Check that the answers you have given are repeated in various sources.
- Revise your research paper to check that it is complete and coherent.

SELF-ASSESSMENT



Assess your work. Answer the following questions.

- Were you able to answer the questions in the *Research* section?
- Did you need help to design or conduct the experiment? And to look for information?
- Did you include all the sections in your research paper?
- Rate your paper from 1 to 5, where 1 is insufficient and 5 means you have accomplished all the objectives.

2

THE EARTH IN THE UNIVERSE

Final task



Length of days

As the Earth rotates on its axis, it also moves around the Sun. So, how do the hours of daylight vary in different places throughout the year?

To answer this question, we are going to research the hours of daylight in different cities.

We are going to use as a reference the capital of your province and the cities of Oslo, Quito and Sidney.

Once the data is obtained, you will organise it to interpret it and make conclusions.



The Universe

For thousands of years humans have wondered about the composition and origin of the Universe. The science that studies the origin and evolution of the Universe is astronomy.

The Universe is all the space, matter and energy that exists. Throughout history, astronomers have suggested different hypotheses to explain the origin of the Universe. Today, the theory most widely accepted by scientists is the Big Bang theory. The Big Bang theory is the most widely accepted theory to explain the origin of the Universe. The theory of inflation explains the first moments after the Big Bang. Different models have been proposed to explain the Earth's position in the Universe. The two main models are the geocentric model and the heliocentric model. To measure the distances between galaxies, we use a light year, a parsec and an astronomical unit. A light year is equivalent to the distance travelled by light in one year. Light travels at a speed of 300 000 km per second. A parsec (pc) is equivalent to 3.26 light years. It is usually used to measure very large interstellar distances. An astronomical unit (AU) is the distance between the Earth and the Sun. Its value is equivalent to approximately 150 000 000 km.

Because the Universe is immense, we only know a very small part of it, in which there are countless galaxies. A galaxy is a group of stars, nebulae and interstellar dust and gas. Nebulae are huge clouds of gas. They are formed by concentrations of hydrogen and helium as well as interstellar dust.

Our galaxy

Galaxies are the places in the Universe where stars, nebulae and planets are grouped together. The Earth is one of millions of celestial bodies found in our galaxy, the Milky Way. The Milky Way is a spiral galaxy that belongs to a galaxy cluster called the Local Group. The Milky Way has a nucleus of old stars, a disk with four spiral arms and a halo. The constellations are groups of stars seen from the Earth, that form imaginary shapes.

Stars are large spheres of gas spheres made mostly of hydrogen and helium. Stars release energy in the form of light and heat.

The Solar System

The Solar System is located in the Orion Arm in the Milky Way.

The Solar System consists of the Sun and a group of bodies that orbit around it: the planets, dwarf planets, satellites and comets. The Sun was born 4 600 million

years ago and it is approximately 40 000 light years from the nucleus of the Milky Way. It is a medium-sized yellow star with a surface temperature of 5 500 °C. It consists mostly of hydrogen and helium, although there are other elements such as oxygen, carbon and iron. The planets in our Solar System move in two different ways: revolution and rotation. Revolution is the movement of the planets around the Sun. The period of time that a planet takes to complete one revolution around the Sun is called a year. Rotation is the movement a body makes on its own axis. The period of time that a planet takes to complete one rotation is called a day.

Planets in the Solar System

The inner and outer planets are all different from each other: different distances from the Sun, different revolution and rotation periods, size and the number of satellites. The inner planets, Mercury, Venus, Earth and Mars, are small, with rocky surfaces and they have few moons. The exterior planets, Jupiter, Saturn, Uranus and Neptune are big, with a gaseous surface and they have rings and many moons.

The Earth's movements

The Earth, like the rest of the planets in the Solar System, moves around the Sun. It also moves on its own axis. The Earth takes 365 days, 5 hours and 49 minutes to complete one revolution of the Sun. The Earth's revolution and the tilt of the Earth's axis cause the seasons. The Earth takes 23 hours and 56 minutes to complete one rotation on its axis. The Earth's rotation causes day and night.

The Sun, Earth and Moon

The Moon is a satellite that was possibly formed when a giant planet, named Theia, hit the Earth 4.5 billion (4 500 million) years ago. A piece of the Earth broke off and remained in orbit around the Earth, held by the force of gravity. The phases of the Moon are the different shapes of the part of the Moon that is illuminated by the Sun, that we see from Earth as the Moon revolves around the Earth. An eclipse occurs when one celestial body comes between two others, so that one is hidden from the other. Tides are the periodic rising and falling of the sea levels as a result of the gravitational pull of the Moon.

The Universe

1. If we take a long-exposure photo of a night sky without light pollution, we can see that the stars appear to make different-coloured circles. Why do you think this happens?



2. In your notebook, draw two diagrams of the Solar System: one with the Earth in the centre with the Sun and the planets revolving around it; and another, with the Earth revolving around the Sun.
3. In ancient times, there were two theories that explained how the bodies that make up the Solar System are arranged. What are their names and what do they both suggest?

Our galaxy

4. On what factor does the brightness of a star depend? What factors affect the colour of a star?
5. Convert the distances between the Sun and the planets (on the table on page 32) to millions of km.
6. If we observe an open cluster and a globular cluster with a telescope, which is brighter? Explain your answer.
7. When we observe the sky at night, it is possible to see both stars in the Milky Way and planets in the Solar System. How can we distinguish stars from planets in the sky with the naked eye?
8. Find out about the constellations that can be seen this month in the sky in your area. Draw one of them and write down the distance its main stars are from the Earth.

The Solar System

9. In your notebook, write if the following statements are true or false. Correct the false ones.
 - a) Planets are rocky bodies that move around the Sun in orbits occupied by other bodies.
 - b) The asteroid belt is located between Jupiter and Saturn.
 - c) Comets orbit the Sun.
 - d) The galaxy of Andromeda is in the Solar System.

10. Find information about meteorites and shooting stars. In your notebook, write a report that explains what they are, where they come from, and the difference between them.

Planets in the Solar System

11. Match each planet of the Solar System to one of the following characteristics.
 - a) It is the outer planet with the smallest number of satellites.
 - b) It is the least dense planet.
 - c) It doesn't have an atmosphere.
 - d) It has the second smallest diameter around its equator.
 - e) Its day lasts approximately 17 hours.
 - f) Its diameter around the equator is similar to Earth's.
 - g) It has only one satellite.
 - h) It is the biggest planet in the Solar System.
12. In a documentary about astronomy, an expert in matter explained that the force of gravity exerted by a celestial body on an object located on its surface is directly proportional to the mass of the object and the mass of the celestial body.

Can you guess on which planet in the Solar System it would be easier for us to jump, and on which it would be the most difficult? Explain your answer.

13. Find out and make a hypothesis that explains why the outer planets have a bigger number of satellites than the inner planets.

Movements of the Earth

14. When is day and night the same length in Spain?
15. During the 2010 World Cup in South Africa, journalists commented on the cold weather. Why was it cold in South Africa in the months of June and July?
16. If you observe the length of a shadow of the same tree at different times of the day or year, you will notice that it is not always the same.
 - a) Why does this happen?
 - b) In which season would the shadow be the longest?
 - c) When would the shadow be the shortest: at sunrise, midday or at sunset?
 - d) When would the shadow point north?
17. Find out the time of the sunrise and sunset in the solstices and equinoxes last year, in the capital of your province. Then calculate the length of day and night on each of the days before. What conclusions can you make from your results?

The Sun, Earth and Moon

18. Why do we always see the same side of the Moon from the Earth?
19. Draw a diagram of a solar eclipse and a lunar eclipse. Label the Sun, the Earth and the Moon.
20. If the Moon moves around the Earth at a speed of 3700 km/h, how many kilometres is its movement of revolution?
21. In your notebook, complete the following table with the phases of the Moon. Indicate the type of eclipse (total or partial) and tides (spring or neap) that can occur during each phase.

Phases of the Moon	Eclipses	Tides
...

22. Knowing that the tides depend on the Sun-Earth-Moon alignment and the proximity of the three bodies, answer the following question: When do you think a very high tide is created, in the spring tides of the spring solstice or in the spring tides of the winter solstice?

23. Find out and explain why the Moon appears to be red during a lunar eclipse.



24. Find information about annular eclipses and answer the following questions:

- a) Do they occur during solar eclipses, lunar eclipses or both?
- b) Why are they called annular eclipses?
- c) Draw a diagram of an annular eclipse.

READ AND UNDERSTAND SCIENCE

The origin of the Moon

It's not clear how the Moon came to orbit our planet. It could be that, passing near our planet, the gravitational pull converted it into a satellite. Perhaps they both formed at the same time in the primitive Solar System. Or it could be the result of a collision between proto-Earth and another gigantic object whose remains joined together after the collision, to form the Moon. The last theory is the most accepted. Some German scientists have analysed rocks brought back by astronauts from the Apollo programme, in which they found chemical remains of something different from the Earth, which must have been the big object involved in the collision.

Alicia RIVERA

EL PAÍS, JUNE 2014

(Translated and adapted)

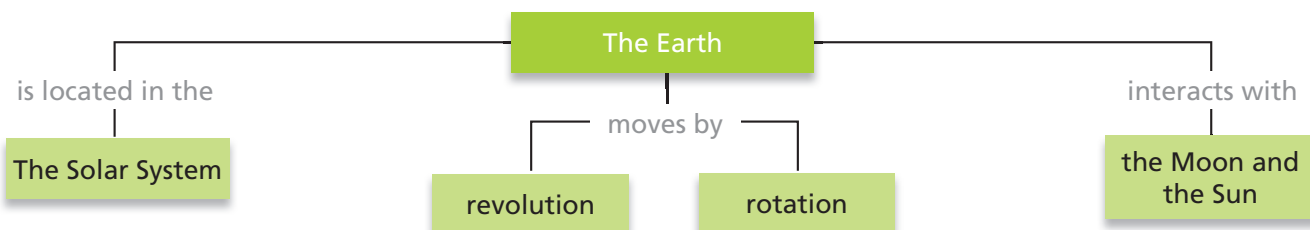
- a) What is the text about?
- b) What does proto-Earth mean?
- c) How do you think the Moon originated?
- d) What recent discoveries support your previous answer?
- e) The Moon is the Earth's only natural satellite, but there are also artificial satellites. Find out about them and explain their origin and use.

STUDY SKILLS

- Create your own summary of the unit using the *Key concepts*. Add any other important information.

- Copy the following diagram in your notebook and add the missing information to create a concept map of the unit.

You can record your summary and listen to it as many times as you like to revise.



- Create your own scientific glossary. Define the following terms: *eclipse, equinox, galaxy, interstellar dust, interstellar gas, gravity, nebula, rotation, solstice, star* and *tides*. Add any other terms you consider important.



Make a sundial



The Ancient Egyptians used sundials to measure time 1500 years B.C. In this science experiment you will build a sundial. You will also learn how it works and how to use it.

The sundial will help us to:

- Orient ourselves with the help of the Sun and shadow.
- To distinguish the direction and length of the shadow at each hour of the day.

Procedure



1. Place the paper or card over the piece of wood.
2. Put the nail in the middle of a long side of the piece of wood.
3. Use the spirit level to place the piece of wood on a flat surface in a sunny area (figure 1).
4. Using the compass, place the piece of wood facing north, with the nail in the south.

If you don't have a compass, observe the shadow when the Sun is at its highest (solar midday); this indicates approximately north. Take into consideration that solar midday in the winter is at 13:00 and in the summer at 14:00.

5. On the paper or card, draw the lines that represent the cardinal points (figure 2).
6. Mark the shadow produced by the nail every hour (figure 3).

Materials



- compass
- piece of wood (100 x 60 cm)
- 20 cm long nail
- hammer or glue
- paper or card
- spirit level

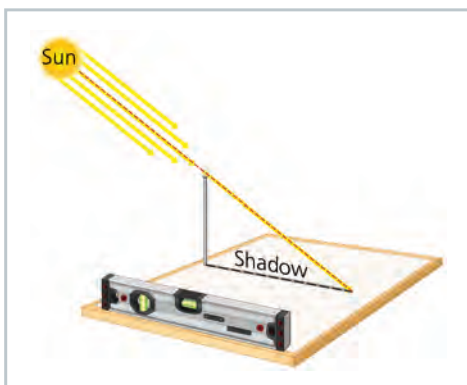


Figure 1

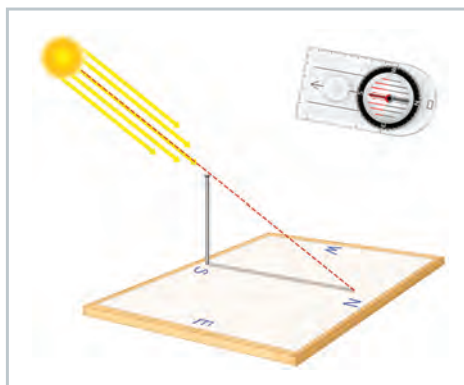


Figure 2

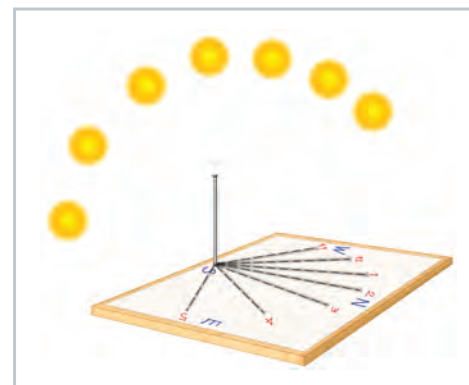


Figure 3

1. At what time was the shadow the shortest?
2. Between sunrise and solar midday, does the shadow get bigger or smaller? Between solar midday and sunset, does the shadow get bigger or smaller?
3. What angle is formed by the shadows of two consecutive hours?
4. Which cardinal point does the shadow point to at sunrise? Which cardinal point does it point to at sunset?
5. Considering your answer to question 4, which cardinal point does the Sun seem to move from and towards?



Length of days



In this task we suggest you investigate the differences in the number of hours of daylight at different times of the year, in different places in the world, and the relation with latitude. You will put the results of your investigation on a poster.



1. Research

- What is the latitude of the capital of your province and the cities of Oslo, Quito and Sydney?
- Which day has the most hours of daylight in each of the locations investigated? Which day has the smallest number of hours?
- At what times of the year is there more difference between the number of hours of day and night? Which times of the year are they more similar?
- How does an increase in latitude affect the length of days and nights? What happens at similar latitudes in different hemispheres?
- What happens in the North Pole during the winter solstice? What happens during the summer solstice? What happens in the South Pole?
- Can you estimate approximately the hours of daylight for the 1st, 11th and 22nd of this month?

2. Presentation

Design a poster to present the results of your research:

- Organise the information before you choose the main content and think about the information to include on your poster.
- Make a plan to organise the information you are going to put on the poster. Revise the parts of a poster in Unit 1.
- Write the relevant information for each section and chose suitable images to illustrate it. Include tables and graphs that you have made.
- Try to make your poster attractive and the information clear. Don't use the same colours for the text font and the background of the poster.
- Make a bibliography of the sources you have consulted.

Procedure

Follow these steps for your research:

Search for information

- Locate the cities studied on a world map. Make a note of their latitude and the hemisphere each one belongs to.
- Do a search on the Internet to find out the times of sunrise and sunset in these locations. Use the 1st, 11th and 22nd day of each month as a reference.

Organise the information

- Make a table with the times of sunrise and sunset in each city and make a graph to show how the hours of daylight vary in each one.
- Write the answers to all questions in the *Research* section.

Draw conclusions and check your research

- Verify your answers. Confirm that your conclusions agree with the contents of the unit.
- Don't use only one source of information. Check that your answers are repeated in different sources.
- Check that you have answered all the questions.

SELF-ASSESSMENT



■ Answer the following questions to assess your work.

- Have you answered all the questions in the *Research* section?
- Was it easy to find the times of the sunrise and sunset in the different cities?
- Did you include all the information required on the poster?
- What rating would you give your poster, from 1 to 5?

3

THE GEOSPHERE



Final task



The environmental impact of mineral extraction

Minerals are extremely useful to us. Minerals have great economic value and are often obtained without thinking about the environmental and social impact of their extraction.

Mineral extraction in third world countries is directly related to smuggling, poor work conditions and child labour.

One of the most sought after minerals is coltan, which is used to make parts of electronic devices. In this unit, you will research this mineral and create a slideshow presentation.



The Earth: origin and composition

The Earth is the third closest planet to the Sun. It is a rocky planet and the only planet that has water in all three states. As a result, it is the only planet with living things. The Earth can be divided into four layers: the **geosphere** or solid layer; the **atmosphere** or gaseous layer; the **hydrosphere** which contains water in all three states; and the **biosphere** where life exists. The solid part of the Earth is divided into different layers separated by areas known as discontinuities. In these areas the seismic waves change velocity. This allows us to identify where each layer ends. There are three layers in the geosphere: the **crust** (continental and oceanic), **mantle** (upper and lower) and the **core** (outer and inner).

Minerals

Minerals and rocks form part of the Earth's crust. Since ancient times, humans have used minerals obtained from the Earth. Minerals are solid, inorganic substances of natural origin. They have a definite chemical composition and most have a crystalline structure.

In nature there are more than 4 000 known minerals. We can identify some minerals by studying their physical properties, without analysing their chemical composition. Physical properties are classified into optical, mechanical and magnetic. A mineral's optical properties relate to how a mineral reacts to light. The mechanical properties of minerals refer to how the mineral behaves when a force is applied to its surface. Some minerals, such as magnetite, behave like a magnet. They attract objects that contain iron and nickel. There are other properties of materials such as transparency, that describes how a mineral reacts to light. A mineral can be **transparent**, such as diamond, when light can pass through it; **translucent**, like quartz, when light passes through it but is distorted; or **opaque**, like galena, when no light can pass through and density, that is the relation between the mass and volume of a mineral ($\text{density} = \text{mass}/\text{volume}$). Density is usually measured in grams per cubic centimetre (g/cm^3). This property is specific to each mineral and is independent of size. So, the density of a mineral is important information for identifying minerals. Minerals are used as metal ores, as raw materials for industry and as gems or precious stones. The responsible use of minerals reduces the impact of their extraction on the environment.

Rocks

Rocks are natural aggregates made up of one or various different minerals. Rocks, like minerals, have properties that allow us to identify them, for example, composition and texture. According to their origin, rocks are classified into igneous, sedimentary and metamorphic. **Igneous:** These originate when magma from the Earth's interior cools and solidifies. Magma is a substance made up of melted materials mixed with gases and water, formed in the Earth's interior. **Sedimentary:** Sediments are fragments of other rocks, minerals and organic remains. Sedimentary rocks form when sediments consolidate. The places where sediments are deposited are called sedimentary basins. **Metamorphic:** Formed by the transformation of other rocks subjected to high pressure conditions and/or temperatures, without reaching a melting state. Metamorphism is the process that changes a rock into a different type of rock. The process by which rocks transform into different rocks is called the rock cycle.

The use of rocks

The main uses of rocks are building, ornamentation, and as a source of fuels and technological materials.

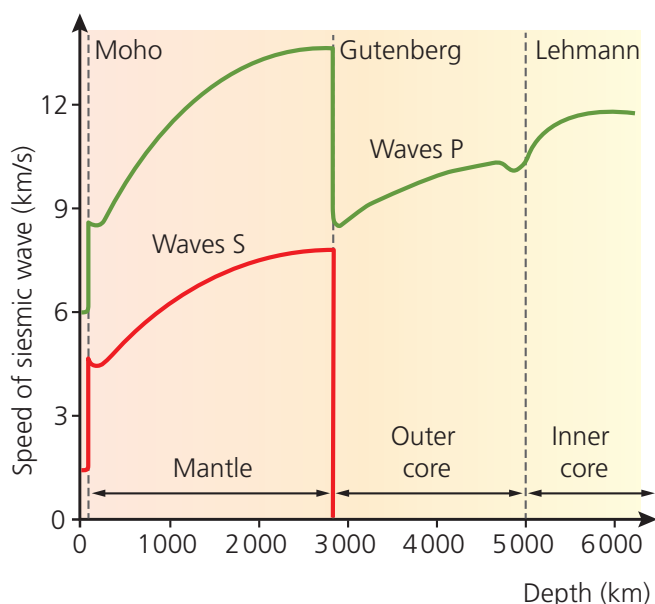
Building materials: some rocks are used directly. Others are modified for building purposes. Cement, concrete, ceramics and glass are some of the most commonly used building materials. They all come from rocks. **Ornamental rocks:** marble, granite, slate and basalt are often used in decoration. **Source of fossil fuels:** sedimentary rocks, such as coal and oil, are used because they produce a lot of energy when burnt. **Source of minerals for technological use:** rocks rich in quartz are a source of silicon, which is used to make computer processors or photovoltaic solar panels. Aluminium, obtained from a sedimentary rock called bauxite, is used to make many objects such as planes, soft drink cans or kitchen utensils.

Extraction of minerals and rocks

Rocks and minerals are extracted from mineral deposits in the Earth's crust. A deposit is the place where minerals or rocks are found in sufficient quantity to make extraction economically beneficial. Extractions are classified according to depth: superficial or subterranean.

The Earth: origin and composition

- Find out the thicknesses of the different layers of the Earth and order them from thickest to thinnest.
- Make a table to compare the characteristics of the continental crust and the oceanic crust.
- Were all materials distributed according to their density from the very beginning? Explain your answer.
- Explain why the following statements are true or false.
 - The seismic method only allows us to know the composition of the Earth's crust.
 - The Earth is made up of solid materials.
 - The Earth's crust has a uniform thickness of 50 km.
 - Denser materials in the geosphere are found on the Earth's surface.
 - The Earth's mantle is located between the Mohorovičić discontinuity and the Lehmann discontinuity.
 - The Earth's inner core is solid because the temperature is lower than in the outer core.
- The following graph shows how seismic waves move around the planet. Which seismic waves are travelling at a higher speed? Which layers of the Earth do they go through?



Minerals

- Which property of materials does the image show?



- Describe four properties of minerals.
- Explain if an ice cube and coral used in jewellery are minerals or not.
- Investigate and then copy and complete the table in your notebook.

Mineral	Ore
cassiterite	...
...	lead
hematite	...
...	zinc
chalcopryite	...

- According to the Mohs scale, what is the hardness of a mineral that scratches orthoclase but is scratched by quartz?
- Explain how to distinguish white quartz from orthoclase, which is the same colour?
- Find out why the colour and streak of a mineral isn't always the same.
- Find out why pyrite is also referred to as 'fool's gold'.

Rocks

- Explain the three characteristics that are used to classify rocks.
- Pumice is a rock that floats in water. Why do you think this is? Is it a natural or an artificial rock? Justify your answer.
- Copy the following terms in two columns in your notebook and then match them.

A: limestone, granite, clay, marble, basalt, chalk

B: detrital sedimentary, non-detrital sedimentary, plutonic, volcanic, foliated metamorphic, non-foliated metamorphic
- Are there any rocks which are not composed of minerals? What type of rocks are they?
- When 1 kg of granite was analysed in the laboratory using different chemical processes, they obtained 250 g of a white mineral, 300 g of another mineral, almost black, and the rest was a grey mineral.
 - What is the name of each mineral that composes granite?
 - Which minerals correspond to the grams of minerals above?
- On an excursion, Ana found a rock that contained a plant fossil that lived on Earth millions of years ago. What type of rock do you think it was? Explain your answer.
- Which rock forms quartzite after metamorphism? What size are the grains of the original rock?

The use of rocks

21. Explain which rocks provide the following building materials:

- a) glass c) cement e) brick
- b) concrete d) lime f) tile

22. Why are coal and petroleum referred to as fossil fuels?

23. What is sandpaper? Explain why it is not made of fragments of gypsum or talc.

24. Copy and complete the table in your notebook for the following rocks: petroleum, chalk, limestone, clay and coal.

Rock	Use	Objects created with it
...

25. Research how concrete and bricks are made. Make a diagram.

Extraction of minerals and rocks

26. Complete the sentences in your notebook.

- a) The rocks extracted from are cut into blocks.
- b) are horizontal tunnels in underground mines.
- c) is sediment that is usually extracted in or near large riverbeds.

27. Explain the meaning of the terms *deposit* and *mine*.

28. Find out what a *slag heap* is. What environmental problems do they cause?

29. Discuss this statement: 'New generation mobile telephones are made of stone'.

READ AND UNDERSTAND SCIENCE

Slow but sure

In Chihuahua, Mexico, giant crystals were found in the cave of Naica. They are mega-crystals of selenite (a variety of gypsum). For years, the Spanish investigator Juan Manuel García has been studying how fast they grow. Thanks to a special microscope designed by Japanese engineers, we now know that these formations grow at the equivalent of one hair every 100 years. However, their growth has stopped in recent years due to mining activities to extract minerals from the underground water that the minerals need to grow.

EVA VAN DEN BERG

National Geographic, November 2011
(Translated and adapted)

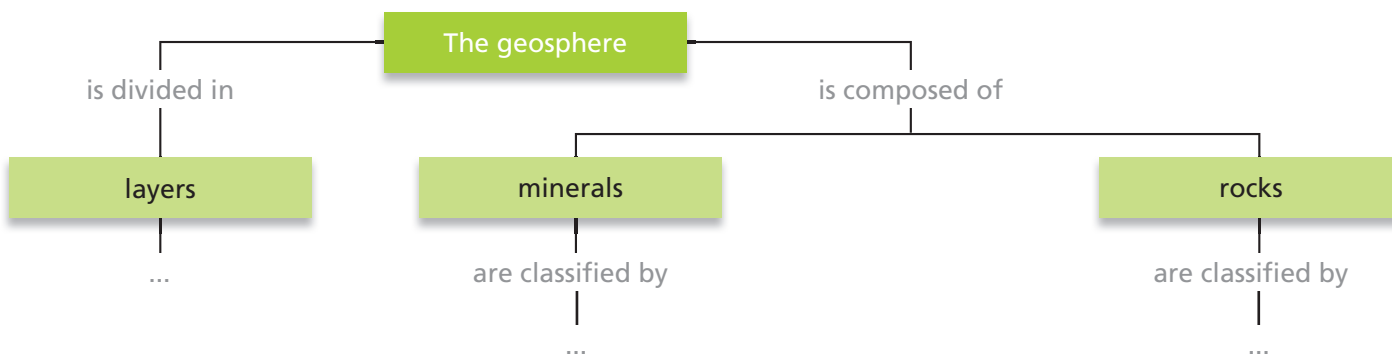
- a) What is the text about?
- b) Can you explain the title?
- c) Why have the crystals stopped growing?
- d) Do you think the growth of these formations can be observed by any person?
- e) Find out about selenite. Explain why water is essential for its formation.

STUDY SKILLS

■ Create your own summary of the unit using the *Key concepts*. Add any other important information.

■ Copy the following diagram in your notebook and add the missing information to create a concept map of the unit.

You can record your summary and listen to it as many times as you like to revise.



■ Create your own scientific glossary. Define the following terms: *quarry, clast, sedimentary basin, deposit, discontinuity, reef, phytoplankton, fossil, gallery, gangue, geosphere, gravel, magma, metamorphism, mineral, ore, rock, sediment, seismic wave*. Add any other terms you consider important.



The texture of rocks



Some characteristics of rocks cannot be seen by just looking at them. In this science experiment, you will learn to use a binocular loupe to compare different rocks and distinguish them according to texture.

Materials



- binocular loupe
- five different rocks, for example, conglomerate, sandstone, basalt, granite and gneiss
- ruler

Procedure



1. Put each rock, one by one, on the slide of the binocular loupe. Look through the eyepieces and move the macrometric screw until the rock is sharply focused.
2. Observe each rock and draw what you see for each rock.
3. Place a ruler next to the rock and, with the help of the loupe, measure the crystals or fragments that compose the rock.
4. Do another drawing of each rock observed.



Analysis of results

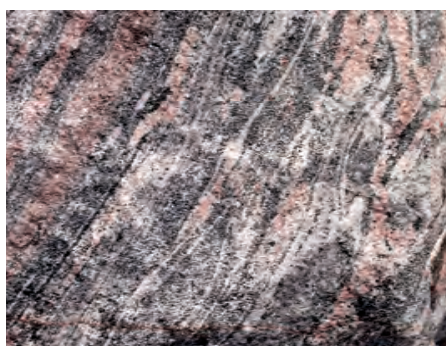


To analyse the results and compare the rocks, use the following table next to your drawings:

Name of rock	Minerals it is composed of	Size of the components	Type of rock
...



Texture of conglomerate



Texture of gneiss



Texture of sandstone

1. Which of the observed rocks is homogeneous? How did you know?
2. What are the main differences between conglomerates and sandstone?
3. What type of igneous rocks are granite and basalt? Can you observe any differences in their textures?
4. Based on the results of this science experiment, define in your own words the different types of rocks (igneous, sedimentary and metamorphic).
5. Which of the rocks observed were formed in the exterior of the Earth's crust? And in the interior?



The environmental impact of mineral extraction



The objective of this task is to research the environmental and social impact of extracting coltan. You will present your information in a slideshow presentation and suggest some measures to contribute to solving the problems.



1. Research

- What are the negative effects of mineral extraction on the environment?
- What is coltan and what it is used for?
- Where are the main coltan mines located? Are there any in Spain?
- How does the behaviour of the consumer affect the exploitation of children in coltan mines? What can we do to help solve this problem?

2. Presentation

- Prepare a slideshow presentation.
- Make a list of three ways in which we can contribute to the sustainable management of mineral resources.

Procedure

Follow these steps for your research:

Search for information

- Find at least four different ways in which mines have an impact on the environment and people. Suggest some possible solutions to the problems.
- Do not trust only one source of information. Check that the answers to your questions are repeated in different sources.
- Make a bibliography of all sources consulted.

Organise the information

- Make a table with the main impact of coltan mining.
- Write the answers to the questions in the *Research* section.

Draw conclusions and check your research

- As a result of your work, resolve the initial questions in the *Research* Section.
- Verify your answers.
- Check that you have answered all the questions.

SELF-ASSESSMENT



- Answer these questions to assess your work.
 - Have you resolved all the questions in the *Research* section?
 - Have you used reliable sources to find information?
 - Have you checked that the answers were repeated in various sources?
 - What rating, from 1 to 5, would you give your presentation?

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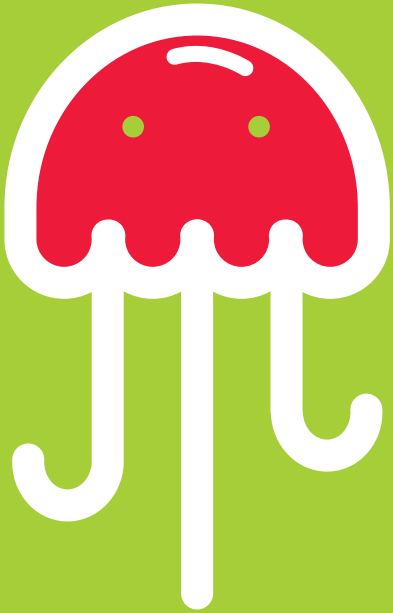
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