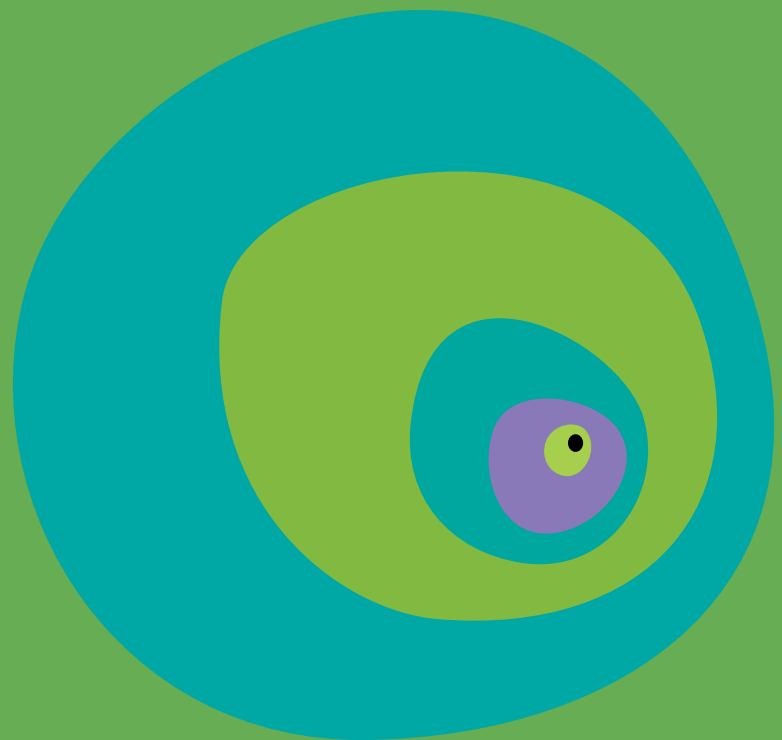


The Parts and The Whole

A Holistic Approach to Environmental
and Sustainability Education



Worksheets

The Parts and The Whole

A Holistic Approach to Environmental
and Sustainability Education



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The Holistic Approach

We have chosen a holistic approach to environment and sustainability education. This basically means one learning area cannot exclude the other educational disciplines as all are inextricably integrated. While the examples selected cannot include all the learning areas, as a starting point sufficient links between and among other educational disciplines can be identified. In addition to a holistic approach to learning, this resource recognizes that schools and colleges will continue to teach in subject areas. The worksheets are therefore divided into the following interdisciplinary connections: Holistic examples cutting across subject disciplines; natural science examples (Physics, Chemistry and Biology); and social sciences (Geography, Social Studies and Business Studies).

Holistic Examples

A holistic approach to environment and sustainability education demonstrates existing opportunities to promote a more synergistic understanding of the environmental, social, cultural and economic factors of local and global contexts. It sheds light on how each of these factors leads to a more sustainable and healthy lifestyle of individuals and their communities and challenges learners to think critically on issues such as equity and social justice.

Natural Sciences

Three learning areas have been used to demonstrate how complex systems have properties that describe their individuality as wholes and that these properties are adapted to the systems of which they are constituent parts. The Physics examples show the connections in global warming, electric grids and how nature works forward. Chemistry shows the connections between human activities and acidification. The Biology examples show how organisms are part of local ecosystems and eventually the biosphere.

Social Sciences

Three learning areas have been used to enhance the interesting and unique aspects of strong sustainability, starting with the natural environments including local culture and already existing community and economic conditions. The Geography example shows the complex issues of the tragedy of the commons. Social Studies recognises local traditions and resources which reinforce the cultural heritage of a location, enabling critical reflections on fairness and sustainable consumption. Business examples link the growing consumption crisis with economic and social responsibility.

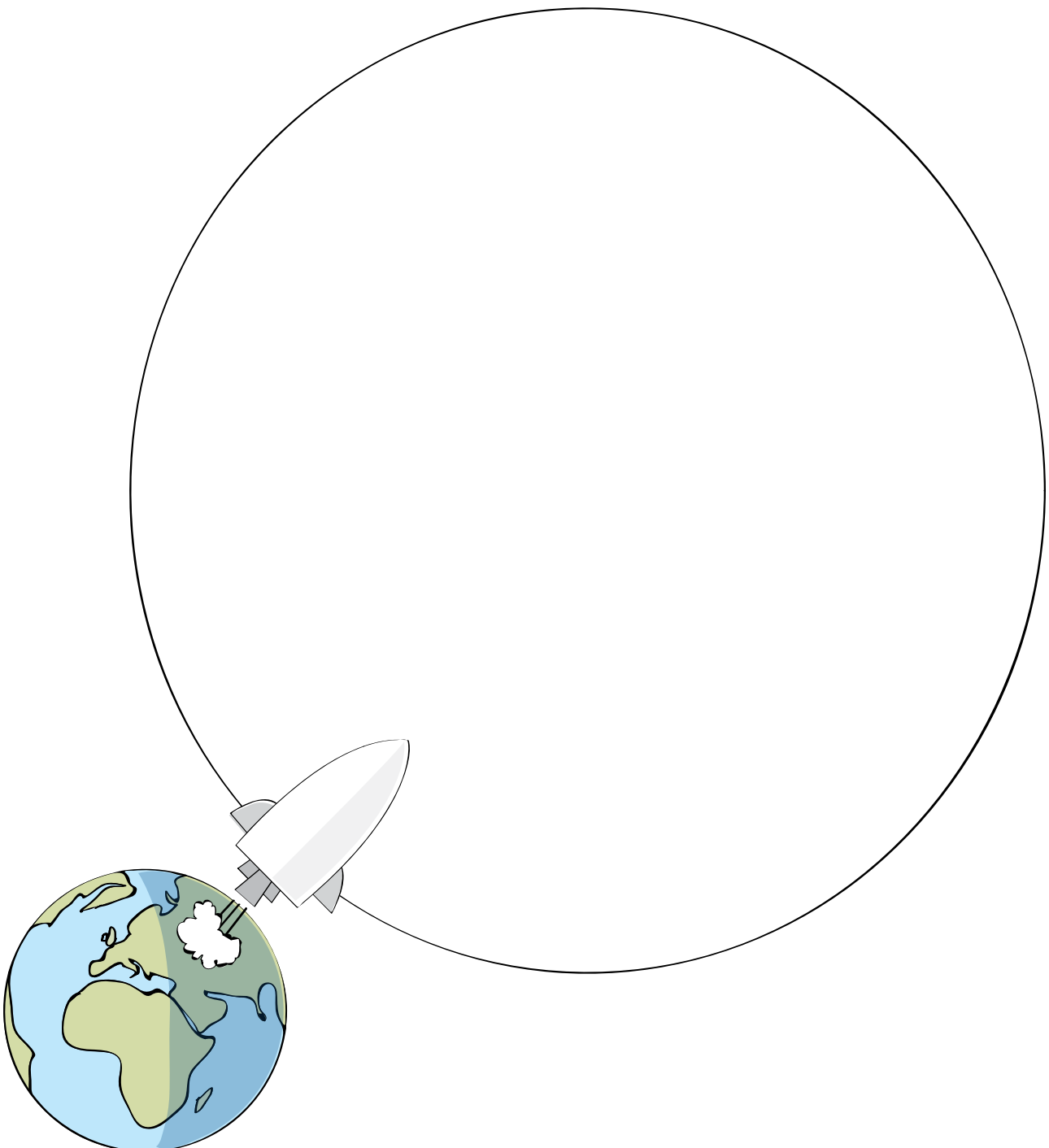
The Mission

Worksheet 1

You have been appointed by the Planetary Council to plan and take part in the greatest adventure in the history of mankind. You shall equip a giant spaceship to make a journey into space and the future. These are the conditions:

- The journey will last for 6000 years.
- You will have access to a shining sun throughout the journey.
- No more than 100 persons are allowed onboard the ship at the same time.

What will you bring?



A Good Life

1. Condition for a good life

Personal assessment

"What are the most important conditions that have to be fulfilled in order to have a good life?"

Write down these conditions without discussing with other learners.

2. Condition for a good life

Discussions in pairs

Form pairs according to the instructions from the teacher.

- Present your writings to each other;
- Discuss and make new agreements on the task.

After our discussions we have agreed upon the following:

3. Condition for a good life

Discussions in groups of four

Form groups of four according to the instructions from the teacher. Repeat the procedure from section 2.

After our discussions we have agreed upon the following:

4. Conditions for a sustainable life

Discussions in groups of four

Revised version after the plenary session. What in our section 3 has to be revised, removed, added or retained?

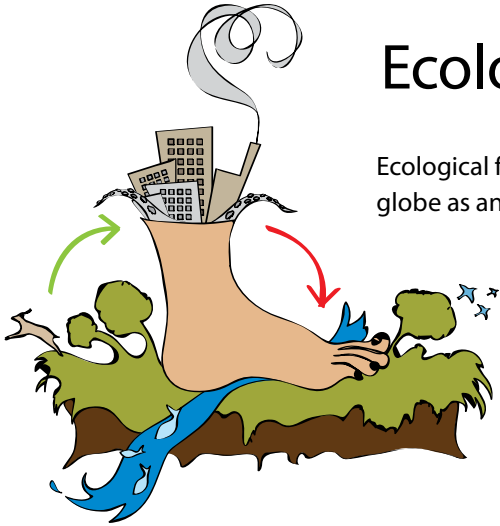
5. The bigger picture: Sustainable life and ecosystem services

Discussions and work in groups of four

- Give examples of different types of ecosystem services that are necessary for having "a good and sustainable life".
- Summarize your ideas and conclusions and present them in a written document, poster or small exhibit.

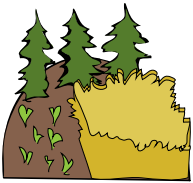
Ecological Footprint

Ecological footprint is now widely used around the globe as an indicator of environmental sustainability.

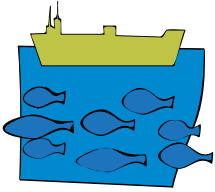


1. What is an ecological footprint?
Write down a short definition of the concept.

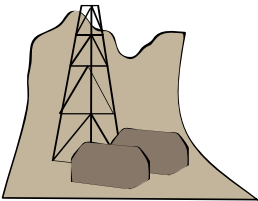
2. The ecological footprint is often divided into sectors according to the main services these areas provide. Look at the illustrations below and give a short description of services we can get from these areas.



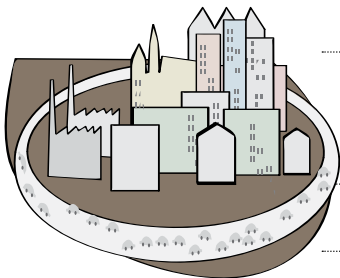
a. Bioproductive Land



b. Bioproductive Sea



c. Energy Land



d. Built Land



e. Biodiversity

Global Hectares and Ecological Footprints of Nations

1. The concept of a global hectare (gha) is a useful tool when we compare the size of the ecological footprint between persons or countries. What is a global hectare?

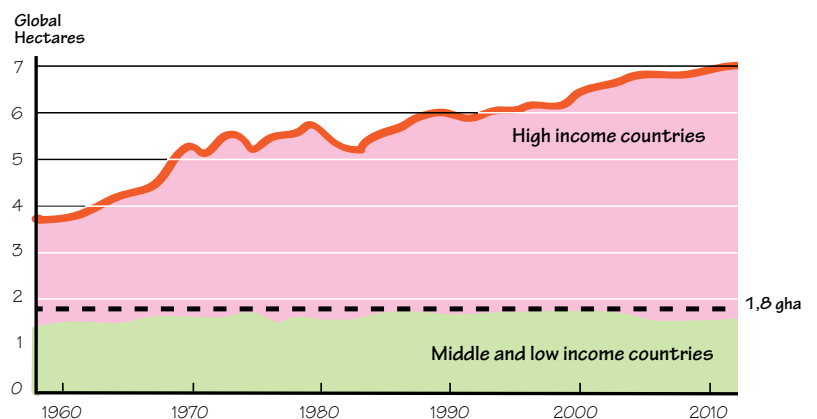
If the global hectares were shared in a fair way between all citizens of the world we would all have access to, in round figures, two global hectares per person (= 20.000 m² or the size of about four football fields). In fig. 1 you will find figures on the average eco-footprint for different nations. In fig. 2 you can see the trend on how they have developed since 1961. Study the tables.

Fig 1.

Country	Population (millions)	Eco-footprint (gha)
Denmark	5	8.3
United States	308	8.0
Sweden	9	5.9
Norway	5	5.6
Germany	82	5.1
United Kingdom	61	4.9
Botswana	2	2.7
South Africa	49	2.3
Available Global hectares	6.7 billion	1,8
Swaziland	1	1.5
Zimbabwe	13	1.3
Lesotho	2	1.1
Angola	18	1.0
Zambia	12	0.9
Mozambique	22	0.8
Dem. Rep. of the Congo	63	0.8
Malawi	14	0.7

Eco-footprint, adapted from Wikipedia (24/04/2012)

Fig 2. Ecological Footprint per person 1960–2010



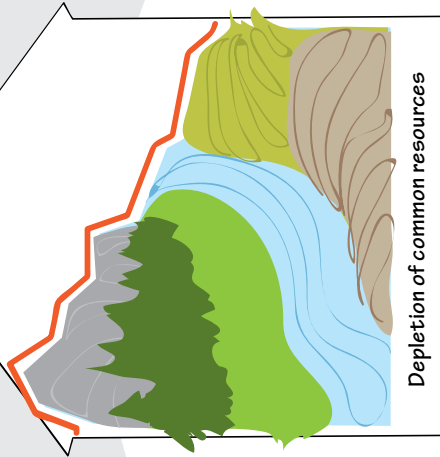
Ecological Footprint Atlas 2010

1. Why do countries have different eco-footprints? Give three good reasons.

2. What has happened with the eco-footprint over time? Describe the trend and come up with three good explanations why.

GLOBAL STOREHOUSE

DEMAND Consumption



SUPPLY

ECO-FOOTPRINT DEMAND
Population x consumption/person
x resource and waste intensity
2.7 gha / person 2010



How can the eco-footprint demand:

grow.....

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diminish.....

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How can the biocapacity:

grow.....

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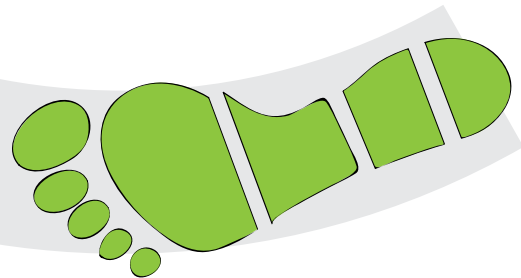
diminish.....

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BIOCAPACITY
Area x bioproductivity
1.8 gha / person 2010



Eco-footprint and Fairness

Background

The size of the personal eco-footprint differs greatly, both within countries and between countries. If fairly distributed every person should have access to approximately two global hectares (gha) each, but in reality we are far from that goal. What could be done in order to reduce these inequalities?



Task

You and your class have been selected to represent your country at an International Youth Conference about Lifestyles, eco-footprints and fairness. As preparation for this conference you will work in groups of 3–4 people with the goal of coming up with smart, strong and wise arguments that should influence the choices and lifestyles of young people in other countries.



Option 1

You live in a developing country. You have learnt that the ecological footprint of wealthy nations is increasing and is far beyond what is sustainable. Write a letter to learners in a developed country informing them of the consequences of their way of life. Suggest to them sustainable ways of living that could help reduce their ecological footprint.

Option 2

You are in a developed country. You have learnt that the ecological footprint of wealthy nations is increasing. Write a letter to learners in a developing country informing them of the consequences of your way of life. Inform them of the choices that you can make and those you have made to reduce your eco-footprint at individual, societal and national levels.

Which sustainability practices would you encourage people in developing countries to maintain in order to keep their eco-footprints small?

The Fish Game

What is needed

- A big sheet of white paper where you have drawn the outline of a lake, this will be your play ground.
- A big matchbox with matches representing fish in the lake (at least 200 matches).

Preparations

1. Divide into groups with 1 boss and 5 players (A–E).
2. The boss puts 50 matches = 50 tons of fish into the lake and names the players A–E.
3. The participants read the instructions for the first game, and without talking to each other they decide on a personal strategy.

Game rules first game

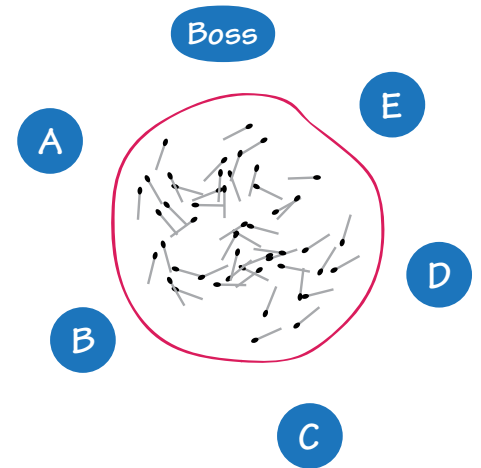
1. One game session consists of 8 rounds.
2. The player (A) who initiates the first round will be the last one in the next round, and so on for 8 rounds. Thus each player has at least one turn to be "first" in a round.
3. You fish by taking matches out of the lake, one player after the other, from A–E. You decide yourself on how big your catch will be during each round, but you have to consider the following conditions:
 - Maximum catch during one round is **6 matches** = 6 tons of fish.
 - The operating costs for boat and equipment are equal to **1 match in each round**, regardless of how big your catch is. This applies even if you haven't had any catch at all! These costs are paid to the boss at the end of each round.
 - At the end of each round the fish population reproduces itself. The rate is that the amount of fish left in the lake will double, but there is an upper limit; the lake cannot feed more than 55 tons of fish at the same time. The boss is responsible for checking that the players follow the rules and is also taking care of the fish-replenishing by adding the right amount of matches each round.
4. During the first game the players are, under no circumstances, allowed to talk to each other or come up with suggestions on how to act.

The winner of the first game is the person who after 8 full rounds has the highest total catch.

Game rules, second game

1. This time you are not competing with your group members. Instead you work as a team and compete against other groups in your class. Within your group (the Boss included) you are free to discuss, reach agreements and collaborate as much as you like.
2. Conditions for the second game:
 - Proceed the same way as during the first game, except for instructions in point 1 above.
 - After the 8 rounds there still has to be at least 50 tons of fish in the lake.

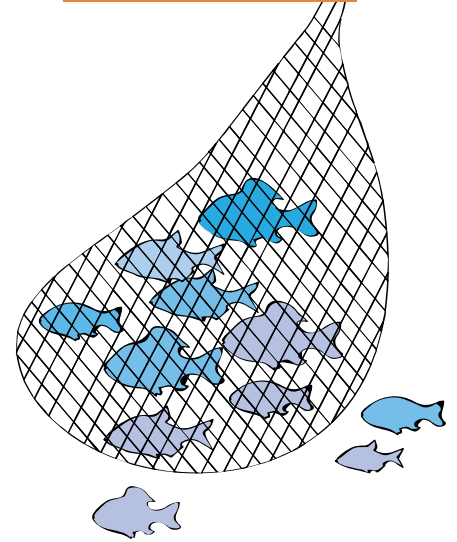
The winner is the group who after 8 full rounds has the biggest total catch.



The Fish Game

A. Play the first and second game and fill in the results from each group in the table below

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
First game Total catch: <i>Winner</i>								
First game Total catch: <i>Our group</i>								
Second game Total catch: <i>Our group</i>								



1. Compare the total catch between the first and second game. Why were the results so different? Reflect on the outcome!

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2. What is required to manage a common resource?

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3. What is the ideal fish population for sustainable fishing?

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4. When does the population of fish start to deplete?

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B. Read about "The tragedy of the commons". Link what you learned from the outcomes of your games to the discussions on "The tragedy of the commons" (for advanced learners Compare Harding's and Ostrom's statements). Discuss in groups or write a short essay.

C. How resilient must the fish populations be to cope with disasters such as an oil spill?

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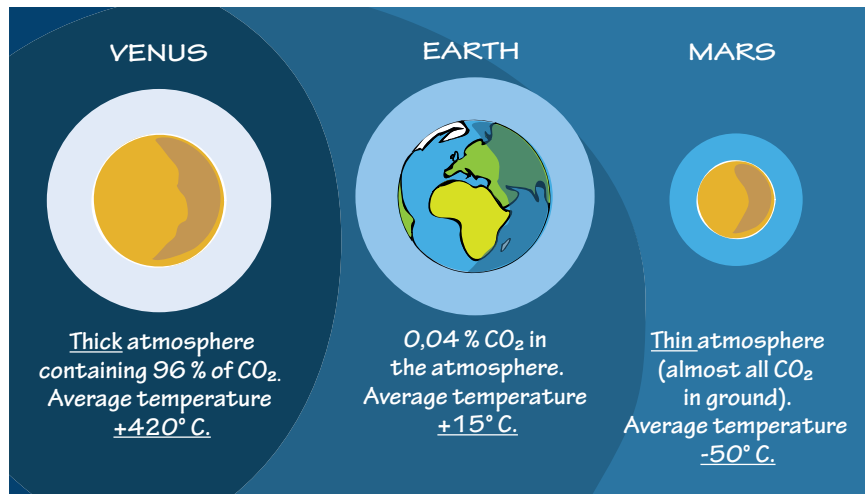
Cool News for a Hot Planet

Three Planets

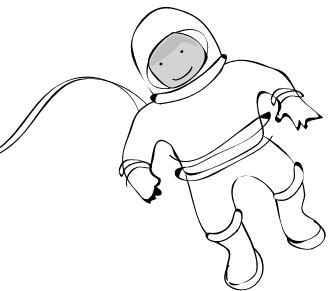
In the illustration you will find basic facts about the temperature and atmospheric conditions on the planets **Venus, Earth** and **Mars**.

A. Read the facts so that you can compare the planets.

B. Use the information from the illustration and fill in the table below



	VENUS	EARTH	MARS
Average temperature (°C)
CO ₂ content in atmosphere (%)
Thickness of atmosphere, use: <u>thin, in between, thick</u>
Distance to sun, use: <u>biggest, in between, smallest</u>



C. In what properties of matter can you find water on these planets, i.e. ice, liquid water, water vapour?

Mars

Earth

Venus

D. Imagine that you land with your spaceship on one of these planets. You put on your space suit, open the door and step out on to the planet. Choose one of the planets and describe what you think you would experience.

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E. Compare your text with a person who has chosen a different planet.

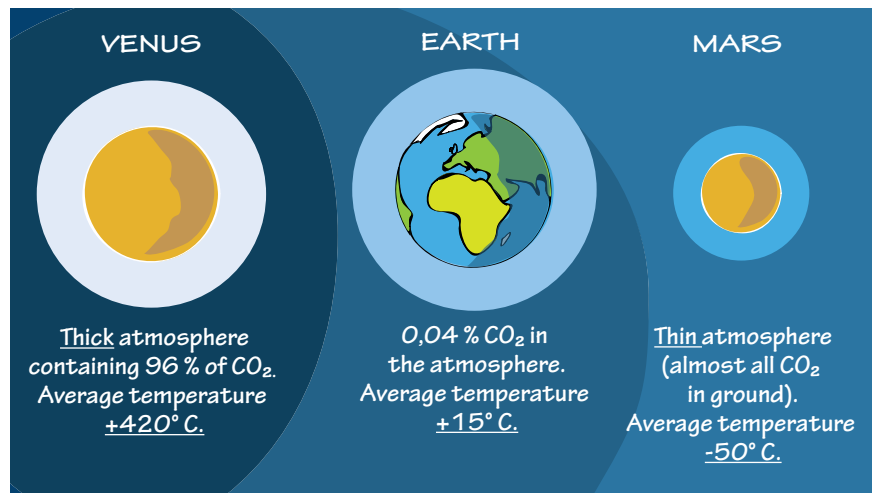
Cool News for a Hot Planet

Three Planets

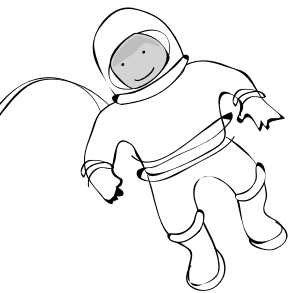
In the illustration you will find basic facts about the temperature and atmospheric conditions on the planets **Venus**, **Earth** and **Mars**.

A. Read the facts so that you can compare the planets.

B. Use the information from the illustration and fill in the table below



	VENUS	Mother EARTH	MARS
Average temperature (°C)	+420°C	+15°C	-50°C
CO2 content in atmosphere (%)	95% CO ₂	0.04% CO ₂	95% CO ₂
Thickness of atmosphere, use: thin, in between, thick	very thick	medium	very thin
Distance to sun, use: biggest, in between, smallest	shortest	in between	biggest



C. In what properties of matter can you find water on these planets, use: **ice, liquid water, water vapour**.

Mars *It is so cold that all water appears as ice*

Earth *You will find water in the forms of ice, liquid water, water vapour.*

Venus *It is so hot that all water appears as water vapour and clouds.*

D. Imagine that you land with your spaceship on one of these planets. You put on your space suite, open the door and step out on the planet. Choose one of the planets and describe what you think you would experience!

"If I landed on Venus my space suit needs to be very strong and heat resistant! It is extremely hot and due to the high content of CO₂ in the atmosphere it is poisonous and has a very high pressure. The sun is not visible and it is dark. The sky is totally covered with thick clouds of water vapour. It is almost impossible to resist the heavy winds that are blowing!"

E. Compare your text with a person who has chosen a different planet

Cool News for a Hot Planet

Properties of Matter

A. Complete the illustration and write down the names of the different parts of the arrangement.

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____

B. Describe what happens with the ice during the heating process. Use the words **solid**, **liquid**, **gaseous** when you describe the properties of matter that water may occur in.

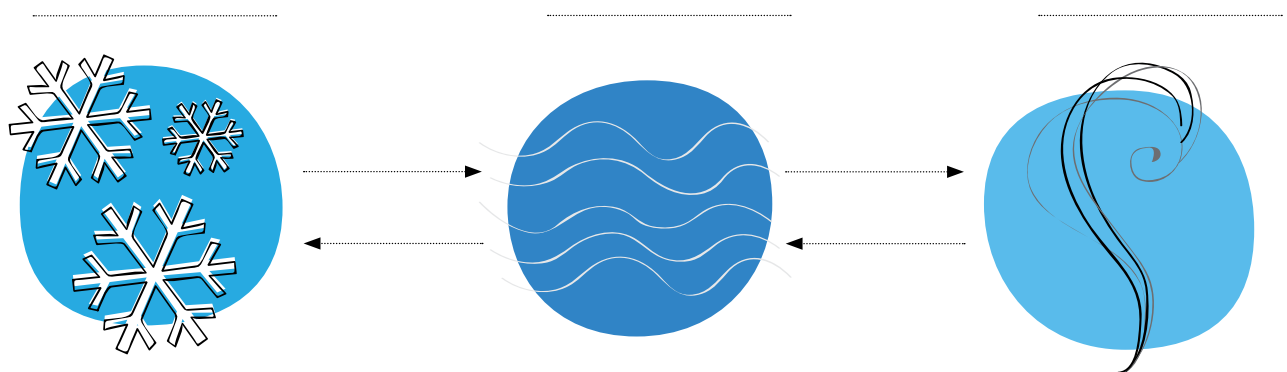
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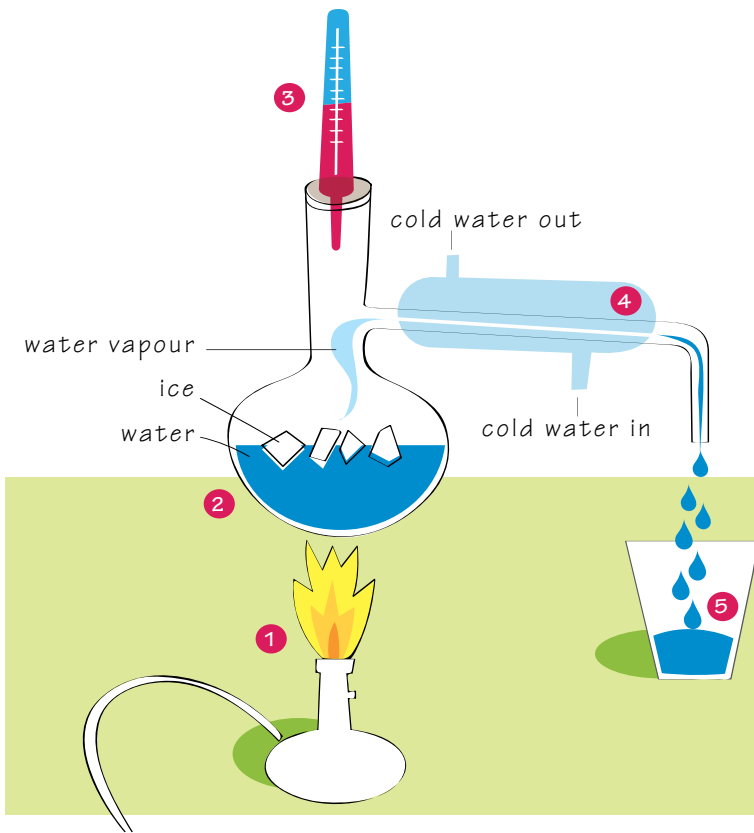
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C. Complete the illustration.



Cool News for a Hot Planet

Properties of Matter



A. Complete the illustration and write down the names of the different parts of the arrangement.

- 1 burner
- 2 flask
- 3 thermometer
- 4 cooler
- 5 beaker

B. Describe what happens with the ice during the heating process. Use the words **solid**, **liquid**, **gaseous** when you describe the properties of matter that water may occur in.

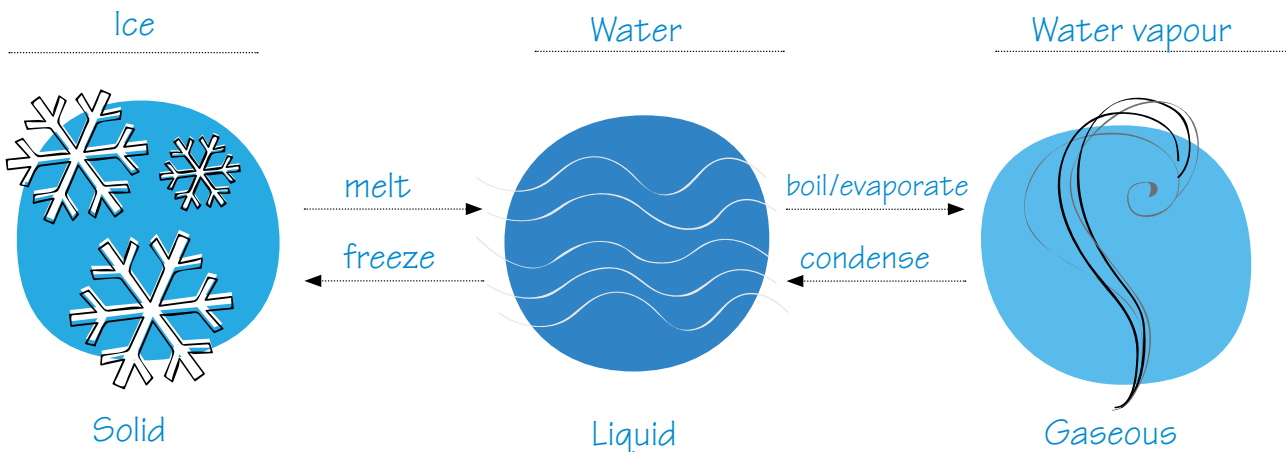
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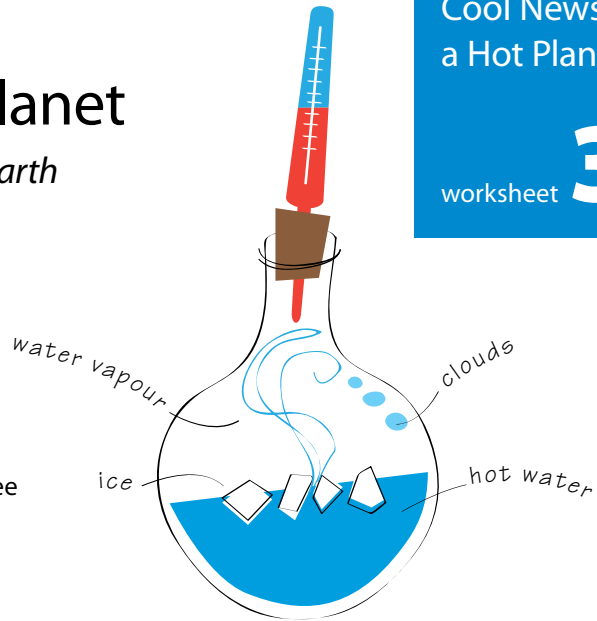
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C. Complete the illustration



Cool News for a Hot Planet

The Flask and The Temperature of the Earth



A. The delicate balance

Put hot water in a flask and add a number of ice cubes. For a short period you will have water at all three properties of matter at the same time!

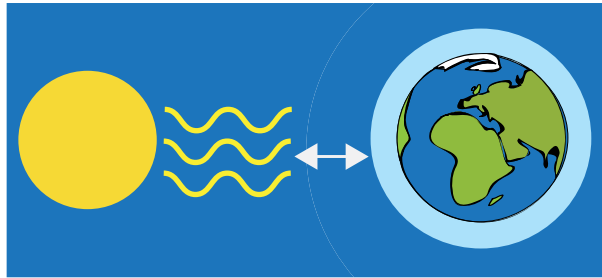
Compare the conditions in the flask with the three planets:

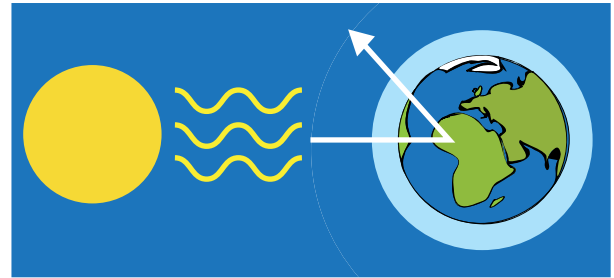
Mars

Venus

Mother Earth

B. What factors influence the temperature and climate of the Earth?



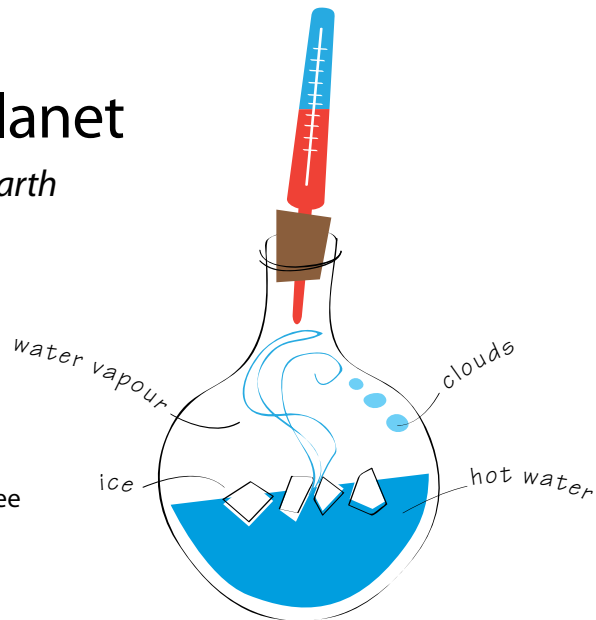






Cool News for a Hot Planet

The Flask and The Temperature of the Earth



A. The delicate balance

Put hot water in a flask and add a number of ice cubes. For a short period you will have water at all three properties of matter at the same time!

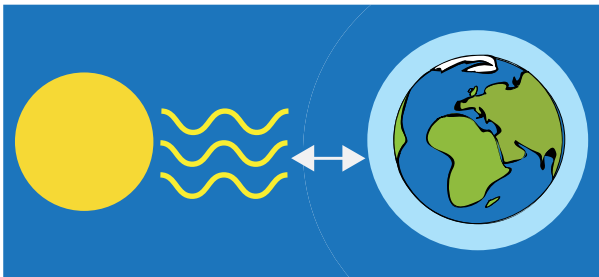
Compare the conditions in the flask with the three planets:

Mars The planet is so cold that water only exists as ice, even the CO_2 is frozen into "dry ice".

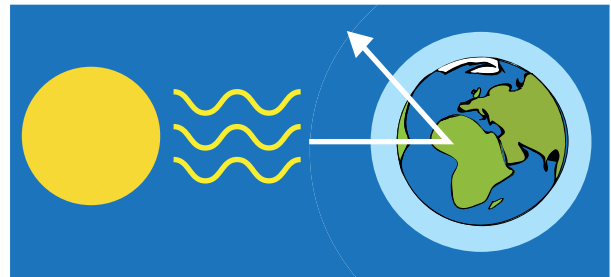
Venus The planet is so hot that water only exists as water vapour.

Mother Earth The planet has balanced conditions that allow water to occur as ice, liquid water and water vapour all at the same time.

B. What factors influences the temperature and climate of the Earth?



The distance to the sun and Earth's axis tilt



The albedo of the Earth. How much of the incoming light that is reflected into space.



The amount of greenhouse gases in the atmosphere, mainly CO_2 , methane and water vapour.



Life has a great impact on both the albedo and the amount of greenhouse gases

Cool News for a Hot Planet

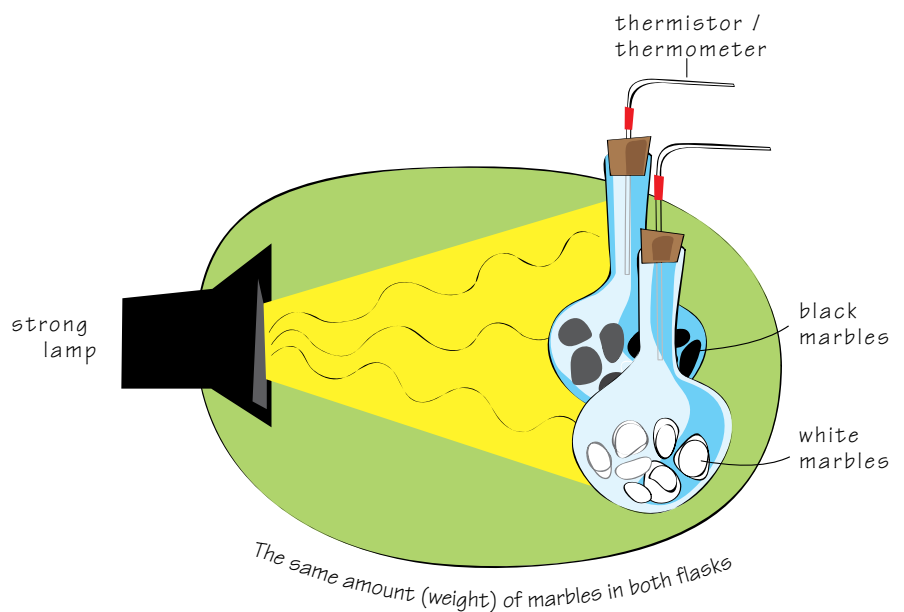
Albedo and Green house effect

These two experiments illustrate how basic physical conditions influence the temperature in a closed system. The results then can be applied to the Earth and the prevailing climate conditions.

Use a strong lamp (60–100W) and sensitive thermometers in order to get a fast and clear result of your demonstration. The ideal situation is, of course, if you have access to thermistors that you can attach to the same measuring unit and display them at the same time. But it also works with simple, separate thermometers – it just takes more time to get a clear difference!

This experiment demonstrates the concept of **albedo** – how much of the incoming light is absorbed or reflected.

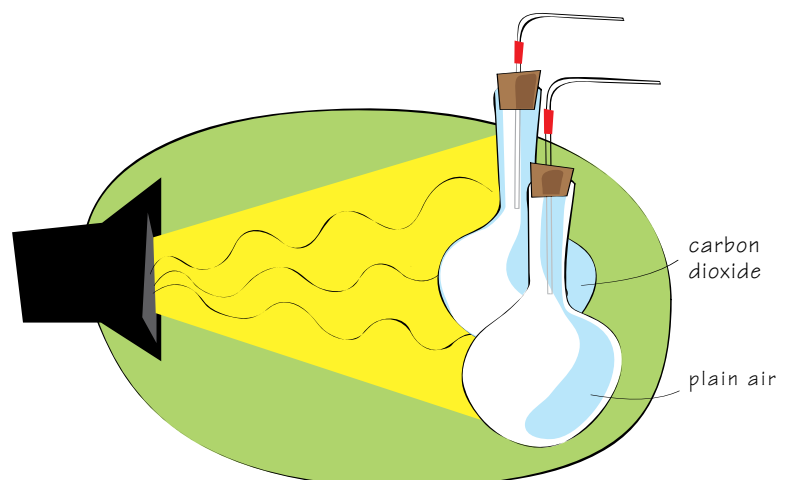
We can use it in our discussions on how melting glaciers or deforestation in the tropics can influence the mean temperature of our planet.



This experiment demonstrates the effect of the greenhouse gas **carbon dioxide** (CO_2) when hit by radiation from a strong light source.

The temperature in the flask filled with CO_2 will increase faster than in the one filled with plain air.

We can use these facts in our discussions on greenhouse effect and climate change.



The Electric Grid

Tools and other equipment that could be of use

To build with and build on

Thin metal plate for producing the "switches" and the "toaster" (0.5–0.8 mm thick).

Plywood sheet (10 mm thick) on which everything should be installed (size 30x40 cm).

Paper glue.



screw drivers



metal shears



drillers



drill



screws



pliers



lamp sockets



filaments



electric motor



connection boxes



batteries



soldering iron



hammer



electric cables



soldering



resistance wire

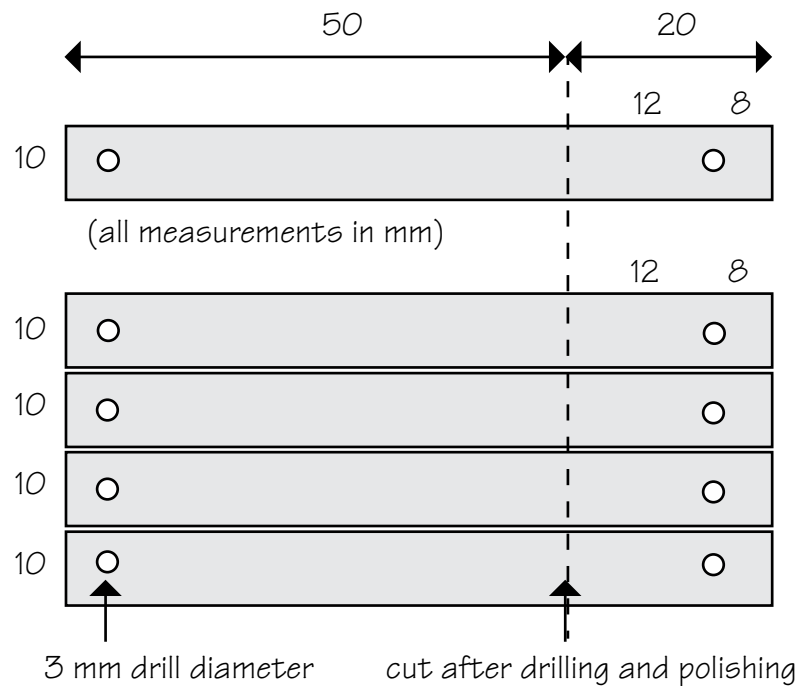


alarm bell

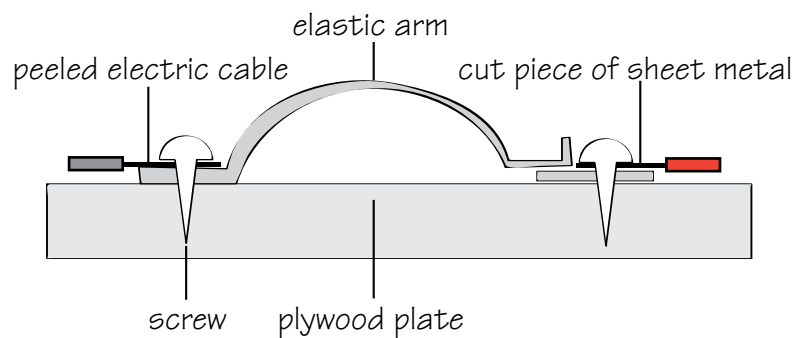
The Electric Grid

Building Electric Switches

1. Draw the external measurements according to the figure and mark where to drill and cut the sheet metal. (If you are making several switches, draw all of them at once next to each other, before cutting and drilling.)
2. Make a dent with the hammer and center punch where you are going to make holes. Use a 3 mm drill.
3. File off the burr after drilling.
4. Use the metal shear to cut the separate switches and cut the sheet metal at the markings. Use a file to smooth sharp corners and edges.
5. Bend and shape the long part of the switch into an elastic arm (see pictures).
6. Mount the switches and use the same screws to fasten the connecting cables for the different circuits.



Cross section of mounted switch with connecting cables

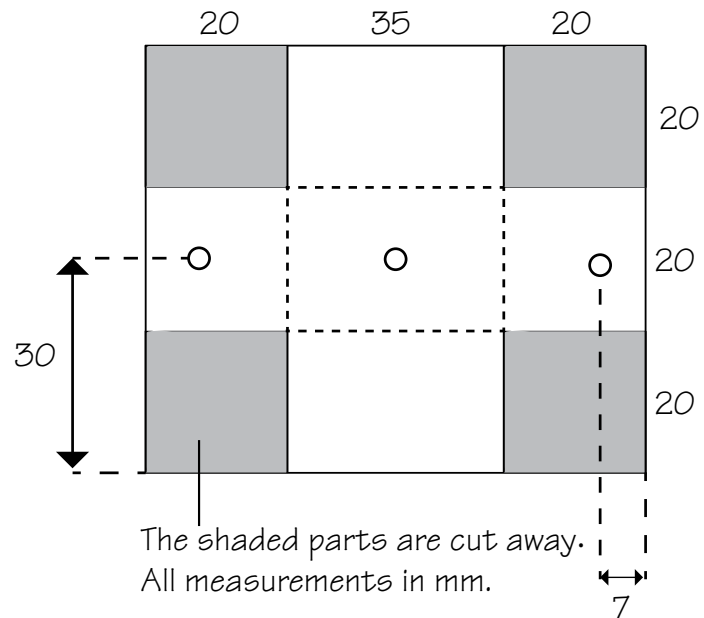


The Electric Grid

Building a Toaster

To build a simple model of a toaster

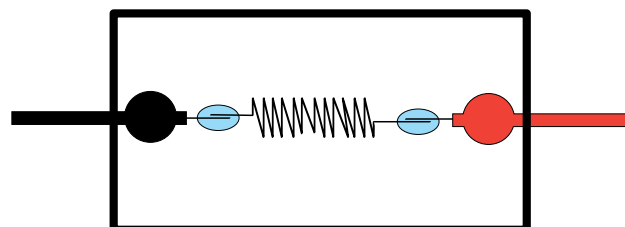
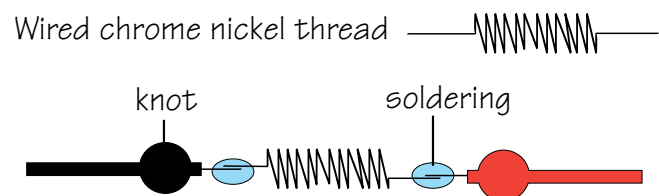
1. Study the blueprint and draw the corresponding measures on the piece of sheet metal provided by your teacher (all the measurements are in mm).
2. Drill the holes (diameter 3 mm).
3. Cut off the shaded parts and smooth the corners and sharp edges with a file.
4. Bend the four flaps so that the sheet metal forms an open box and screw it to the model.



Installation

5. Cut 10 cm of chrome nickel tread (0,4 mm) and wire it tightly around a nail or a very thin screwdriver to make a filament sprial.
6. Find suitable connection cables, make a knot at the end of the cable and peel the plastic from 5 mm away.
7. Solder the cable ends to the chrome nickel spiral.
8. Install the filament sprial inside the toaster by threading the free cable ends from inside. Prevent the soldering and the spiral from coming into contact with the toaster walls.

(If you don't have a soldering iron, twining the cable ends works just as well.)

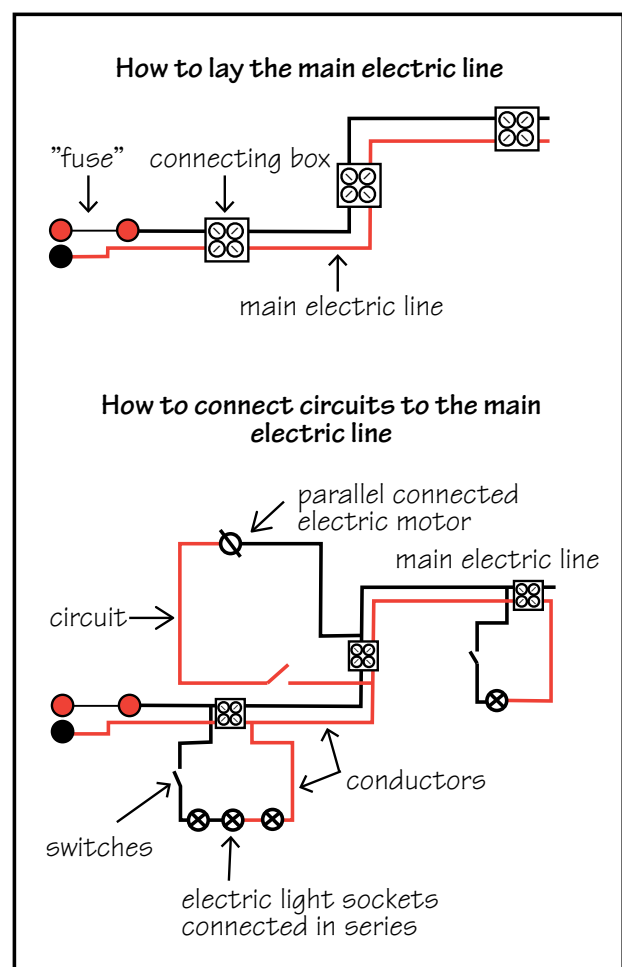
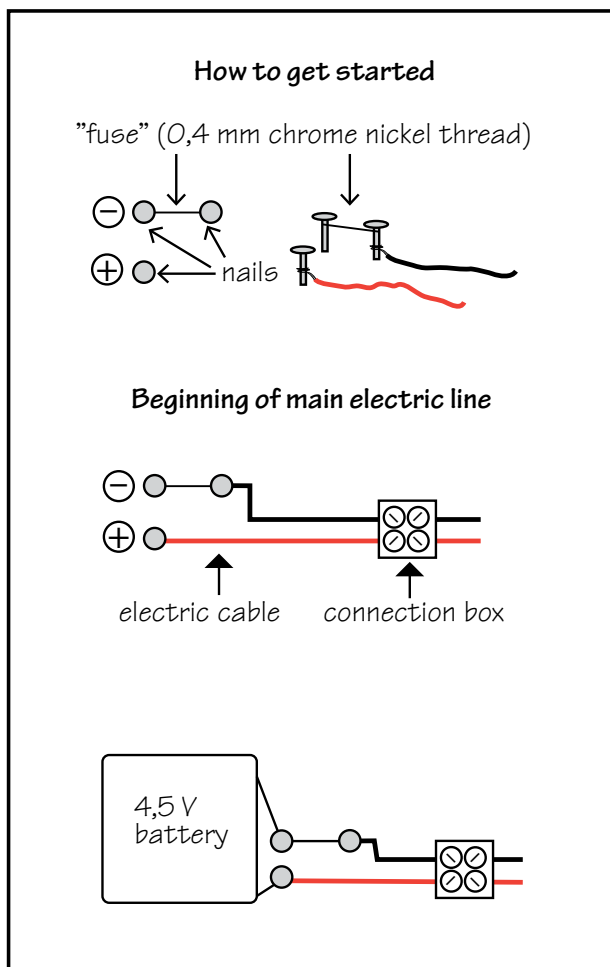


spiral installed in toaster

The Electric Grid

How to build an electric grid

1. Hammer in two nails where the battery will connect to the electric grid in your model.
2. Hammer in a third nail at a distance of 2 cm from one of the battery poles.
3. Create a simple "fuse" by connecting this third nail to one of the poles.
Use a chrome-nickel resistance wire of 0.4 mm, see illustration below.
4. Connect electric cables to the two nails and lay out a main electric line that will reach to all the rooms in your model.
5. Put connection boxes where you need connections to the main electric line.
6. Connect all the objects to the main line at appropriate positions.
7. Make sure that every circuit has its own switch and that the cables are fixed correctly to the plus and minus poles in your grid.



Nature Works Forwards

Spontaneous Processes

Experiment 1

Arrange nine drawing pins in a square and throw another 9 drawing pins into the air. Can you throw these in such a way that they land forming the same pattern of a square?

Yes No

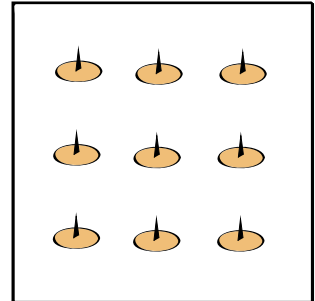
1. State the experience from the experiment as a law of nature.

.....

2. Find two more examples of this law.

.....

.....



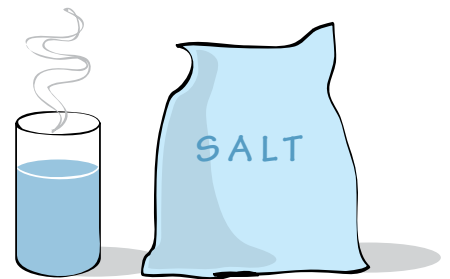
Experiment 2

Put salt in a beaker of warm water. Stir. Stop when it's not possible to dissolve any more salt.

3. How can you show that the salt is there, though invisible?

.....

.....



4. According to the law you just stated, can this be reversed?
That is can you remove the salt from the water?

Yes No Why?

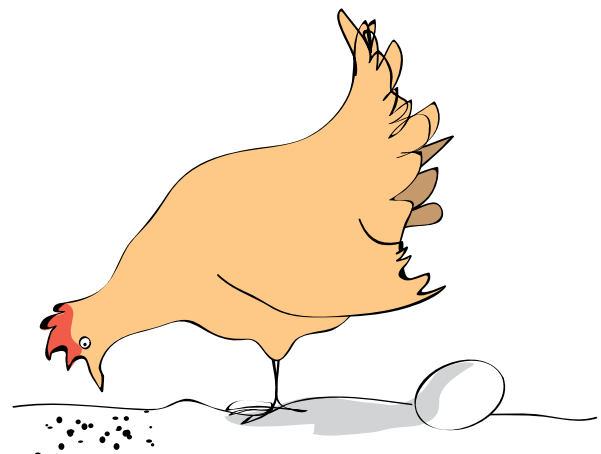
If you answer yes, how?

.....

Group discussion

Find examples of "unspontaneous" processes. This means processes that create order, like with the hen growing because of seeds and the egg out of the hen.

Prepare to present the examples for the class.



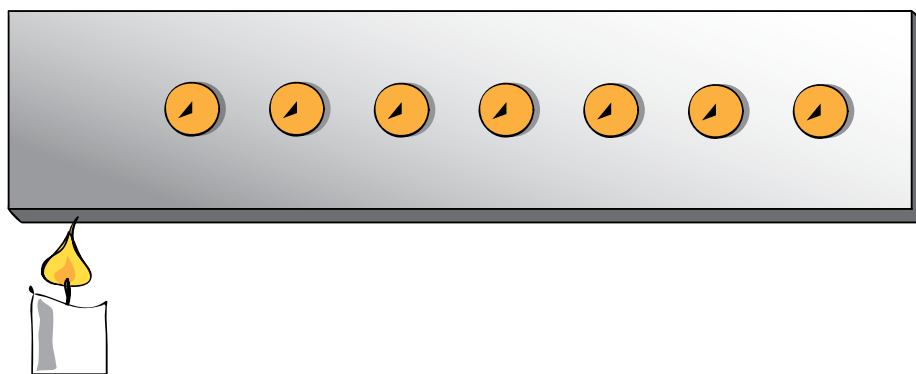
Nature Works Forwards

Cooking the Egg. What Happens?

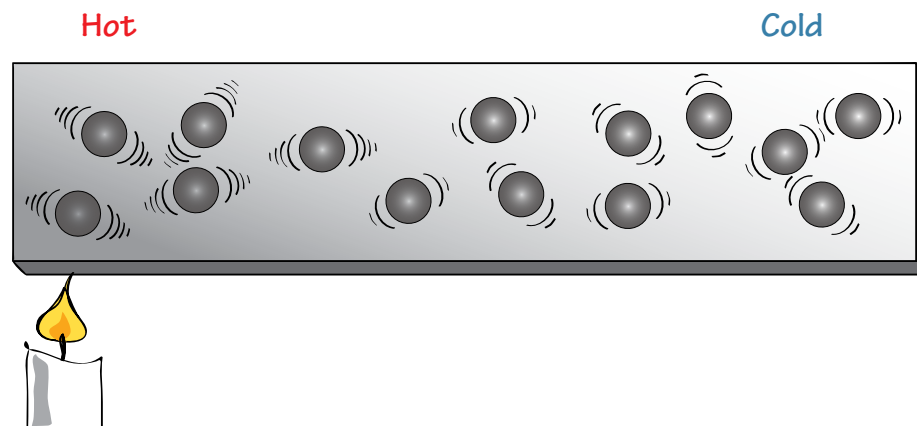
If the purpose of the egg is not to be hatched into a chick but to be eaten as a tasty breakfast, it needs boiling. Whatever we want to do, natural resources are needed, in this case of course heat, one form of energy. What is really happening when we boil the egg?

Experiment 3. The hot bar

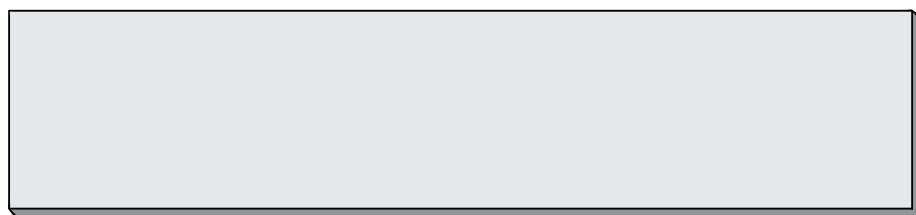
Use vaseline to stick the drawing pins to the metal bar. Hold the bar over a candle. Keep the heat on the same end of the bar and wait for the result. In what order do the drawing pins fall and why?



Atomic particles vibrate more on the hot side



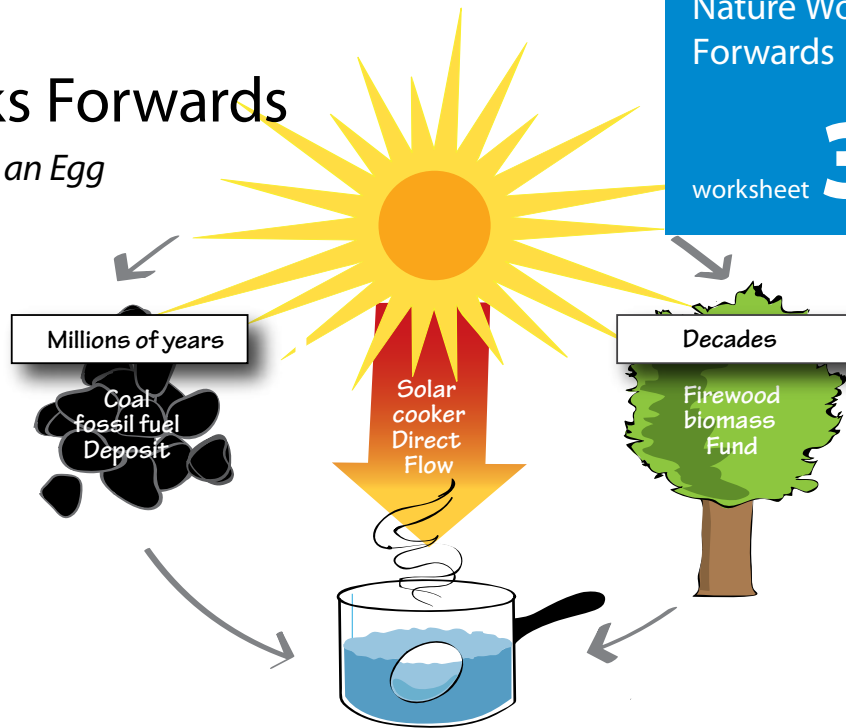
Draw the molecules and show how they vibrate after the candle is taken away but while the bar is still warm:



Nature Works Forwards

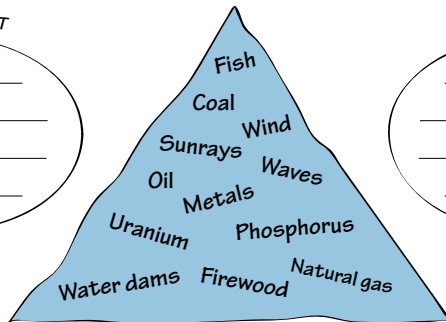
The "Best" Way to Boil an Egg

Where does the heat come from?



Question 5: Which of the three categories do the items in the triangle belong to? Sort them!

DEPOSIT



FUND

FLOW

Deposit (non-renewable)

Natural resource stored for millions of years

Fund (renewable)

Natural resource stored for short time

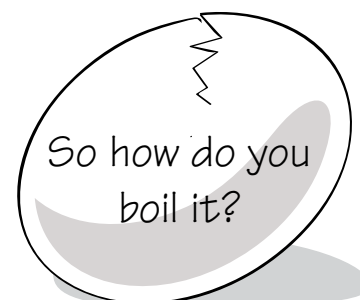
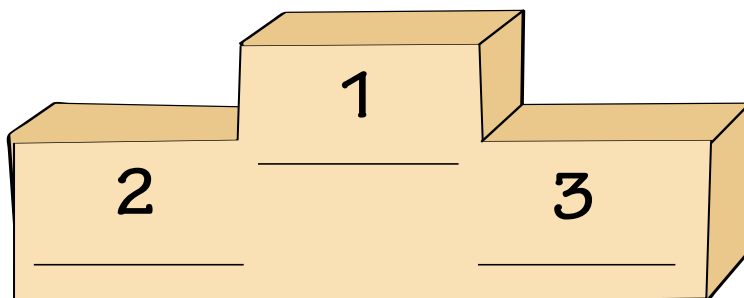
Flow (renewable)

Natural resource flowing more or less constantly

Assessing the sustainability

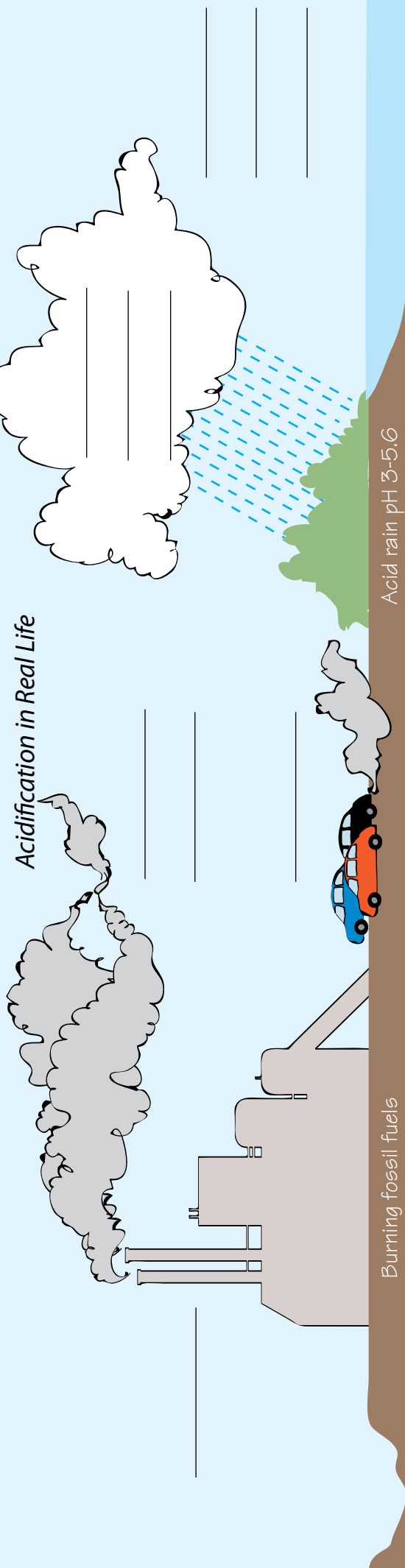
Three choices for cooking

If you were to grade the above categories in terms of sustainability, how would you grade them?



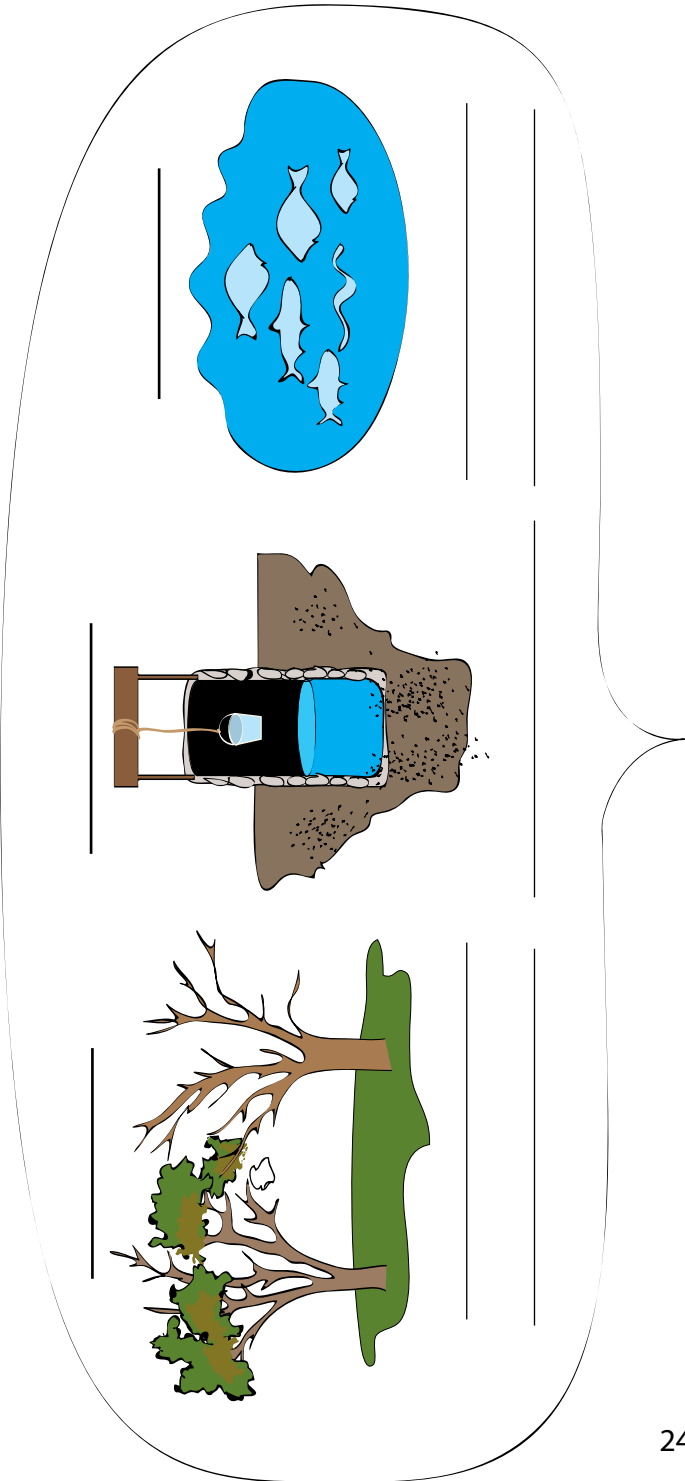
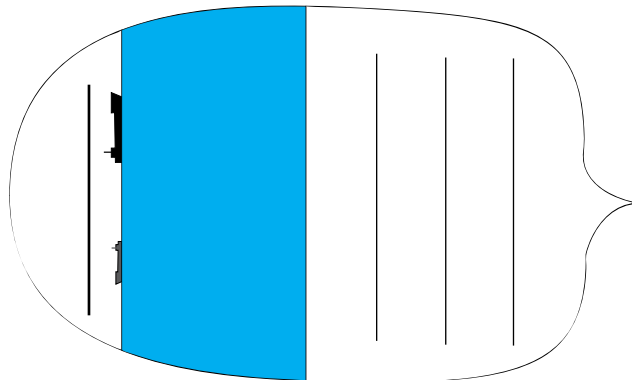
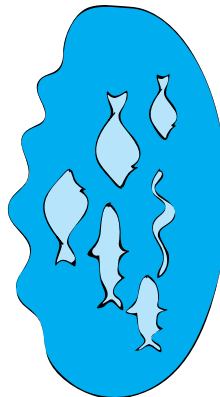
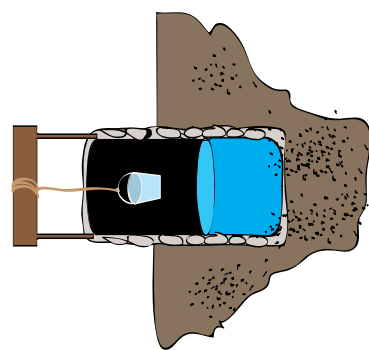
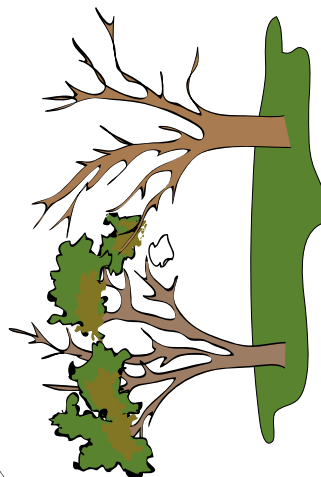
Acid Circumstances

Acidification in Real Life



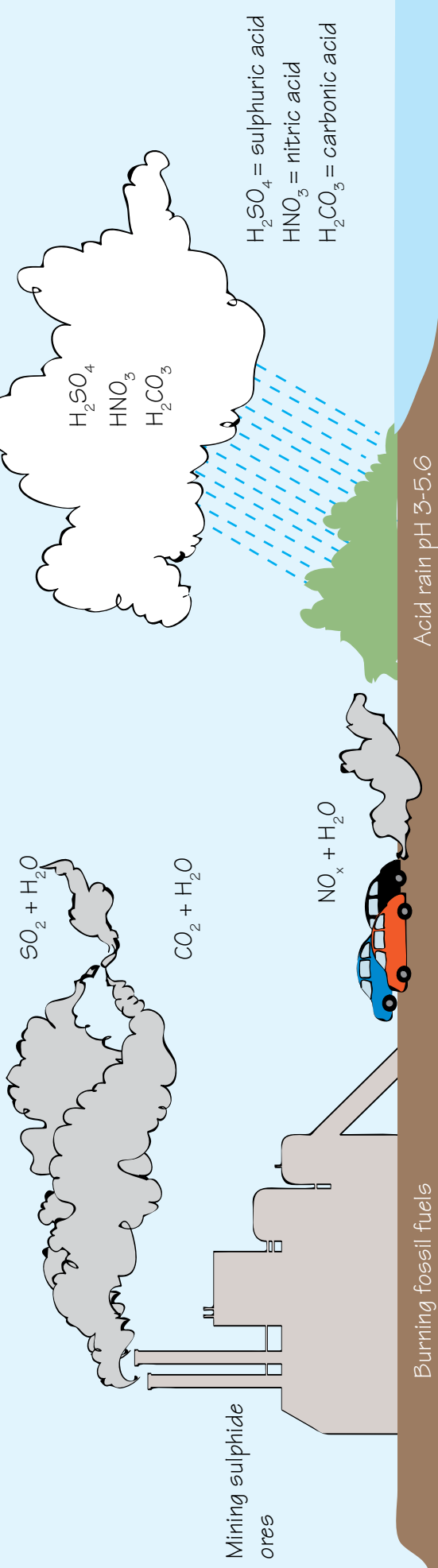
Burning fossil fuels

Acid rain pH 3-5.6



Acid Circumstances

Acidification in Real Life



Forests

Needle loss, dying trees
Impaired growth
Higher sensitivity to diseases

Soil and groundwater

High concentration of heavy metals in soil and groundwater

Lakes

Acidified water
Decline of fish number
Extinction of species

Mainly through emissions of SO_2 and NO_x

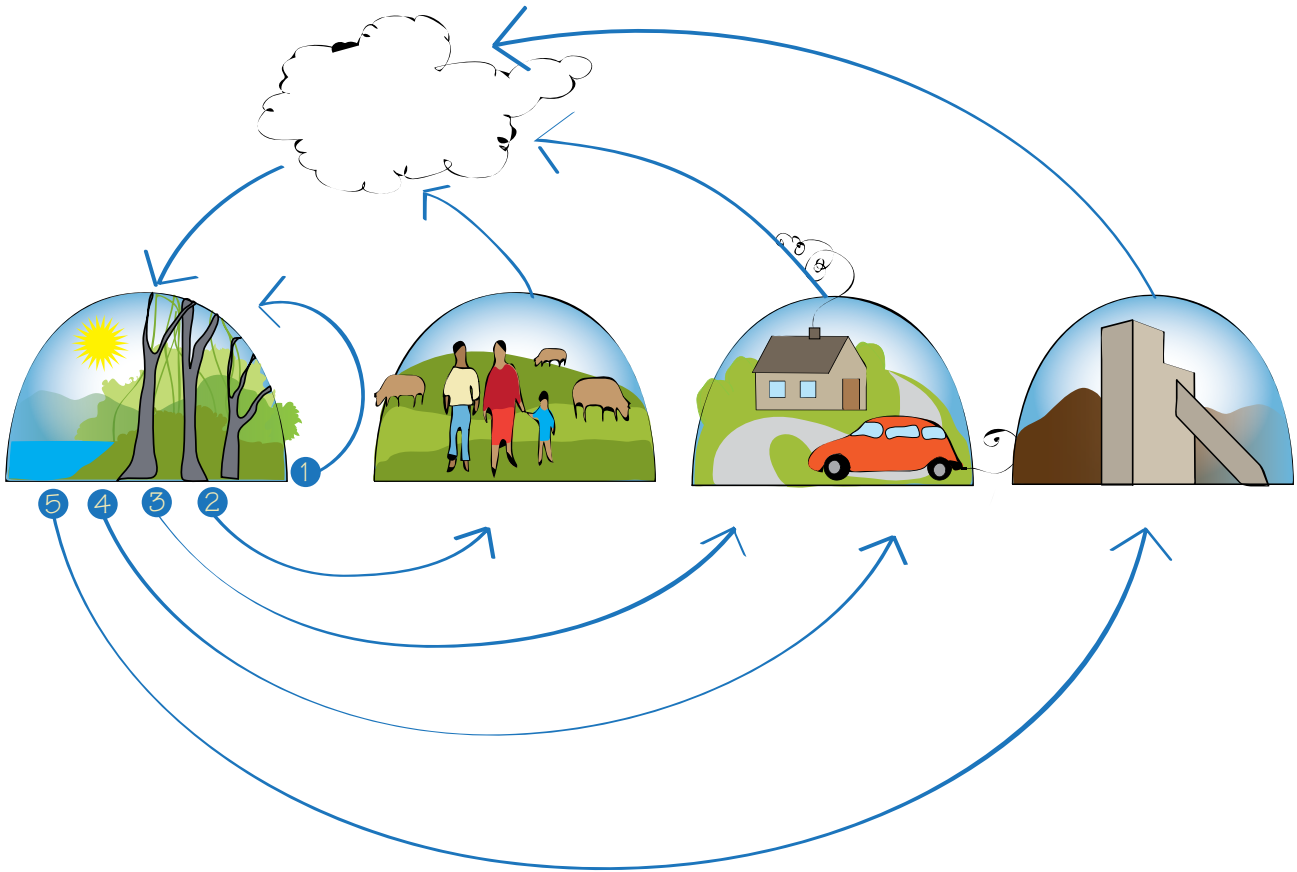
Oceans

Acidified water
Disturbed calcification process among echinoderms, crustaceans and molluscs

Mainly through emissions of CO_2

The Carbon Cycle

A. Complete the document.



B. Describe the different tracks in the carbon cycle and estimate the required time for the carbon atoms to make a full circulation within each track.

Track 1

.....

Track 2

.....

Track 3

.....

Track 4

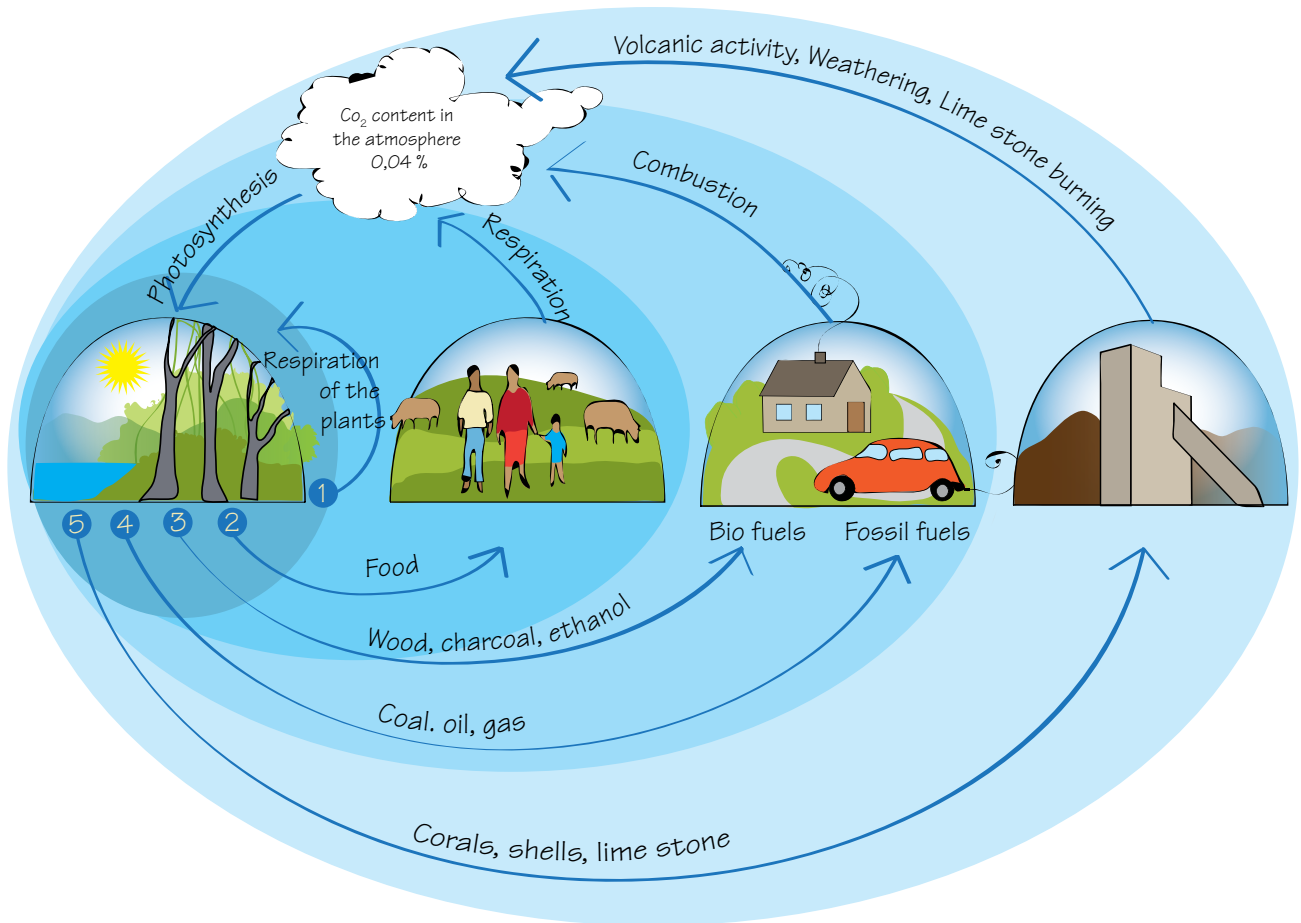
.....

Track 5

.....

The Carbon Cycle

A. Complete the document.



B. Describe the different tracks in the carbon cycle and estimate the required time for the carbon atoms to make a full circulation within each track.

Track 1 _____

Track 2 _____

Track 3 _____

Track 4 _____

Track 5 _____

The Carbon Cycle

The flux of Carbon (track 1–3)

1. Describe how the green plants are linked to the carbon cycle.

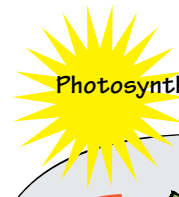
2. Why is it correct to say that the entire carbon cycle is driven by the sun?

3. You eat a sweet fruit from a tree and after a while your body has digested it. Describe how this process is part of the carbon cycle.

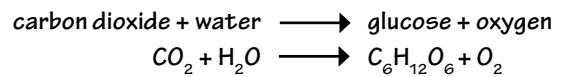
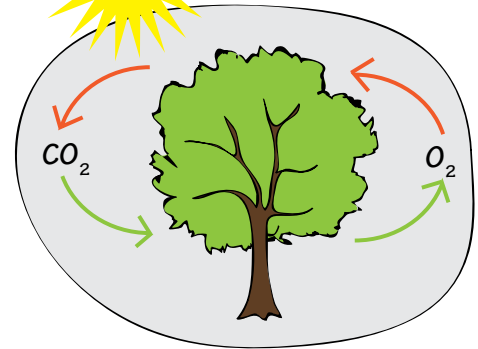
4. Write a simplified chemical reaction formula of the process (sugar = glucose = $C_6H_{12}O_6$).

5. You use different types of bio fuels to heat your house and make your food. Describe how the use of bio fuels is connected to the carbon cycle.

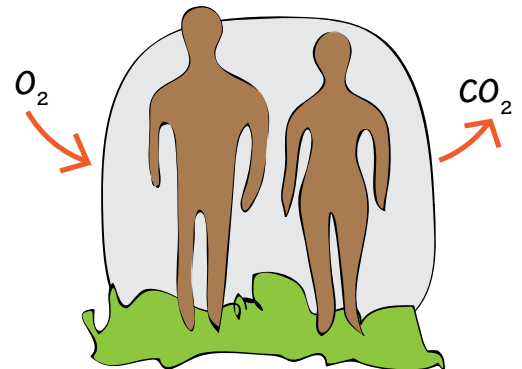
6. Write a simplified chemical reaction formula of the process (wood = cellulose = $C_{12}H_{22}O_{11}$).



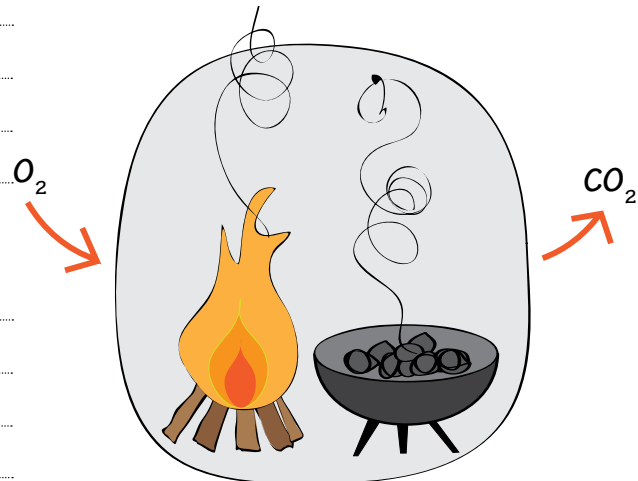
Photosynthesis and respiration



Respiration



Combustion of bio fuels



Wood

Charcoal

The Carbon Cycle

The flux of Carbon (track 3–5)

A. Conduct the experiment according to the instructions from your teacher.

1. Describe the difference in energy content in ethanol and petrol.

.....

.....

.....

2. Describe the different ways in which ethanol and petrol are connected to the carbon cycle.

.....

.....

.....

3. Describe the differences of how the use of ethanol and petrol contribute to increased CO₂ levels in the atmosphere.

.....

.....

.....

B. Conduct the experiment according to the instructions from your teacher.

1. Why did the indicator change colour during the experiment?

.....

.....

.....

2. Describe how this experiment is connected to the carbon cycle.

.....

.....

.....

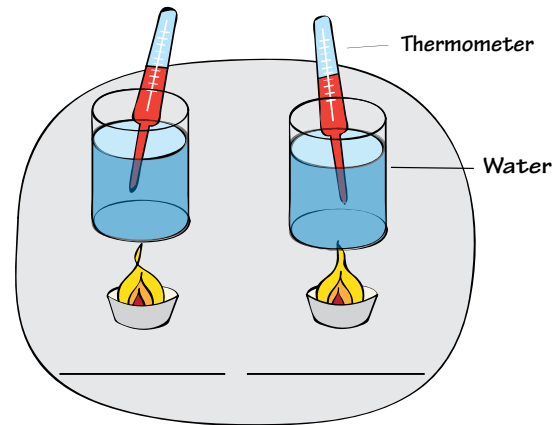
3. How can the use of fossil fuels affect shells and corals in the ocean?

.....

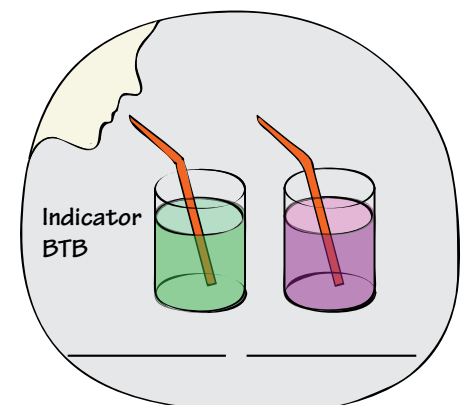
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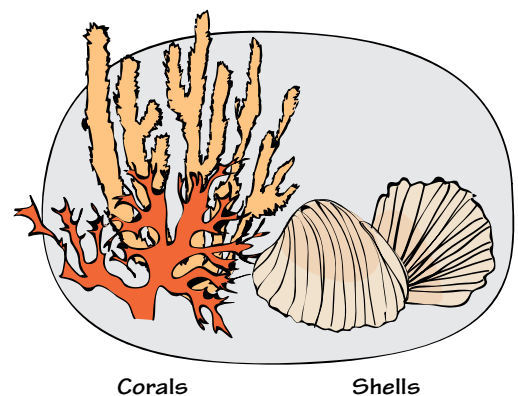
Combustion of bio fuel and fossil fuel



Carbon cycle and acidification



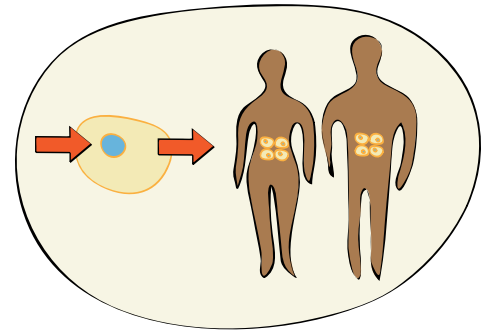
Ocean acidification



The Parts and The Whole

The cell is the smallest unit that shows characteristics of life. To stay alive the cell has a metabolism where it takes in energy and resources from the surroundings and excretes different types of waste products. Cells survive by using resources in a linear flow.

1. Give examples of resources and waste products that are involved in the life processes of a cell.

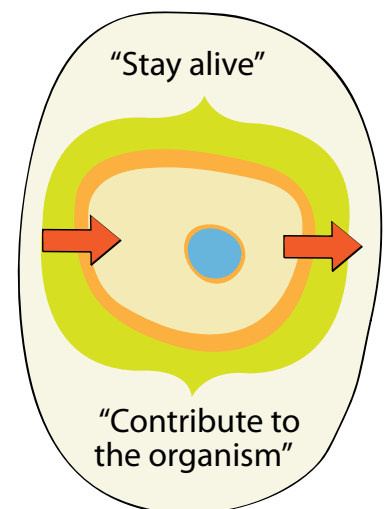


2. Identify five cell types in your body.

3. Why do you think that there are different cell types in your body?

4. Give five good examples of how these different cell types contribute to the functioning of the whole organism.

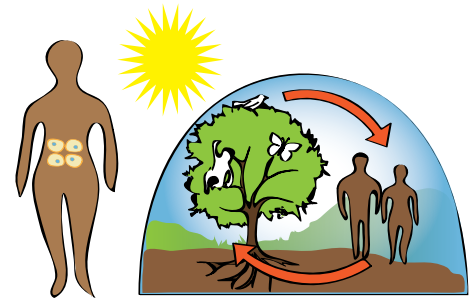
5. Look at the illustration to the right. Cells within an organism have two different "obligations". Write a short description of the relationship between the cell and the organism.



The Parts and The Whole

An organism is the smallest functional unit in an ecosystem. To stay alive the organisms have to take in energy and resources from their surroundings and get rid of different types of waste products. Organisms survive by using resources in a linear flow.

1. Give examples of resources and waste products that are involved in the life processes of an organism.

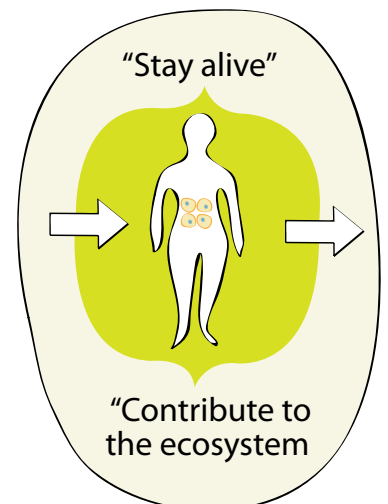


2. Identify five different species that can appear in an ecosystem.

3. Why do you think that there are different species (high biodiversity) in an ecosystem?

4. Give five good examples on how these different species contribute to the functioning of the whole ecosystem.

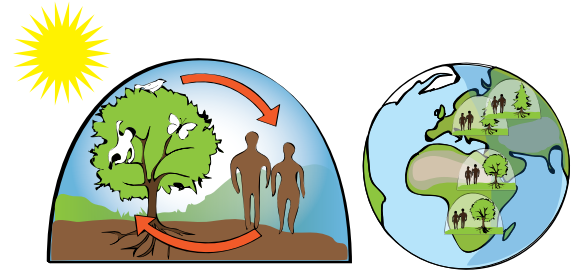
5. Look at the illustration to the right. Species within an ecosystem have two different "obligations". Write a short description about the relationship between the species and the ecosystem.



The Parts and The Whole

The ecosystem is the smallest functional unit that, with only solar energy, can recycle all the resources it needs. To “stay alive” the ecosystem is dependent on a close cooperation between many different specialized species. Their collaboration has to supply the ecosystem with a sufficient amount of energy and also recycle all necessary resources so efficiently that there will be basically no waste products.

1. Give examples of resources and waste products that are involved in the life processes of an ecosystem.



2. Identify three different ecosystems that can appear in the biosphere.

3. Why do you think that there are different ecosystems in the biosphere?

4. Give three good examples of how these different ecosystems contribute to the function of the biosphere.

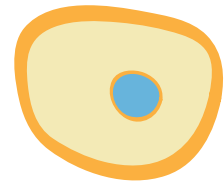
5. Look at the illustration to the right. Ecosystems within the biosphere have two different “obligations”. Write a short description of the relationship between the ecosystem and the biosphere.



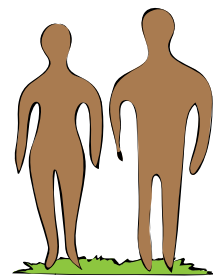
The Parts and The Whole

The health and wellbeing of all systems (cellular, organism, ecosystem and biosphere) is dependent upon certain optimal factors. These conditions are termed boundaries and at the global level they have recently been termed planetary boundaries.

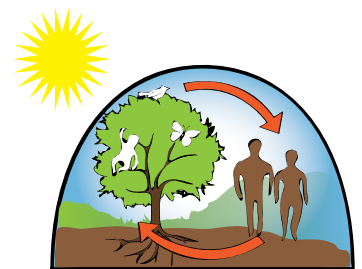
1. What are the optimal conditions of a cell in the human body?



2. What are the optimum conditions for a human being for survival?



3. What are the optimum conditions for sustainability of a natural ecosystem?



4. What are the optimum conditions for sustaining life on the Earth?



What are we Doing With Our Water?

Water in marriage

In Zulu tradition in South Africa, on the day of her traditional marriage, as one part of the ritual, a maiden is accompanied by a few relatives and friends to the river early in the morning for a bath in the free flowing waters. This bathing marks the end of a period of about three days preceding the ceremony when she stays inside the hut.

1. In what ways do your people use water?
2. Do people in your area still bath and wash in rivers, ponds or other water bodies?
3. Why do people bath in river water or do not bath in it?

Exploring the Environment for Water

Group 1, Task

Identify the sources and location of water in your study area. Draw a map to show your findings to the rest of the class. Use keys to indicate sources such as faucet/tap, river, pond, wells, puddles, bottles.

Group 1, Questions

- a. Describe what the water looks like.
- b. In which different forms and colours is it found?
- c. Where is it located?
- d. What is its quality and quantity?
- e. Is it free for everyone? Why or why not?

Group 2, Task

Identify uses of the water in your study area. Draw a map or poster to share your findings with the rest of the class.

Group 2, Questions

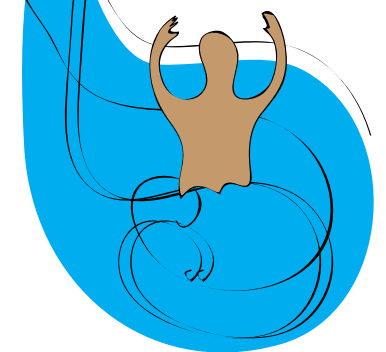
- Where is the water being used as a home for other living things?
Where is the water being used to maintain life?
Where is the water being used for cooling or heating?
Where is the water being used to grow plants?
Where did you find the water being used for other things? What are they?

Group 3, Task

Look for ways in which human activities are having negative or positive impacts on the quantity and/or quality of the water. Draw a map to show the location of these places and clearly indicate which are negative impacts and which are positive.

Group 3, Questions

1. What human activities did you identify as having a negative effect? Why?
2. Which human activities did you identify as having positive effects? Why?
3. What are the consequences of these human activities on other human beings?
4. What are the consequences of these human activities on other living things?



What are we Doing With Our Water?

Sharing Results

Working in the same groups as during the previous activity, each group is then asked to take its map, illustrations and notes and complete the following task.

Task 1: Summarise what you found

Use half the class session for your group to sit together and summarise your findings from the field experience. Describe what you saw? Group 1: sources of water. Group 2: uses of water. Group 3: positive and negative human activities.

What are the most important things that you learnt?

How do your findings affect people in a positive way?

How do your findings affect people in a negative way?

Task 2: Planning for plenary

Use the second half of the class session to plan a way to present your findings to the whole class. Each group will have a 10 minute presentation and 5 minutes for discussion. All group members should be involved in the presentation in some way. Develop visual aids to make your presentation interesting.



Fresh water 1%
Ice 2%
Salt water 97%

What are we Doing With Our Water?

Rising to Action: Plenary

Conserving valuable natural resources, such as water, means that we all need to take action, not only as individuals, but collectively. The challenge for each group is to share the results of their field study in a way that will raise the interest and concern of their audience to the level of wanting to take action to protect the existing natural sources and supplies of water, and to conserve and improve its use.

Task 1

Starting with Group 1, each Group gives its 10 minute presentation to the whole class, followed by a five minute period for questions and answers.

Task 2

After all three groups have presented, divide the class into 3 new small groups and give them at least 30 minutes to each identify an action project to be implemented by your class in the study area. Follow the Guidelines below to write an Action Project Plan for your project.

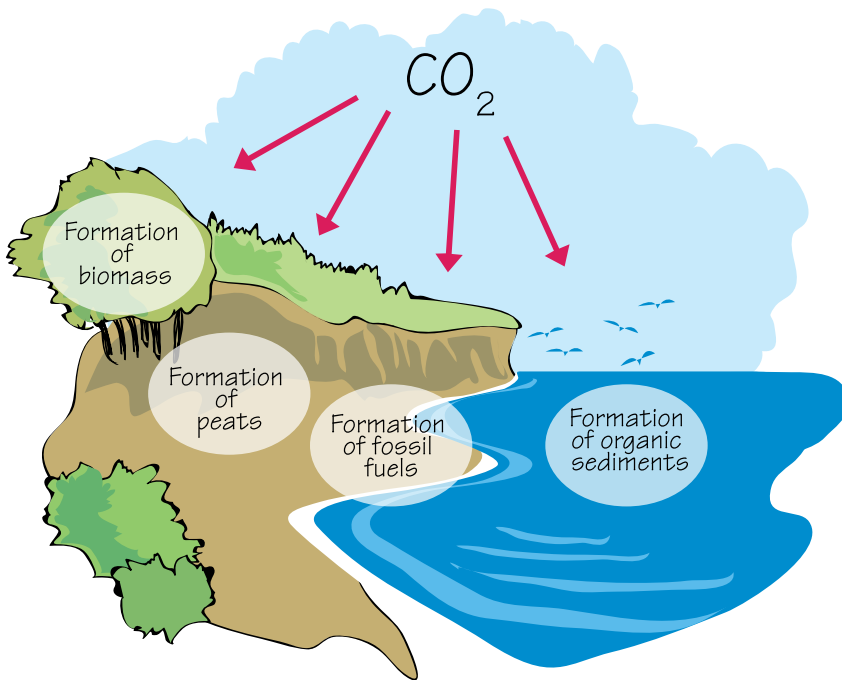
- Title.
- *Introduction*: What is the issue or problem? Provide the information which led you to take action.
- *Objectives*: List at least three things you wish to achieve.
- *Methodology*: List the action steps you will undertake to achieve each objective.
- *Resources*: What resources (manpower, financial, in-kind work, etc.) will you need? (Explain how the class can obtain the needed resources.)
- *Schedule*: Show when each action step will be taken (and who will be responsible for seeing that it is done well and on time).
- *Partnerships*: List possible partners in the community (e.g. a relevant non-governmental organization (NGO) or institution, company or individual).
- *Evaluation*: Explain how your action project will be evaluated and by whom.

Task 3: Assignment

Each group presents its Action Project Plan. The learners all have an opportunity to question and discuss each of the presented Plans. Learners will summarise the good points and suggest how this could be done to improve the situation. They can then form interest groups and write a letter to the Member of Parliament or local councillor offering their suggestions.

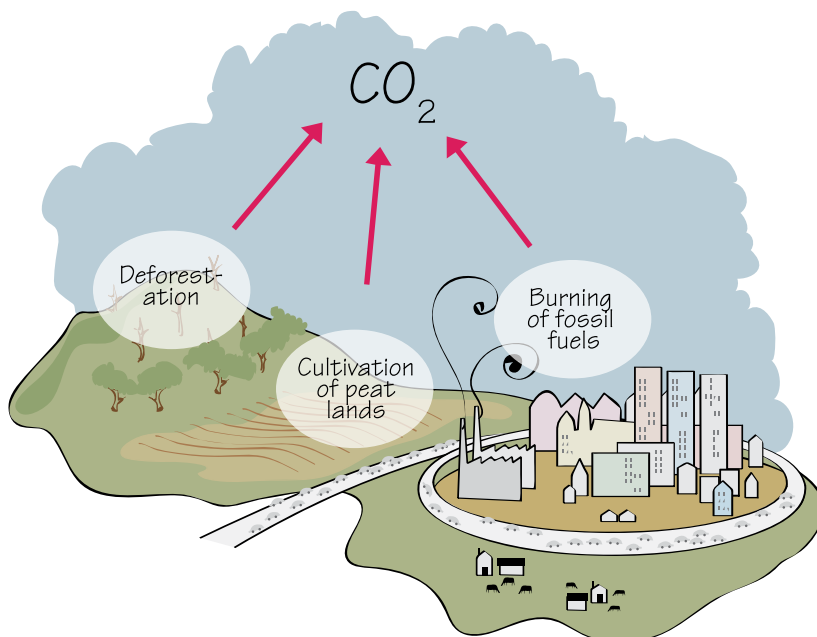
The Mystery of the Enclosed Garden

The Balance of Carbon Dioxide in the Atmosphere

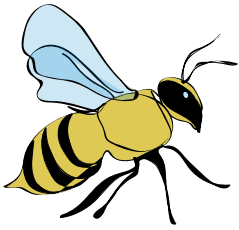


A. Explain how carbon dioxide is removed from our atmosphere (carbon sinks).

B. Explain how carbon dioxide is released into the atmosphere (carbon sources).



The Bee-Keeper's Story



In 2008 two Zimbabweans, Mr and Mrs Shumba, returned from the bank carrying a bag full of money, Z\$ 5 trillion in total. They had failed to buy maize-meal, sugar or cooking oil for the family as the foodstuffs were not available on the market. As Mr Shumba sat down and pondered what to do for his family, he remembered how his grandfather used to sustain his large family with honey from the African wild bees. Mr Shumba then made a decision to set up a bee-hive.

He was helped by Mr. Hove to make a hive using locally available resources. Mr Hove also asked for a bottle of honey, in return for his services and not money. After a while a swarm of bees had settled in the hive and before long, Mr Shumba managed to harvest the honey for his family. He relied on the harvesting skills which his grandfather had taught him. He used some herbs which he burnt to make the bees drowsy during harvesting. In addition to the honey, the community also noticed that an edible berry shrub which had not produced fruit for a long time was now full of berries and more bird species could now be seen in the area. At the beginning of the next rainy season, two other varieties of berries and other small fruits returned. Children could be seen chasing a variety of colourful butterflies which they had not seen before. The community also noticed that many children no longer suffered from frequent bouts of colds and coughs as in the past.

As the demand for honey increased Mr Shumba set up two more hives and started selling the surplus. He could now pay school fees for his children. One day he went to the city to seek market opportunities. The following morning his wife phoned him to say that all the bee-hives had been burnt as someone from the community had tried to harvest honey illegally. Mr Shumba was devastated by the loss and boarded the next bus to return home. As he sat in the bus on his long journey back home, he made up his mind that he was going to re-start the bee-keeping project and started planning the new strategies he was going to use to ensure the future sustainability of the project.

Whose bees were they?

Discuss the ownership and benefits of the bees.

As individuals learners write answers to the following questions:

1. What issues in the life story captured your attention?
2. Where do you think the bees came from?
3. Who is the owner of these bees?
4. What benefits did the bees provide to Mr Shumba and the environment?
5. Make a list of some developments in this local community as a result of the bee-keeping.
6. How much do you think the bees are worth in economic terms? And to whom?

In groups of four, discuss your answers and write your summary on flip charts. You should be able to group the issues into ecological, social and economic benefits



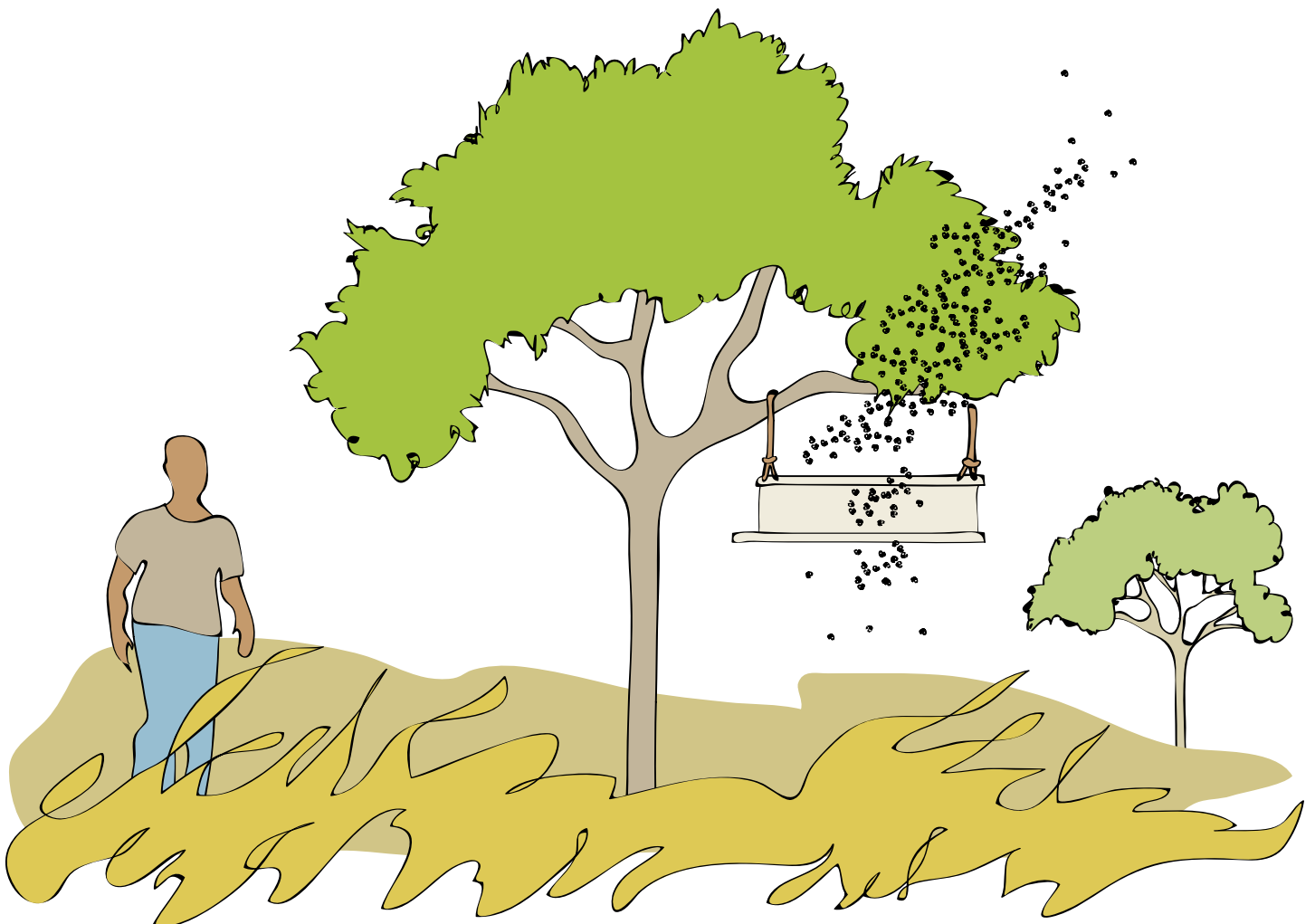
The Bee-Keeper's Story

What went wrong?

Discuss the following questions in groups of four.

1. Why do you think the neighbour burnt the bees?
2. How do you think the neighbour should be treated if he gets caught?
3. How did burning the bees affect Mr Sumba's family, the community, the illegal harvester and the natural environment?
4. Why do you think Mr Shumba felt encouraged to go home and re-start the bee-keeping project?
5. Suggest new strategies for Mr Shumba. How can we use this to build a sustainable community?

As a group suggest a community plan for sustainable bee-keeping.
Present your plan to the class and display it on a flip chart.



The Bee-Keeper's Story

Assignment

In groups of four, show how we can deal with community misunderstandings about the environment.

Using examples from other ecosystem services:

- How could you apply the strategies discussed above to new situations in our society today?
- How can the management of an ecosystem service support sustainable community livelihoods?

You will need to do more research for this exercise. Present your work on a flip chart, as a poster or write an essay.

The Happy Planet

Personal Needs for Survival

Activity 1

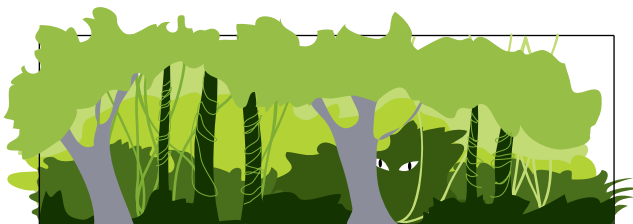
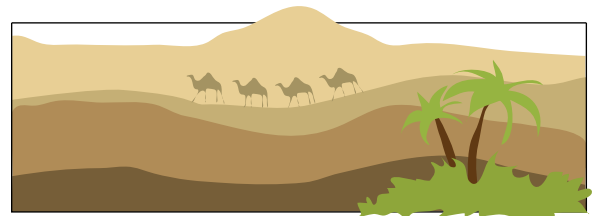
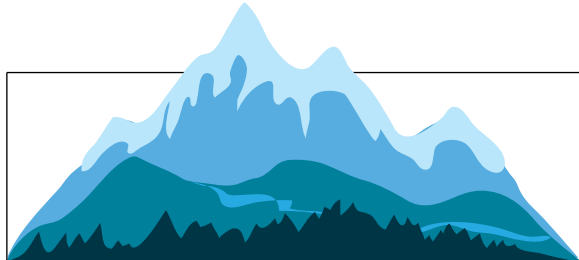
Go outside the classroom and think about what you used this morning to keep you alive, with the help of what you see, hear, smell or feel around you. List down these vital resources.

In pairs, select and list four resources from the above list which you agree to be the most critical ones for you to survive and for each resource, explain what you need it for in your life.

1 2

3 4

Identify the common, life-sustaining resources in different places using the following pictures.



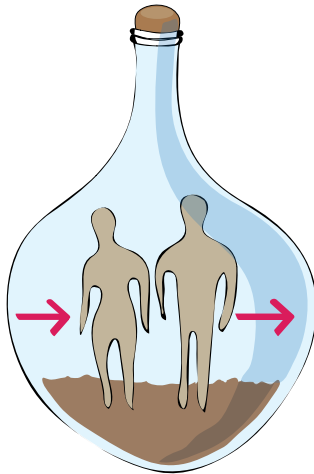
Who do you think is the owner of these life-sustaining resources?

These are some of the life-sustaining resources, also referred to as “the global commons”. They come from nature and provide non-negotiable “ecosystem services”.

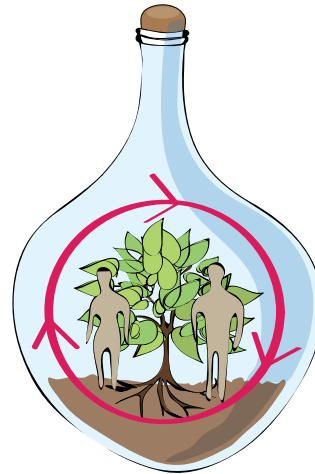
The Happy Planet

Understanding Personal Boundaries

Activity 2



A. Linear flow



B. Recycling

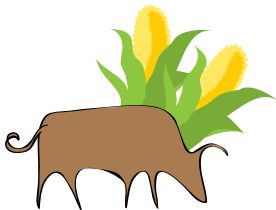
Explain what you think may happen to an individual in each bottle in terms of the life-supporting systems such as:



Water.....
.....
.....



Air.....
.....
.....



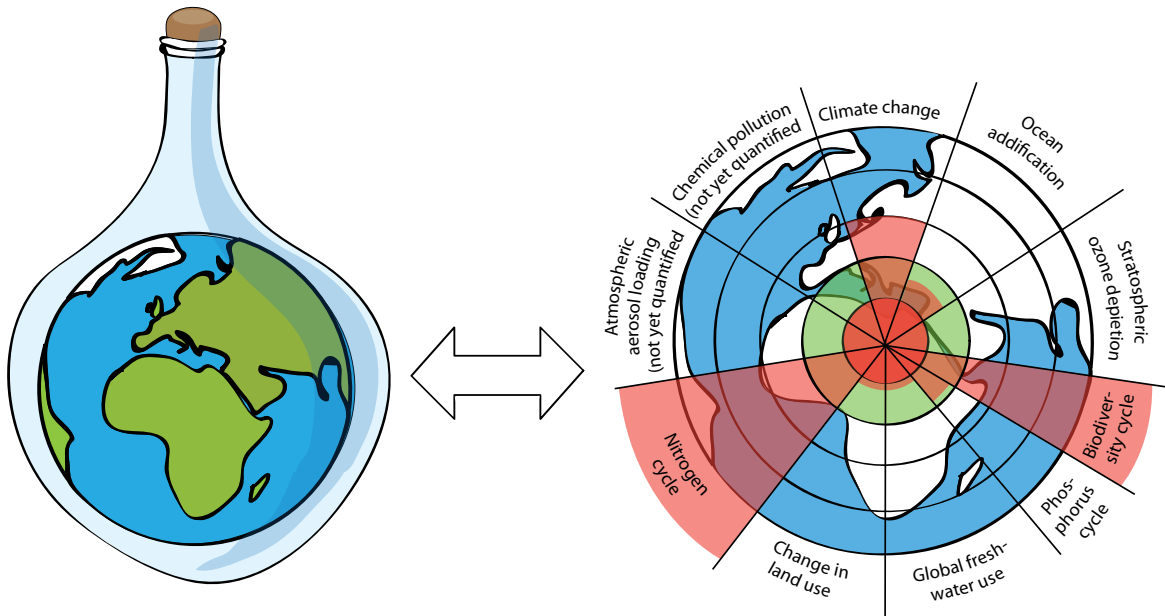
Food.....
.....
.....



Energy.....
.....
.....

Your responses show that there are limits or boundaries as to what can be reached in the usage of these available resources at a local scale.

Activity 3



If the Earth was put in a bottle, the red segments show the boundaries we have already surpassed.

Suggest some of the social and economic activities that have led to the development of the situations in the red segments:

Biodiversity loss

.....

.....

.....

Climate change

.....

.....

.....

Nitrogen loading

.....

.....

.....

The Happy Planet

Activity 4

Read the following evidence-based story which inspires hope.

Beyond Deforestation – Restoring Forests and Ecosystem Services

Despite continued forest conversion and degradation, forest cover is increasing in many countries across the globe. New forests are regenerating on former agricultural land, and forest plantations are being established for commercial and restoration purposes. Plantations and restored forests can improve ecosystem services and enhance biodiversity conservation, but will not match the composition and structure of the original forest cover. Approaches to restoring forest ecosystems depend strongly on levels of forest and soil

degradation, residual vegetation, and desired restoration outcomes. Opportunities abound to combine ambitious forest restoration and regeneration goals with sustainable rural livelihoods and community participation. New forests will require adaptive management as dynamic, resilient systems that can withstand stresses of climate change, habitat fragmentation, and other anthropogenic effects.

Source: Chazdon, R.L.2008. in www.sciencemag.org/content/320/5882/1458

There has also been a remarkable reduction in ozone layer depletion, which shows that it is possible to restore the life-sustaining systems and ecosystem services.

Explain how the ozone layer is being restored.

Suggest how you as an individual, your school, family or community can reduce biodiversity loss.

Other activities we can do in our communities as part of our commitment to taking environmental action

The following are highlights of how some communities have engaged in practices that have reversed the tragedy of the commons to a healthy, life-sustaining planet. A series of 12 Handprint booklets has been developed through the CAPE Capacity Development Programme as a resource for educationists to guide Action Towards Sustainability. Copies of the booklets can be obtained through ShareNet and they cover a range of topics which include: Re-using shower and bath water, Bees, Carbon Sequestration, Greens, Invasives, Springs, Disappearing river, Garden Design, Waste, Worming, Mother-tree-Seedlings and Rooibos. These can also be downloaded from www.capeaction.org.za.

Activity 5

As learners, you can ask your teacher to help you start engaging in school-based environmental projects as guided by the Hand-Prints series or any other projects appropriate to your school situation. You could initiate the project as a class, but it could gradually become a whole school activity to demonstrate strong sustainability and agency.

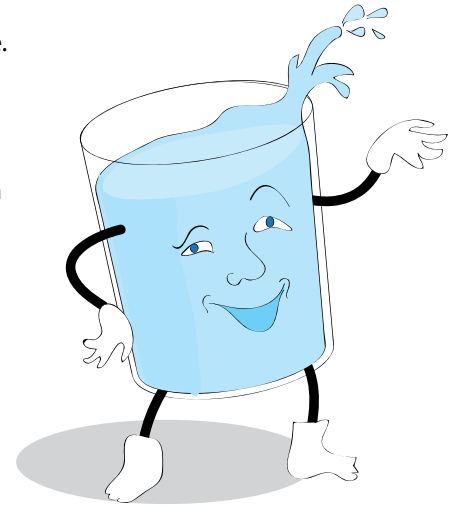
The Story of the Invisible Water

In this story there are two actors – **Tim a young school boy (T)** and a **Glass of water (W)**. The dialog between the actors will be interrupted by a number of exercises when the audience discusses or reacts to certain parts of the dialog. The first exercise will be done before the dialog starts as a preparation for the performance.

Exercise 1 (Worksheet 1)

When we start our story the schoolboy Tim is eating breakfast, chatting with his mother. Tim asks for water and his mother hands him two litres in a jug asking him if it is enough. Tim answers, looking into the glass of water he just filled up:

- T:** I think two litres would be enough for a whole day!
W: Two litres is not enough for a whole day!
T: Stop that! You are a glass of water and you should not talk to me!
W: Yes I am a glass of water but in this story I won't keep quite! As being water I am tired of being treated like air. Two litres is maybe what you drink as pure water, but there is so much water in your life that is invisible. How much of me do you think one person needs?



Exercise 2 (Worksheet 1)

We come back to the story when Tim counts and guesses how much water he uses daily:

- T:** Hmm... If I include the water in a couple of cups of tea, not more than 3 litres anyway!
W: Well, well, but you don't use me only for drinking, do you?
T: No, of course, if I count taking a shower and washing my clothes and all the other problems that water can solve in my life maybe a hundred litres per day.
W: Not a bad guess, but many people use 500 litres per day. But we are still only talking about water coming home through a tap of some kind. But don't forget that the water you use is mostly invisible!
T: (irritated) Yes, I know that water can boil or evaporate and become invisible steam, but personally I don't use that form of water!
W: Cool down. Let me ask you a question: How much of me is used to make a slice of toast?
T: (laughing) Aha, a trick question! When you toast bread you take water away from it. That's why it gets so hard!
W: You're right, Tim, but listen, here's the really invisible water in the bread: When the wheat in that bread was a plant it needed a lot of water. Water was also needed to treat the grain, bake and pack the bread. So every slice needed 40 litres of water before it reached your plate.
T: (protesting) It still tasted quite dry!
W: This invisible water sure is tasteless as well as invisible, but it's very real. And it's the same thing for one apple: 70 litres. Or a cup of coffee: 140 litres.
T: Wow, that's more water than I thought I used during the whole day, just for one cup of coffee ...!

W: And then we haven't talked about meat. One portion of bacon needs 480 litres of water. So in total a typical so-called English breakfast uses 1100 litres of water. Imagine first one bathtub of water and then two more, and there it is: the water needed for one typical breakfast in an industrialised country. Most of it is for the meat. Meat is the biggest single source of water consumption. A non-vegetarian in a western country consumes 15 bathtubs of water every day just to keep himself not thirsty and not hungry. A vegetarian uses half of that.

T: But what about in other parts of the world? In India for example?

W: In India a breakfast needs 300 litres instead of 1100 litres, about one fourth. In China they use 600 litres, half of the western breakfast. In Africa less water is used. Water and money seems to flow in the same direction.

Exercise 3 (Worksheet 1)

Exercise 4 (Worksheet 2)

We come back to the story as Tim slowly realizes how much water we use:

T: I slowly realize that we really need a lot of water. Do we have enough?

W: (boasting) Yes, Mother Nature is very generous with water. Why is the planet called The Earth, anyway? It should be called "The Water" or rather "The Ocean", because more than 97 % of the me is salty, and you humans don't have much use for seawater. And of the remaining fresh water most of it is too dirty to be useful.

T: But I have seen fresh new rain coming down in most places again and again! And water wells are almost everywhere.

W: Yes, the planet receives a one meter thick blanket of water from the sky every year. About half of this meter evaporates back to the atmosphere, some of it after having done a very important work in the plants. And ...

T: Stop it! Stop before you drown me in figures! Dear glass of water, what do you think, how could we make water last for everyone?

W: Well, Tim, if there is going to be enough water for all humans and all the others who need me, you must learn to understand me beneath the surface so to say. I mean: How do you humans get the water? What is water doing between the cloud and the egg? Try to see how I move all the time. Water is moving up and down. You know how desperately water wants to go downwards. I'm almost unstoppable when it comes to that. And then the sun and the trees lift me up again.

T: But you move sideways also, in the clouds blowing around.

W: Yes, and you humans, you have also always moved sideways – towards me, because you are smart and want to live. But you haven't quite understood how I move. It didn't matter hundred years ago that people didn't know that one kg of wheat needed 1000 liters of water. Did you know that a two gram computer micro chip needs 32 liters of water? But now you humans must understand this, because you now have so many people craving so much invisible water. Tim, not only computer games have virtual things. A loaf of bread contains virtual water. Isn't that amazing, one kg of bread contains much more water than one kg of water itself! So Tim: Here is your question again: How could you make the water last for everybody in the future!

End of the story

Exercise 5 (Worksheet 2)

Exercise 6 (Worksheet 3)

The Story of the Invisible Water

These exercises should be done partly in a group, and partly by yourself. Inspiration and some background information will be presented in the role play *"The story of the invisible water"*. Other necessary facts and tasks will be presented by your teacher in the following lessons.

1. Water content I

Which of these objects contains most water?

Discuss in groups and motivate your answer:

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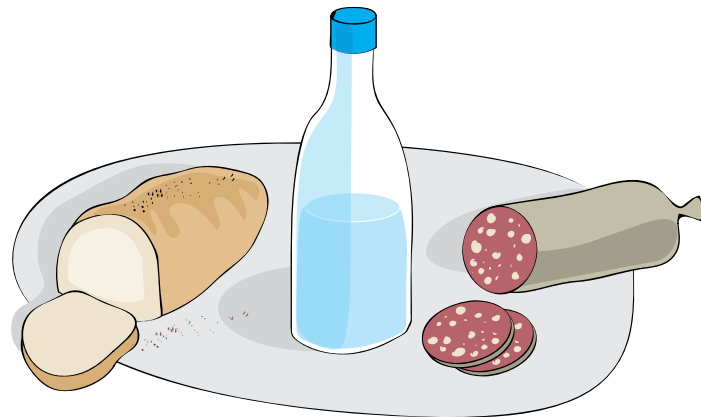
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2. Your daily water Work in groups

How much water per person do you use in your group per day?

Make a list, sum up the volume and share with the class before the story continues.

Purpose	Amount of water	Purpose	Amount of water
.....
.....
.....
.....
		Total sum

3. Water content II Short group discussion:

a. In the story they speak about invisible or virtual water. Explain the world virtual water!

.....

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.....

b. After having heard the second part of the story:

Which item from Exercise 1 contains most water? Explain!

.....

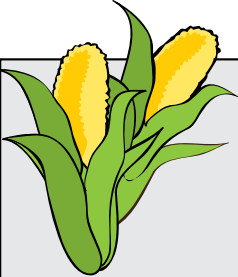
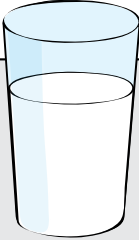
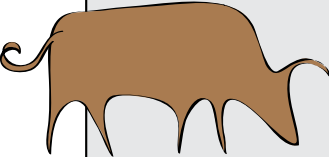

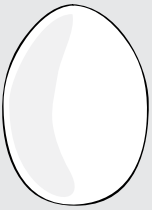

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The Story of the Invisible Water

4. Virtual water in different products

- Guess the amount of virtual water in the products below.
- Compare your guesses with some of the guesses of your classmates.
- Add the correct answers from your teacher (www.virtualwater.eu).

	My guess	Correct answer		My guess	Correct answer
					
					
					

d. Personal comments.

.....

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5. A water lean meal

You need appropriate statistics from your teacher or connection to the Internet.

- Put together a good and nutritious dinner with a small water footprint.
- Compare your results with your classmates.

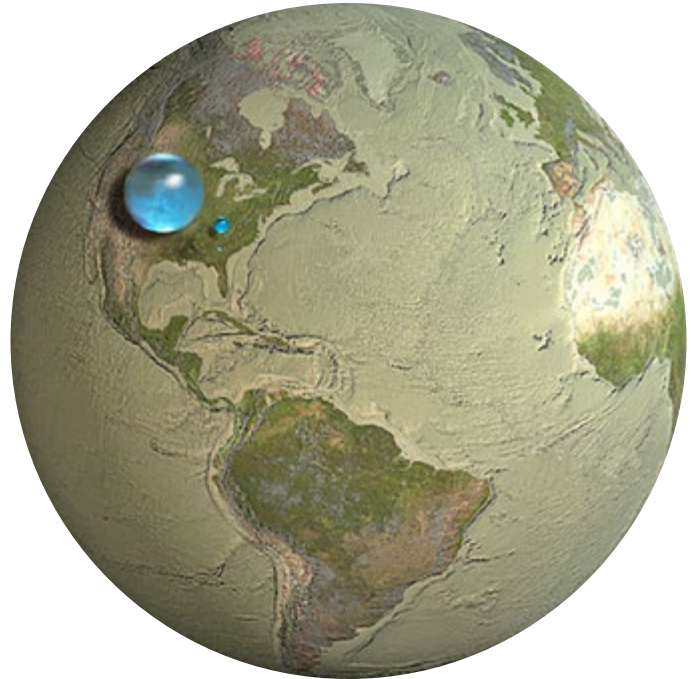
Valuable links:
www.waterfootprint.org
www.virtualwater.eu

The Story of the Invisible Water

6. Water for everyone

Write a short newspaper article or make a small poster exhibition under the heading "A fair and sustainable use of our common water!"

- Work in groups of 2–3 persons.
- Decide on the target group of your article or exhibition.
- Discuss how to adapt your material to the target group.
- Use the illustrations below for your inspiration and bring in other facts, figures and concepts you have learned during this course.



The largest sphere represents all water on, in, and above the Earth.

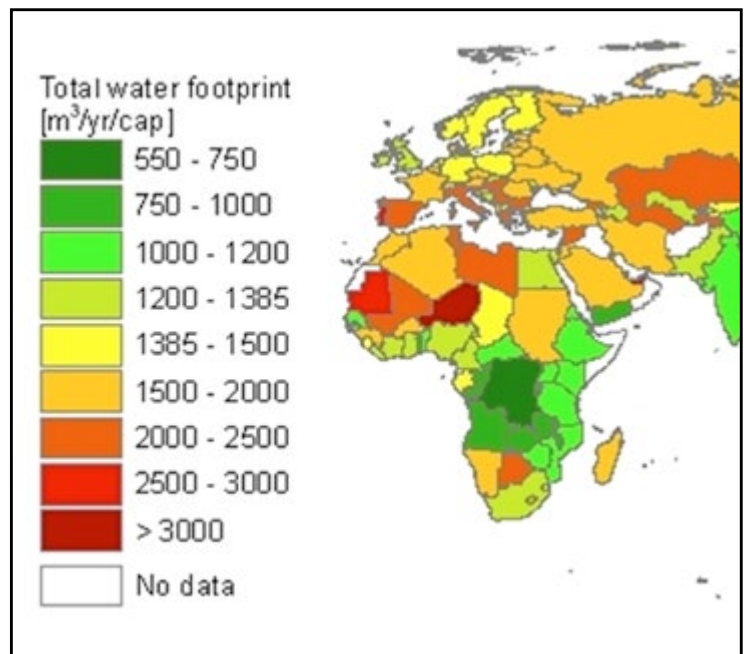
The smaller sphere represents Earth's total liquid fresh water.

The smallest sphere represents all available fresh water in lakes and rivers.

The map shows the average national water footprint in m³ per year per capita in the period 1996–2005.

Countries shown in green have a water footprint that is smaller than the global average.

Countries shown in yellow-red have a water footprint larger than the global average.



Valuable links:
www.waterfootprint.org
www.virtualwater.eu

Sources

The Water in and above Earth: Howard Perlan, USGS. Jack Cook, Woods Hole Oceanographic Institution Data source: Igor Shiklomanov, 1993. <http://ga.water.usgs.gov/edu/earthhowmuch.html>.

Average Water Footprint: Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: the green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No.50, UNESCO-IHE, Delft, the Netherlands.

Myths and Legends

Example 1 and 2 below are mythical stories that were common in some African customs. Discuss and answer the questions.

Example 1

In Zimbabwe, there is a tree that was believed to be able to provide food if elders went under its shade and asked for food in times of need. The food would be provided by the gods at the base of the tree. Traditionally the cutting down of that sacred tree was therefore prohibited. Have you heard of similar stories from your area?

Example 2

In Malawi, killing a leopard was only authorized by the chief of the area. Anyone found killing it would be punished by the chief by banishing him from the area. If an exception was made, then the skin of the leopard was confiscated by the chief.

To discuss the questions below, consider people's respect for traditional stories and their values, myths and how they promote biodiversity and ecosystem services.

Discussion

1. Using the information provided in the story, one could argue that there are no ecosystem services in this story.

a. Do you agree with this view or not?

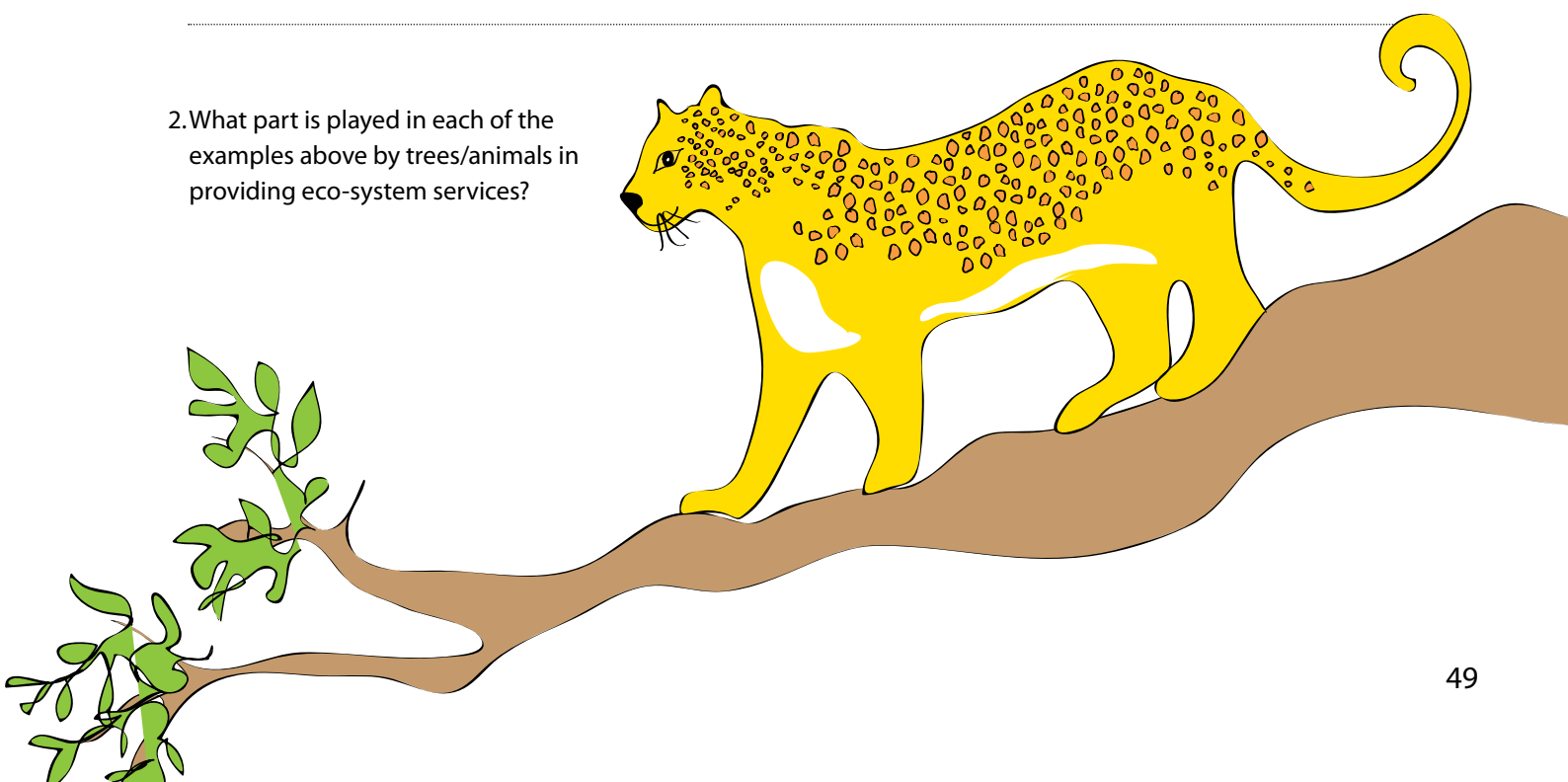
b. Give reasons for your opinions. You should support your answer with examples from your community/country wherever possible.

.....

.....

.....

2. What part is played in each of the examples above by trees/animals in providing eco-system services?

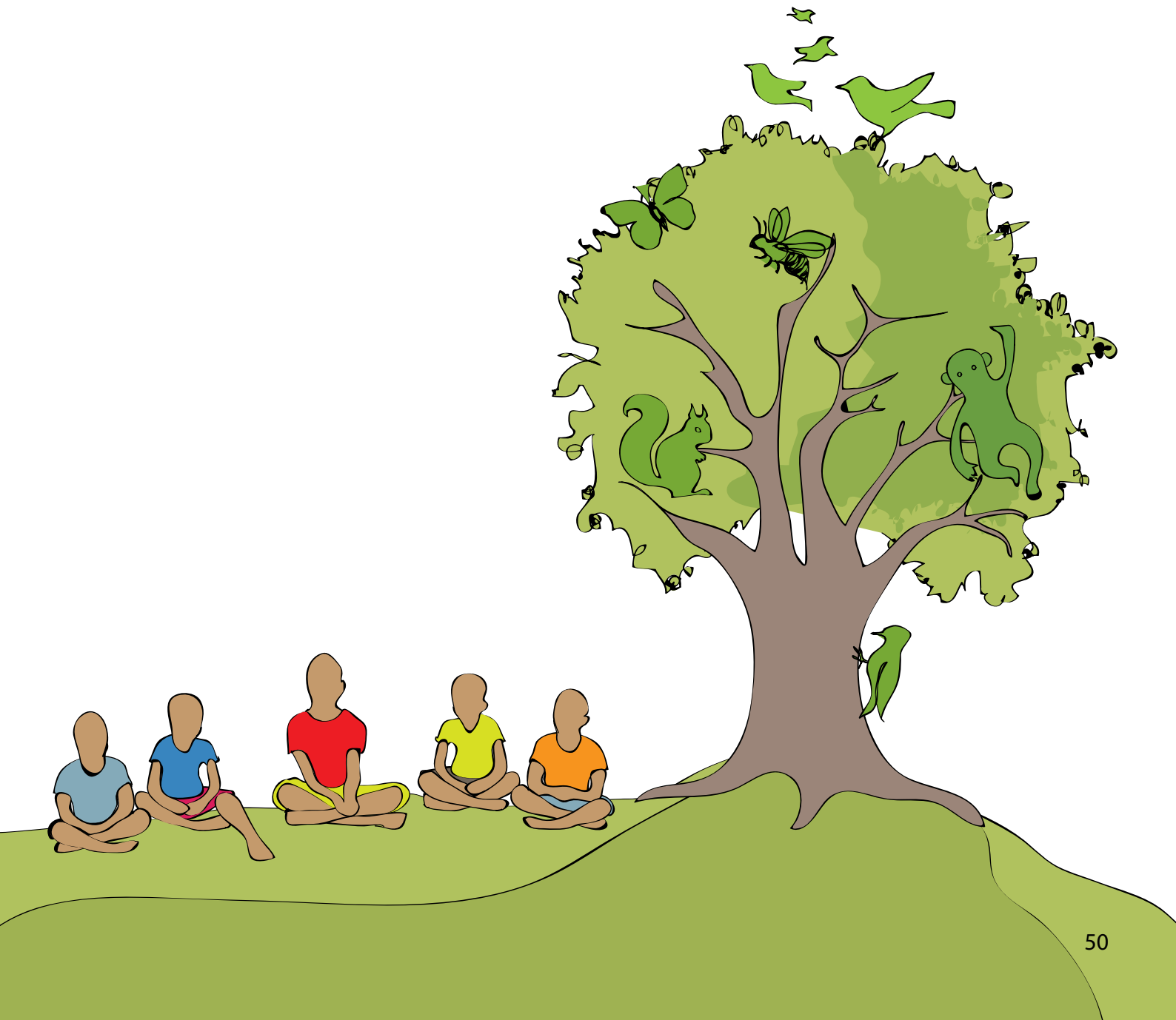


Role of Indigenous Knowledge

Discussion

Some people argue that there is a clash between modern thinking and indigenous knowledge which no longer holds the same respect it used to.

1. What role can indigenous knowledge play in the conservation of natural resources?
2. What role can you play towards the conservation of biodiversity?
3. Using modern ideas and your experiences in life, create a story and a myth that promote conservation of natural resources.
4. How can we actively engage everyone in biodiversity conservation?



Myths and Legends

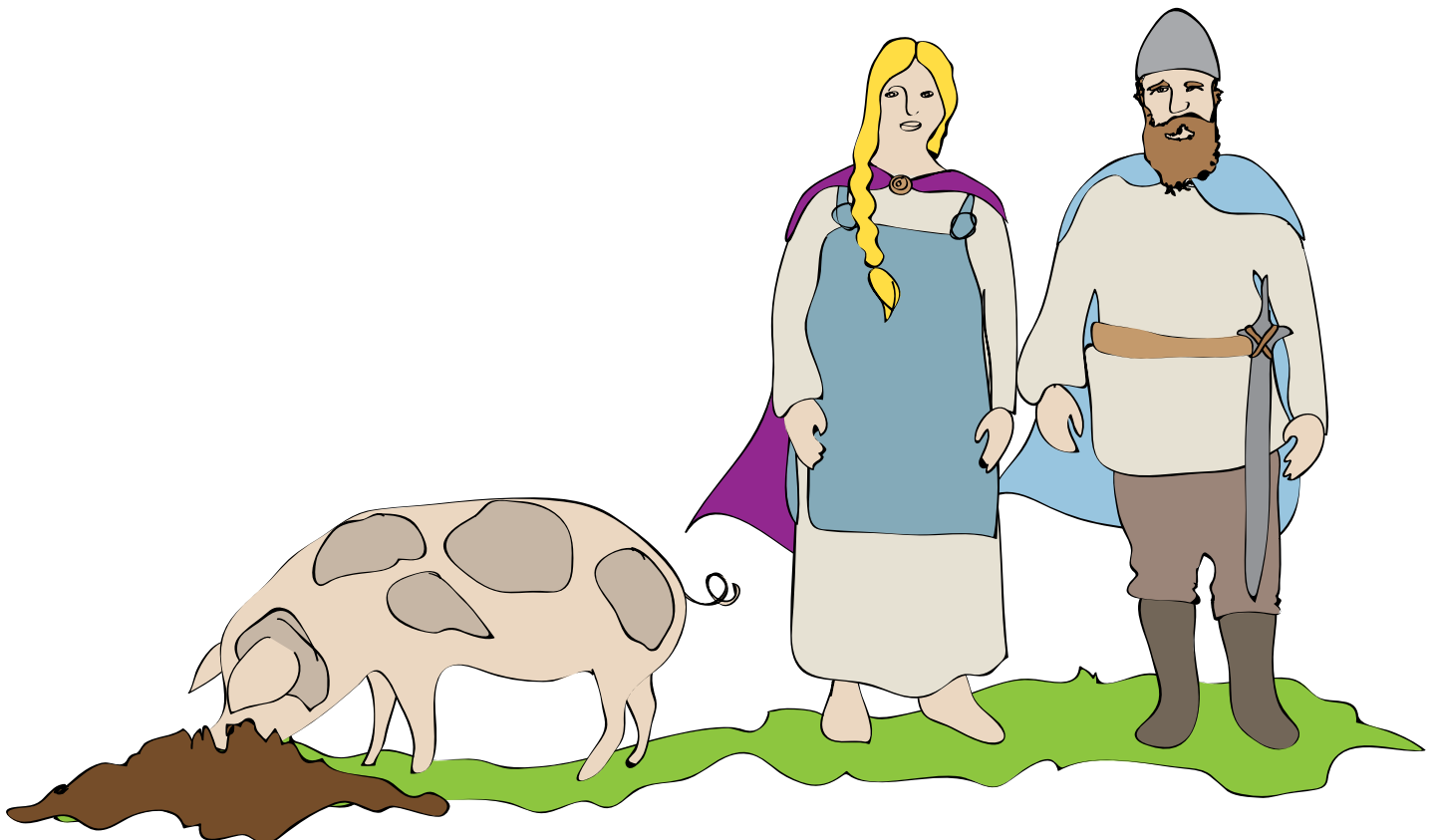
Sharing old stories

Discussion and writing

Legend in Sweden

The Vikings dominated the Northern countries in the 8th century. They believed in the Asa gods as part of their religion. The Vikings were a warrior society and if you died fighting you came to Valhalla where all the gods lived. In Valhalla they had a big feast every evening where they feasted on a pig. After they finished the pig meat they collected all the bones and put them in a leather bag. The next day the pig would resurrect. One evening one of the Vikings broke the bones of the pig and ate the marrow. As result of this, the next day the pig was not resurrected.

1. What sustainability lessons can we pick from this story?
 - a. Think of other stories that you have heard. Share your story with the rest of the group/class.
 - b. What is the link between the story and sustainability?
2. Using modern ideas and your experiences in life, create a story and a myth that promotes conservation of natural resources.



The Enviro Meal

– Instructions for Learners

Your team must plan and prepare a meal, which you will eat together. You will need to purchase all of the ingredients you need for the meal with the money provided by your teacher. Afterwards, your meal will be audited to assess its environmental impacts, in terms of food types and packaging. The Enviro Meal audit sheet will be used to assess these impacts. Your team's final score represents the impact of your meal on the environment. The higher the score, the greater the impact.

Activity 1 – Planning an Enviro Meal

Planning the meal: Your team has about 20 minutes to plan your meal. If your group is more than six people select four members to do the shopping.

Shopping: Allow at least an hour for the shopping. Most of the challenges and difficult choices in this activity will be experienced while shopping.

Cooking and eating the meal: Return to base and prepare the meal. Set the tables and decorate them. Enjoy the meal together and taste the food prepared by the other teams.

Activity 2 – Auditing the Enviro Meal

Auditing the waste: In your group categorize the waste you have collected in the box. Sort it into various packaging types for recycling. You will then need to explain why you have sorted the waste in such a way.

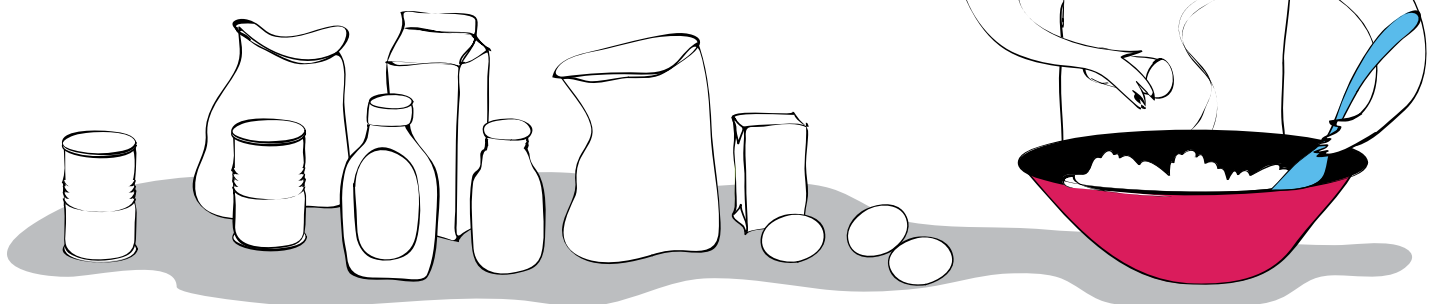
Auditing the meal: Each team should audit their meal using the Enviro Meal audit sheet.

- On the Enviro Meal audit sheet, list each item purchased and its price.
- Calculate how much money was spent and how much was left over.
- Separate the packaging into types, according to the Enviro Meal score sheet. Count how many pieces of each type of packaging are present. For example if a team has two soft plastic bags, it will accumulate packaging points for each of the two items. Calculate a subtotal for packaging.
- Identify the food types present. Calculate a subtotal for food types.
- Calculate a final score and interpret it using the Enviro Meal scale.

Reporting and consolidating: Ask each team to present their score and to explain why they got the score they did. Discuss the activity and the learning that has taken place. Having gone through the activity, what could be done differently and improved to reduce your score?

Enviro Meal scale

- 10–40 Sustainable consumption
- 41–60 Just above sustainable consumption – need to make changes
- Over 60 Highly unsustainable – in need of radical change



DISTANCE TRAVELED	Score	OVERSPENT	Score	PACKAGING	Score	FOOD TYPE	Score	LOCAL/ NATIONAL /IMPORTED	Score
How far and by what means did you travel to the shop to purchase your items?		\$ 3 multiplied by the number of people in your group. Have you overspent?		What kind of packaging is on your purchases? You need to count each package e.g. 3 plastic bags = 3 x 4		What kind of food have you bought?		Where does your food come from? How far has it traveled to the shop?	
Walked	0	Under budget	0	No packaging at all	0	Homegrown in your own garden	0	Home grown	0
Cycled	0.5	Up to \$ 50 cents over	1	Returnable glass bottle	1	Vegetables, fruit salad, pure fruit juice	1	Local. This item was obtained from an area less than 30 km away	3
By car – 1 km	1	\$ 50 cents to \$ 1,00 over	2	Discard bottle	2	Bread, rice, pasta, maize meal, tea, coffee, milk	2	National. This item was obtained from an area more than 30 km away but still in the country	10
By car – 2 km	2	\$ 1,00 to \$ 1,50 over	3	Paper, cardboard, tin	3	Mixed juice	3	Imported. This item was imported from another country	30
By car – 3 km	3	\$ 1,50 to \$ 2,00 over	4	Composite packaging, aluminium can, soft plastic	4	Chicken, fish, tins, custard, ice-cream	4		
By car – 4 km	4	\$ 2,00 over	5	Hard plastic	5	Red meat, alcohol, fizzy drinks	5		
By car – 5 km	5								
By car – 6 km	6								

Activity 3 – Debriefing the Enviro Meal activity

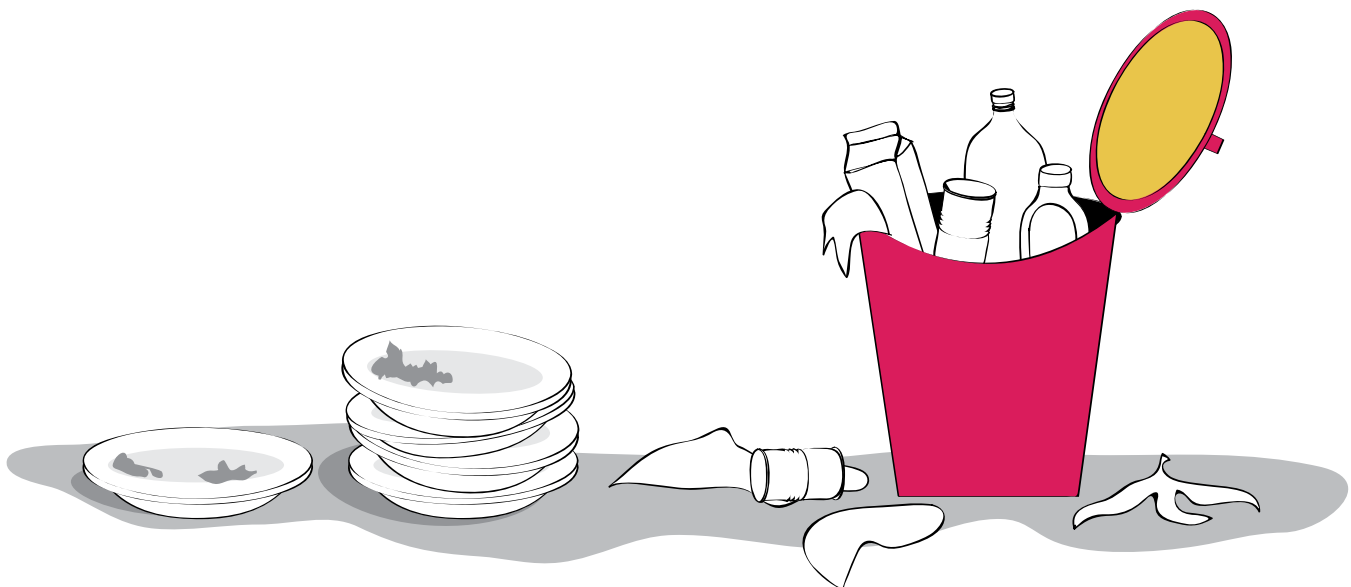
Main discussion question:

- What could you have done to reduce your score in this activity?
- If you could do the Enviro Meal again, would you do it differently?
- What influenced the decisions you made as a group?
- Did you stick to your original plan? If not, why not?
- Did the options available at the shop make it easy for you to make environmentally-friendly choices?
- Who do you think is responsible for limiting our options in this way?
- What do you think of the scoring system in the audit sheet?
- What aspects of the audit sheet would you like to change?
- Your environmental impacts have been audited using someone else’s value system. How does this make you feel?
- Do you agree with the way this activity interpreted your environmental impacts as a consumer?
- Are there other environmental impacts, which the activity does not consider?
- What can you do, in your own life, to reduce your environmental impacts as a consumer?
- What will happen to the packaging and leftover food after this activity?
- Why is it important to consider how the food is farmed (organic or not) or whether it is fair trade or not?

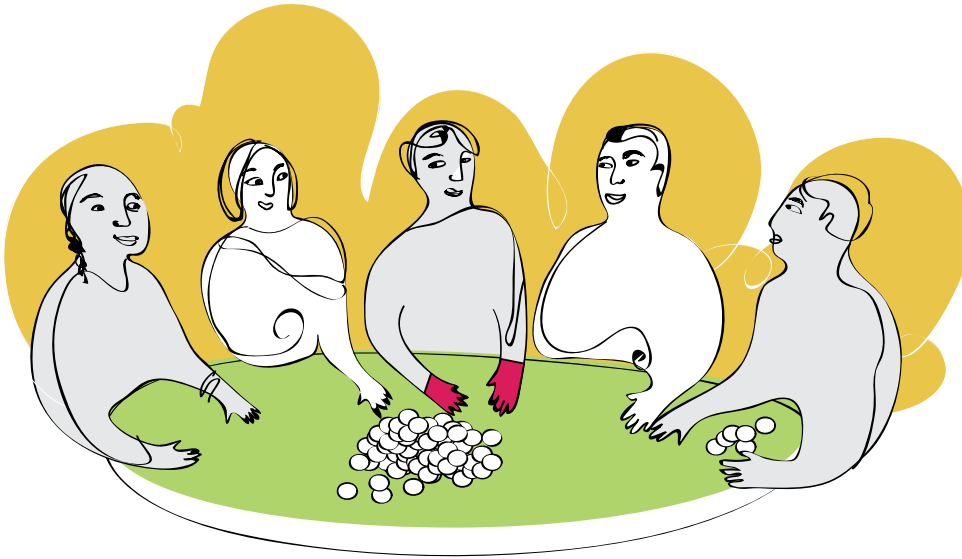
Writing

Write a short essay expressing your opinion on the following:

- How does the activity help to explain the relationship between our food choices and their impact on the environment?
- How can our meal choices help our efforts to achieve strong sustainability?



The Scramble



The world's wealth is represented by the 100 coins or tokens.

Participants stand or sit in a circle. To begin with two participants will wear gloves, two will have only one free hand and one already has 5 coins. When you have told them to start, they gather as many coins/tokens as possible. There is only one rule – no learner may touch another member of the group at any time.

- 1** When the teacher tells you to start, gather as many coins/tokens as you can without touching another person.
- 2** Count your coins and write the number down.
- 3** Choose your group by checking (X).
If you have more than 13 coins – check Group 1; between 6 and 12 coins check Group 2 and less than 5 coins check Group 3.



More than 13 coins



6–12 coins



Less than 5 coins

.....

- 4** Form your group.



Great wealth and power
(GWP)



Some wealth and power
(SWP)



Little wealth and power
(LWP)

.....

Creating Economic “Fairness”

Do you think you had a fair share? Create a plan in your group for the fair distribution of the coins/tokens for the whole class (the world’s wealth). Describe your plan and explain what needs to be done.

Say why your group’s plan is fair.

Appoint a spokesperson to explain your group’s plan to the others and answer questions from the other groups.

Voting

My group is



I am voting for
this plan



Plan



Plan



Plan

Use the ballot paper to decide which plan wins the vote.
Give a reason why this plan won the vote.

Ballot Paper

My group is



.....



.....



.....

I voted for this plan



Plan

.....



Plan

.....



Plan

.....

Vote calculation

You will now do a calculation of the votes. The following will apply in order to choose the highest rank plan from voting results:

1. participants in **Group 1** have **five (5)** votes each,
2. those in **Group 2** have **two votes (2)** each, and
3. those in **Group 3** have **one-half (1/2)** vote each.

Group 1 plan	No of votes from	Strength of vote
	Group 1	x 5 =
	Group 2	x 2 =
	Group 3	x 0.5 =

Total votes for Group 1 plan

	Group 1	x 5 =
	Group 2	x 2 =
	Group 3	x 0.5 =

Total votes for Group 2 plan

	Group 1	x 5 =
	Group 2	x 2 =
	Group 3	x 0.5 =

Total votes for Group 3 plan

Which plan has won this vote? This is the plan that will be carried out.

Debriefing the Activity

Draw on the following questions to prepare for a productive discussion. Make sure you are prepared for a discussion of changes needed and changes undertaken.

- ⊗ How do inequalities of distribution relate to other current issues like environmental destruction?
- ⊗ Is there a connection between fairness and sustainability?
- ⊗ What aspects of this game represent how the world's wealth and power are distributed?
- ⊗ Some participants were wearing gloves, others had only one free hand and one person already had 5 coins. How does this game help a better understanding of the situation or attitude of poor people/nations? Of the situation or attitude of wealthy people/nations?
- ⊗ Why were some people given more votes than others? Was this an accurate representation of those with more or less power in the world?
- ⊗ Who are the "haves" and the "have nots" in the world today? Which countries are the "haves" and the "have nots"? Who are the "haves" and "have nots" in our country today? In our state or community? Why?
- ⊗ Why should the "haves" be concerned about the situation of the "have nots?" For what reasons? Economic? Moral/religious? Political? Why might the "haves" give money or resources to the "have nots"? Is this a way to solve the problems of poverty?
- ⊗ Do you think there should be a redistribution of wealth and power throughout the world? Why or why not? If yes, how would you propose to accomplish this? What principles would guide your proposals for change?

Writing

Write a short essay with the title "How fairness in resource distribution can help to achieve sustainability?" to express your opinion on the distribution of wealth and power in your country or in the world.

You may want to consider the following to guide you:

- ⊗ What is economic fairness to you?
- ⊗ Describe how you felt about the relative position you achieved in the activity.
- ⊗ Are there responsibilities associated with having wealth and power?
- ⊗ How do wealth and power affect one's ability to enjoy human rights and human dignity?
- ⊗ Should poor countries pay back their debts? What would happen if they did not have to pay them back?

Group discussion and poster design

In groups of four learners discuss the question: What is the connection between fairness and sustainability? Then each group designs a poster.

Chocolate, Slavery and Fair Trade

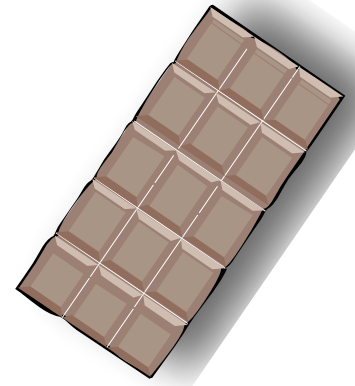
Where does our Money Go?

Activity 1

Stakeholder shares of a 20 square chocolate bar

The price we pay in the shop for a bar of chocolate is divided into something like the table below. If the 20 square chocolate bar represents where our money goes, how many blocks do each of the following groups receive?

Group	Percentage	Chocolate blocks
Shops		
Chocolate companies		
Government (VAT)		
Non-cocoa ingredients and costs		
Cocoa Farmers		



Convert the table to a pie chart to show where our money goes when we buy chocolate, and what percentages go to each group. Add more information to each segment to explain what it does, e.g. Shops – pays wages to shop workers. Use a separate paper for the pie chart.

Who decides the chocolate stakeholder shares and why?

Can you think of three reasons why the percentage paid to farmers for their cocoa beans is so low?

Chocolate, Slavery and Fair Trade

Social and Ecological Impacts

Use these lines for your notes and write your answers on a separate paper.

Activity 2

Social impact

1. Describe at least two social consequences resulting from farmers being paid so little for their cocoa beans?

2. Many cocoa farmers and their children have never eaten chocolate. What is your comment?

Slavery

3. There are even some cocoa farm workers who are not paid at all for their work. A worker who is not paid is called a slave. Slaves on cocoa farms are often children, brought to work far from their homes and families. Describe what you think about this.

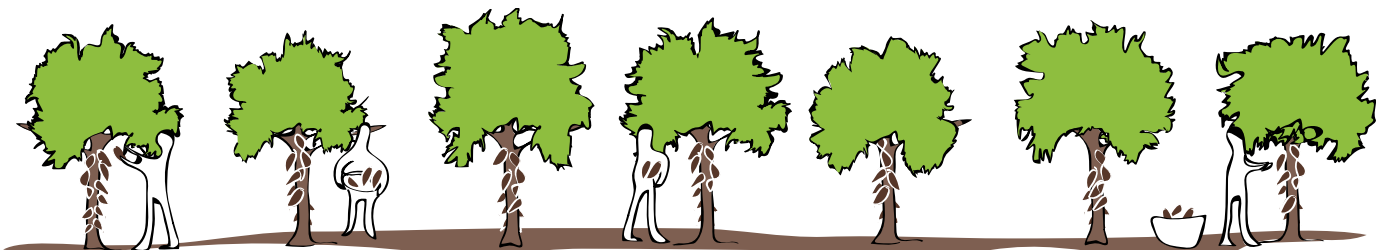
Ecological impact. Monoculture and deforestation.

4. Another problem that can happen with cocoa farming is that the forest gets cut down to grow more cocoa to sell. Sometimes people create plantations or large farms of cocoa trees. Why could this be a problem?

Chemicals

5. Cocoa trees do not grow well outside the forest so farmers on the big cocoa farms use large amounts of chemicals called pesticides to keep away bugs and diseases. They also use fertilizers that make plants grow faster. How may this be a problem?

6. In what ways do you think farmers could protect the environment if they get more money for their cocoa?



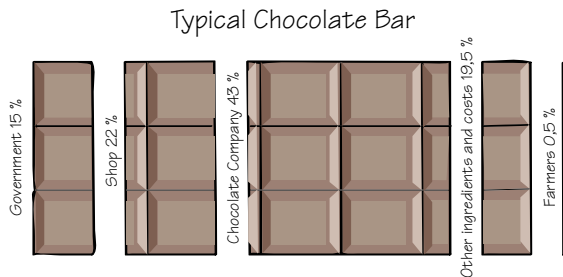
Chocolate, Slavery and Fair Trade

What can You Do?

Use this text-sheet for your notes and write your answers on a separate paper.

Activity 3

Where does our money go?



Using the information above, calculate the breakdown of the cost for each of the following chocolate bars:

Cost: 45 cents

Government VAT: _____

Shop or Supermarket: _____

Chocolate company: _____

Other ingredients: _____

Farmers: _____

Cost: 55 cents

Government VAT: _____

Shop or Supermarket: _____

Chocolate company: _____

Other ingredients: _____

Farmers: _____

1. Think about the words **Fair** and **Trade** then write down your understanding of Fair Trade.

2. Describe at least three problems of marketing/selling fair trade products?

3. What do you think you can do to get supermarkets and shops to sell Fair Trade chocolate?

Campaign

How can you persuade your friends and family to buy Fair Trade products?

Think of three good arguments.

You can start with **your class**, then **your school**... At home you start with **your family**, then **your community**...

Cell Phones, Gorillas and Armed Conflicts *Electronic Waste*

Activity 1

Background information

By 2009 there were more than **five billion** cell phone connections worldwide. (It will take you 32 years to count to one billion.)

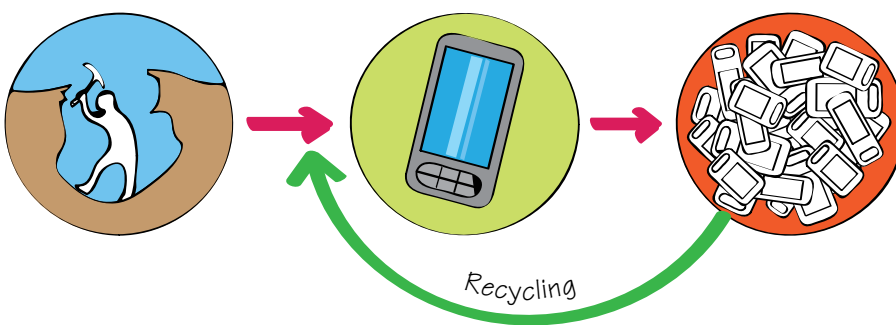
The average life span of a cell phone is only **14 months**.

It is estimated that **426 000** cell phones go out of use every day. That totals to about **155 million** a year.

Only **10 %** of the cell phones are recycled and it can be estimated that around **140 million** cell phones are thrown out each year.

Recycling cell phones protects landfills from the many potentially hazardous chemicals found in the phones, including antimony, arsenic, copper, cadmium, lead, and zinc.

1. How many phones have you owned in your life time?
 2. What is the longest time you have had with your cell phone?
 3. How many cell phones will you have owned by the time you are sixty years old?
 4. Can you name three alternatives to throwing out your cell phone?
-
-



1. Put three labels on the diagram to show the process

2. What is the problem with this linear process of production?
 3. Describe and explain three ways that may help us to reduce the problem.
-
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Cell Phones, Gorillas and Armed Conflicts

A Blessing or a Curse?

Activity 2

Discussion topics on economic pressure versus the ecological environment

As the need for coltan continues to grow, uncontrolled mining practices in the DRC will continue to damage the already endangered lowland gorilla.

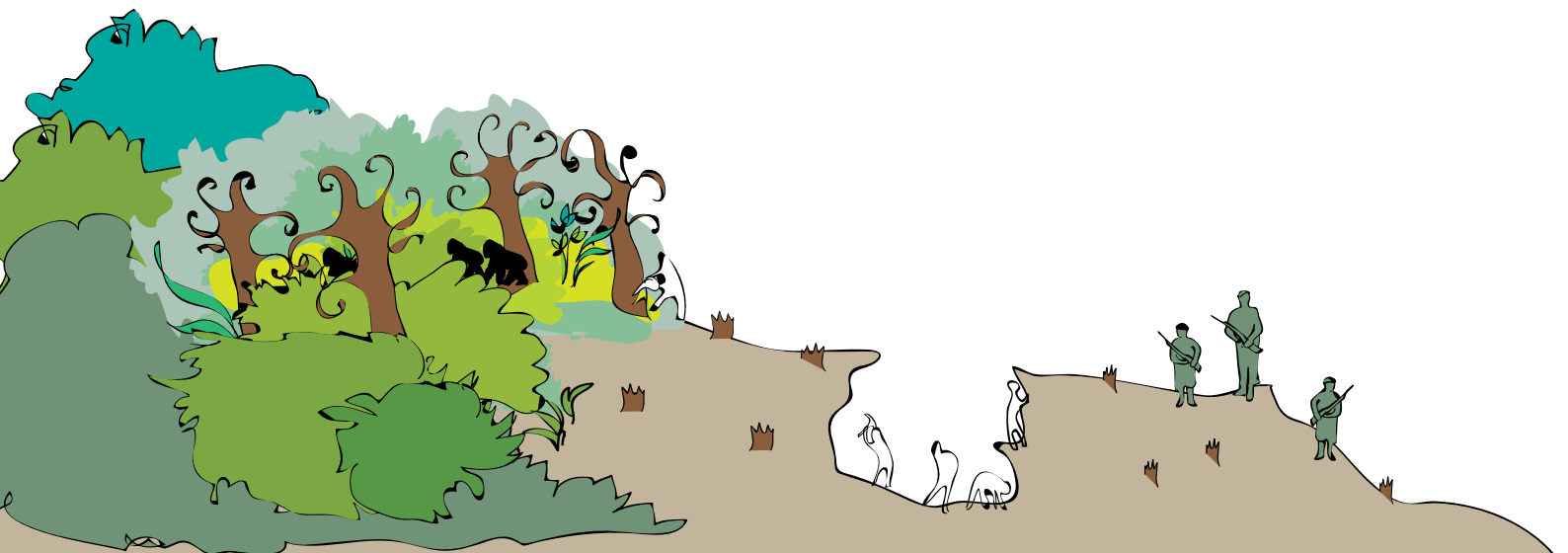
The population of gorillas has declined from about 9,000 in 1996 to just about 3,000 individuals today.

Armed groups in the region are operating mines which have paved the way for large-scale destruction of rain forests in the area, effectively decimating the gorillas' natural habitat.

Mining has also attracted more than 10,000 illegal miners into protected parks.

Discussion questions

1. The value of cell phones as a means of communication is coming at the cost of whole species and important habitats.
2. In your opinion what is causing the conflict in the DRC?
3. Describe and explain how cell phone users are helping the conflict in the Congo?
4. What do we lose if the lowland gorilla becomes extinct? Can you describe the connection between the plight of gorillas in the DRC and the huge worldwide demand for cell phones?



Cell Phones, Gorillas and Armed Conflicts

Do Something!

Activity 3

Discussion topics on possible solutions (agency)

What can be done to deal with the issues discussed so far?

We have all heard of "Dolphin safe tuna". Hopefully, we will soon hear about "Gorilla Safe cell phones".

Resell your cell phone. Some cell phone companies take unused cell phones and refurbish them, then sell them to developing markets in Latin America and Africa. How do you feel about this?

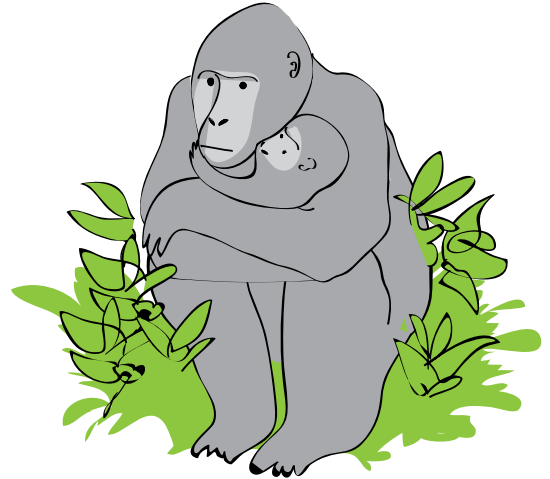
Compile a project portfolio or design a poster

Resources in ecologically sensitive areas can be a curse instead of a blessing. Choose one resource that in your opinion has turned out to be a curse rather than a blessing to the local people.

Compile a project portfolio or design a poster to shown how this has happened. Remember to offer some possible solutions.

E-waste

Discuss how the recycling of electronic waste can be problematic.



Economic Responsibility

Why Protect the Antelope?

The local government will decide on a tax that will be used for conservation measures that will keep the antelope population stable at present level. Keeping your monthly income in mind, how much would you be willing to pay in taxes for this cause?

Activity 1

Group activity (in a group of five)

Decide the amount of tax you are willing to pay (your valuation) without telling the others and give it to the facilitator.

My occupation

I am willing to pay this much

Write down your reasons for choosing this amount

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Activity 2

Group discussion (in a group of five)

1. Share your knowledge about the antelope.

Each representative will now share what they know about the antelope.

2. Each group will now discuss the following:

What would be an appropriate tax rate for the cause of protecting the antelope (expressed as a percentage of monthly income)?

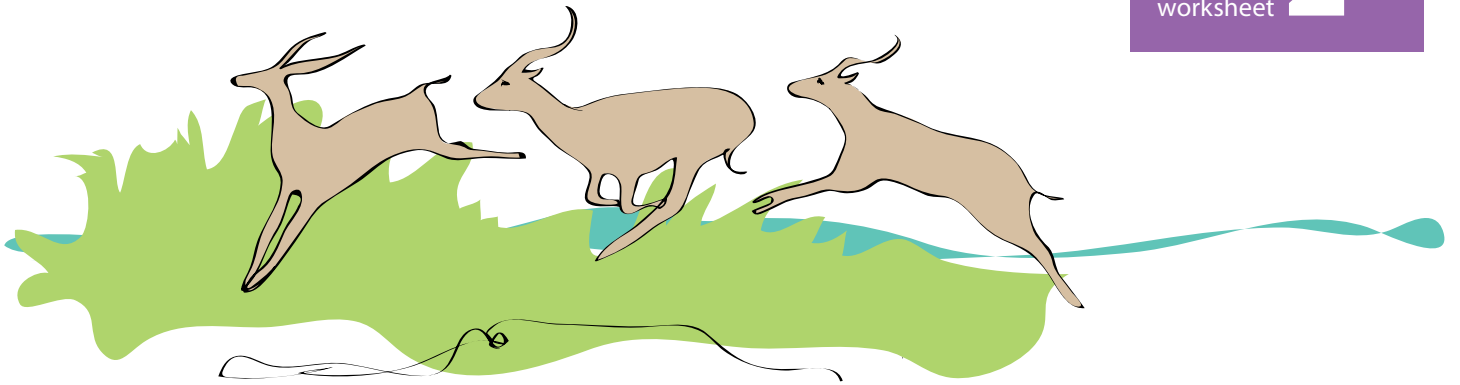
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What other possibilities can be considered for governing the stock of antelopes?

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Economic Responsibility



Activity 3

Plenary group presentations and discussion

1. Each group will now present their proposal.
2. Plenary discussion.
Discuss the results from a strictly utilitarian point of view.

What is the marginal utility (usefulness) of money?

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How is the utility on money linked to governance of ecosystem services?

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Answer these questions:

- What is tax fairness to you?
 - Describe how you felt about the tax you have to pay in the activity?
 - Are there responsibilities associated with having different jobs and power?
 - How do wealth and power affect one's ability to enjoy ecosystem services?
 - Should rich countries help poor countries to protect their ecosystem services?
- or
- Design a poster.



SWEDESD

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The publication has two parts:

The first part is a teacher educators' manual that outlines examples with a holistic approach to environmental and sustainability education. Examples are selected as a starting point for establishing links among different subject matters.

The second part is in the form of a file containing a set of worksheets to be used together with learners' activities. The worksheets cover three sections: holistic examples cutting across subject matters, natural science examples (Physics, Chemistry and Biology) and social science examples (Geography, Social Studies and Business Studies).