

## 4 What Can You Learn?

### b - Energy is a natural resource

#### Purpose

To explore key concepts in greater depth and relate them to your school situation

#### Key concepts

Energy is a natural resource.

Energy is a resource which is part of our universe. People harness some of this natural energy to help us do the things we want to do.

- 
- Investigate your connections with natural energy sources (solar, geothermal, wind and water) through the family of Rangi and Papa
  - Explore a Māori perspective of how fire came to be on Earth and how it is related to the sun
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#### Consider

- How many different sources and forms of energy are there in the natural world?
- What kinds of energy do we get from the family of Rangi and Papa?
- How do we use these natural energy sources?
- How do we interact with the different sources and forms?

#### Evaluate/Reflect

- What forms (sound, heat, light, movement) of energy can you recognise in the natural world?
- What things might energy be useful for?
- What are some of the ways we work with the natural energy around us?

#### Activities

Background text - Energy is a natural resource

4b.1 Introducing electricity

4b.2 Energy in the natural world

4b.3 Maui gets fire from Mahuika

4b.4 What makes them go?

4b.5 Play the Energy Game

4b.6 Lemon Power

# Background Text

## Energy Is A Natural Resource

**Although people harness energy for use, we do not create energy, for energy is a natural resource.**

Energy can be seen working in the natural world around us, for example, in the movement of the wind, in the pull of the moon's gravity which produces the tides, in the warmth and light of the sun and in the spark of lightning. Energy is also driving the growth of every living thing.

Some of the Māori ancestors associated with energy sources include Tamanuiterā (the sun), Ruaumoko (who is still under the ground and responsible for geysers, hot springs, volcanoes and earthquakes) and Tāwhirimātea (winds). The energy sources of fire, wind and the sun feature prominently in Māori culture. Māori also worked with the energy of the moon (marama), timing planting, harvesting and fishing with its phases to reap better harvests.

**Most of our energy comes from the sun.**

Most energy flow in the natural world comes initially from the sun. The sun drives the water cycle, by evaporating water from land and sea. This gives us the potential for hydro-power. The sun creates the temperature differences that cause wind to blow, giving us the potential for wind power. The sun is the basis for the food chains which begin with plants, indirectly providing animals (including humans) with the food energy to survive and grow. Our stores of fuel in the form of firewood, coal, oil and gas also come from the sun.

**Energy flows in natural systems.**

Plants convert the sun's energy via photosynthesis into plant tissue. This is then consumed by plant-eating animals, which may in turn be consumed by carnivores, and so on. At each step on the food chain, energy is used by the organism to maintain itself and energy dissipates as heat. This dissipated energy can't be easily recaptured. So we can picture the natural food chain as a flowing cascade of energy through the different life forms, with the sun providing a constant source of new energy into the system at one end and energy dissipating back to the atmosphere at the other end. Along the way, some energy is stored in body tissue in each animal that is a link in the food chain, and some energy is burned and goes back to the atmosphere as heat. That is why it takes a lot of plants or small animals to feed one large animal. While the sun is responsible for the vast majority of our energy, there are some other sources of energy in nature such as geothermal (heat from the earth) and tidal energy (gravity from the moon).

## 4b.1 Energy In The Natural World

This series of activities helps us to identify the energy sources in our natural world, and explores our relationships and interactions with them. Link this information back to your school environment by using the Pool of Knowledge and Precious Energy Map.

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### You will need

- Pictures of energy sources and uses
- To do the extensions you need copies of The Phases of the Moon, the poem Children's Tale by Hone Tūwhare as well as the tape of Te Wao Nui a Tāne, by Hirini Melbourne to listen to the song Uira (lightning)

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What do you already know about natural energy sources and our interactions with them?

- Review what you already know about the sons of Rangi and Papa, and the concept of inter-relatedness that was introduced in Me in My Environment
  - Recall the stories you have read about Tāwhirimātea and Tamanuiterā
- 1 Using the pictures of natural energy sources provided as a prompt, brainstorm: "How we can observe Tamanuiterā and Tāwhirimātea?"; "What do they give us?" Repeat for ahi (energy from fire), wai (energy from gravity acting on water) and the volcano and mudpool – signs of Ruaumoko's energy.
  - 2 Take a picture of an energy use and identify the natural energy source that is being harnessed. Try and find others with pictures that relate to yours – e.g. all those with Tamanuiterā (sun), Tāwhirimātea (wind), wai (water), ahi (fire), Ruaumoko. (Note, tides and waves both involve energy from water, though each has a different origin). Arrange the pictures and make up an energy story about the pictures. Write it up on a big piece of paper, then act it out with others.
  - 3 See if you can apply any of these pictures of energy sources and uses to your Map. (You could use pins and wool to show where). Can you draw other energy uses that relate to your Map?

### Consider

- How many energy sources you could identify?
- What are all the signs of energy sources and forms in our environment?

### Extensions

#### Te Maramataka (The Phases of the Moon)

- Split into pairs or small groups. Using copies of Te Maramataka, ask each other which would be a good day for... (choose an activity listed under one of the days). Discuss how Māori worked with the energy of the moon to try to increase their harvests. What day of the Maramataka are you in now?

#### Ruaumoko

- Read the poem Children's Tale by Hone Tūwhare and explore the signs of Ruaumoko in your area.

#### Uira (Lightning)

- Use the tape Te Wao Nui a Tāne by Hirini Melbourne. Listen to the song Uira and then make up your own song, story, poem or picture about an energy form.

## Children's Tale

The taniwha breathes fire and hot stones.

The taniwha snorts hot dust and steam.

Golden snot trickles from its nostrils.

Deep inside the Earth

the taniwha takes deep-breathing

exercises to keep in good shape

for when it has to remind us all

that we are not as powerful as he.

Its name: RU-AU-MOKO.

It is the boss of all the taniwha.

It doesn't give a fart for anyone

or anything. But when it does –

WATCH OUT!

The Earth won't be able to contain itself.

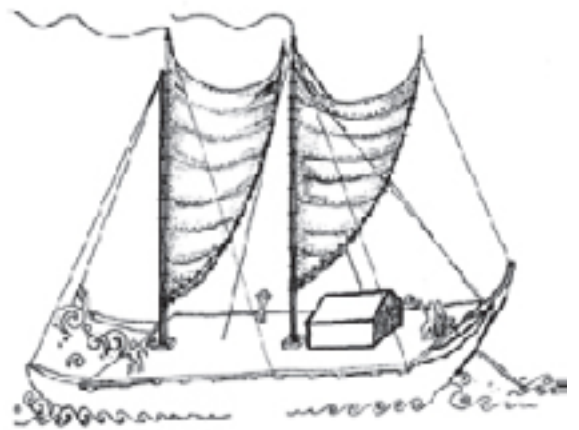
Earth Mother will split her sides with laughing.

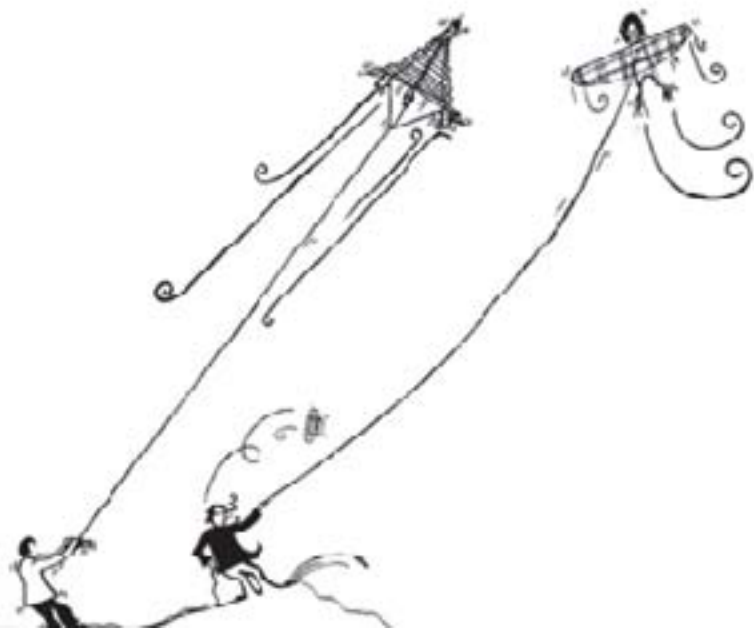
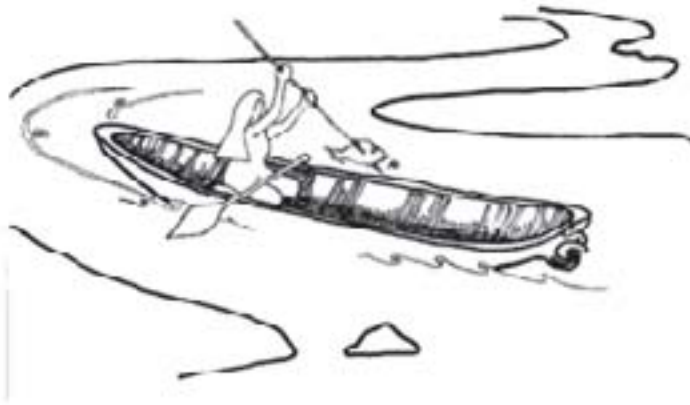
Hone Tūwhare

MIHI

Collected Poems







# Te Maramataka – The Phases of the Moon

Source: [Te Taura umara te Reo Māori](#)/The Māori Language Commission

The cycle begins with each new moon. There are 30 phases in each cycle. "Whiro" is the first night of the new moon, "Tirea" the second until reaching "Mutuwhenua", the last night of the new moon. The cycle restarts on the appearance of the next new moon, with "Whiro", "Tirea" and so forth.

These names have been taken from the almanac of a number of tribes. The majority of the names are similar. The differences are only in the sequence of the phases. As many names were similar, the Māori Language Commission decided to use those names employed by the majority.

## **WHIRO**

The moon enters a new phase. An unfavourable day for planting food and for fishing. A productive night for taking eel.

## **TIREA**

A reasonably good night for crayfishing, eeling and for planting food. A good day for collecting shellfish.

## **HOATA**

A very good day for eeling, for crayfishing, for planting umara and for sowing seed crops.

## **ŌUE**

A good day for establishing tuber beds, planting food and for fishing.

## **ŌKORO**

Another good day for planting food. Fish are restless.

## **TAMATEA-KAI-ARIKI**

A day for planting food. West winds prevail that only rain will quell.

## **TAMATEA-Ā-NGANA**

Eels are voracious feeders this night. A good day for planting food and for fishing but beware the fog and foaming sea.

## **TAMATEA-ĀIŌ**

Eel, fish and umara are abundant but small. A productive day for collecting shellfish. Fishermen beware!

## **TAMATEA-WHAKAPAU**

A favourable day for planting food from morning to midday. Not a day for the fisherman.

## **ARIROA**

A disagreeable day, one for marking time.

## **HUNA**

Do not plant food. Not a day for fishing. Eel and crayfish are wary.

## **MĀWHARU**

A most favourable day for planting food. Kūmara are large but rot quickly. A good day for fishing and a good night for trapping crayfish and eel.

## **ŌHUA**

A very good day for planting food.



**ATUA WHAKAHAEHAE**

Not a day for planting food or for fishing.

**ŌTURU**

A good night for bobbing eel. A good day for fishing and for planting food from midday to sundown.

**RĀKAUNUI**

A very good day. Crops are bounteous. A good day for fishing but not eeling.

**RĀKAUMATOHI**

A very good day for fishing but not eeling. Seed plants grow vigorously.

**TAKIRAU**

Takirau faintly visible. The moon is hazy. Food is bountiful but small in size.

**ŌIKE**

Not a good day for fishing or for planting food.

**KOREKORE TE WHIWHIA**

An unproductive night on shore, winds sweep the seas.

**KOREKORE TE RAWEA**

Not a fruitful night. Food is scarce but await the turn of the tide.

**KOREKORE PIRI KI TANGAROA**

A good day from midday to sundown. A productive period for taking eel trapped or otherwise. Most foods are plentiful.

**TANGAROA-Ā-MUA**

A good day for planting food, for fishing and eeling.

**TANGAROA-Ā-ROTO**

A productive day for fishing and planting food.

**TANGAROA-WHAKAPAU**

A good day for fishing and the cultivation of seed beds.

**TANGAROA-Ā-KIOKIO**

A very good day for taking eel, for fishing and for setting crayfish and eel baskets.

**ŌTĀNE**

A good day for fishing, eeling and crayfishing. A reasonably good day for planting food.

**ÖRONGONUI**

A very productive day for planting food, fishing and eeling.

**MAURI**

Not a productive day. Food is frugal. Fish are restless and turntail.

**MUTUWHENUA**

Unproductive day and night. The moon diminishes, the world is now in total darkness.

## 4b.2 Māui Gets Fire From Mahuika

This story activity reinforces how important energy is and the idea of a source (where it comes from). You can use the whakapapa (genealogy) of fire to show how Māori valued fire as a direct descendant of the sun and a precious energy source to be cared for.

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### You will need

- Your whakapapa of Rangi and Papa on display
- The whakapapa of fire and explanation provided (How Fire Came to be on Earth)
- Story: Mahuika from Wahine Toa: Women of Māori Myth by Patricia Grace with pictures by Robyn Kahukiwa
- Discussion Guide: Mahuika – Guardian of Fire

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- 1 Establish a link back to Rangi and Papa on your whakapapa display using the story provided: How Fire Came to Be on Earth.
  - 2 Read the story Mahuika reproduced from Patricia Grace's text and look at the pictures done by Robyn Kahukiwa.
  - 3 Use the discussion sheet to help reflect on the story. Retell this story in your own words and/or act it out.

### Consider

- Where did Māui get energy from?
- Why was fire so important for Māui's people?
- Where do we get fire from now?
- What are all the things we use fire for at school, and at home, and what effect does this have on the environment?
- When might you need to be able to make a fire? What would be required?
- What other explanations do you know about what the sun is or where fire comes from?



Illustration: Robyn Kahukiwa

# Mahuika

"Where do you come from?" I called. And he replied, "I come from the west." "Then come and tell me what you want," I said, "because you are a relative of mine. You must be Māui-pōtiki, I have heard of your deeds on earth. I am Mahuika who keeps fire."

"Fire has been lost to the world," Māui said, "so I have come to ask you for a flame." So I pulled out one of my flaring fingernails and gave it to him. He thanked me and went on his way.

But when he was out of sight he doused the fire in a stream. I did not know at the time that he had done this deliberately.

He returned and asked for more fire, so I pulled out my second fingernail and gave it to him, and again, once out of sight, he put out the fire. My mōkai came running to me saying, "He is killing your children."

Māui returned again and again, and each time, because he was a relative of mine, and because of a promise I made to the people of earth, I gave him fire.

Soon I had given him all of my fingernails except for one. When he returned for this last nail I became angry, "You ask too much," I called, and threw the last fire-nail at his feet, so that fire leapt and spread about him.

He turned and ran with the flames pursuing him – and as fire began to surround him he changed into a hawk so that he could fly above it. But when the rising flames caught hold of his wing feathers and scorched them he dived down into a lake, only to find that the water was boiling.

What a dilemma he was in then. He had to beg his ancestor Tāwhirimātea to send rain.

It was rain, the drenching rain that saved Māui – and almost destroyed me. Fire was almost lost to the world. But as the flood waters rose about me I sent the last seeds of fire into the earthly trees – the kaikōmako, māhoe, tōtara, patetē and pukatea – and asked the trees to be the guardians of fire forever.



Kaikomako



Mahoe



Patete

# Mahuika

Mahuika was the guardian of the fire on earth. She had married Auahitūroa, the son of Tamanuiterā and had the fire children, Kōnui, Kōroa, Māpere, Manawa and Tōiti, which were personified as the fingernails of her hands. Māui-tikitiki-a-Taranga put out all the fires in his parent's village in the Paerau, and set off to find and approach his ancestress, Mahuika. After describing his origins and establishing kinship, he requested fire from his kuia. Mahuika pulled off Tōiti, which burst into flame, and gave it to Māui, who promptly went to some nearby water and extinguished it. Pūkeko, the pet of Mahuika, observed this act and went running back to inform his mistress. Māui returned to his ancestress and begged for another fingernail. Mahuika obliged by giving him Māpere. Pūkeko vainly tried to warn his mistress of Māui's pranks.

Māui continued requesting Mahuika's fingernails and then dousing them in the water until the chieftainess had only one left. She was infuriated when she finally realised Māui was tricking her.

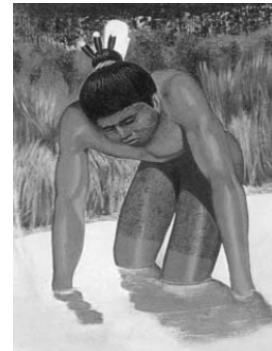
And when he asked for Kōnui, she called to Whaitiri, the goddess of lightning, to send down burning coals, and she dashed her last fire child to the ground where it burst into flames which began to consume the world. Māui was terrified and changed into a kāhu (hawk). He flew up to get away from the fire raging on earth but was nearly caught and his wings were singed. You can easily see the burnt edges on Kāhu's wings today.



Māui then called to Tāwhirimateā to send down rain. It took very heavy rain to put out Mahuika's fire, so heavy that there was a flood. Luckily, Mahuika had saved a few sparks which she threw into the kaikōmako tree and the pukatea, māhoe, tōtara, patetē and mataī also, so that fire could be obtained from these trees by friction.

Māui-tikitiki-a-Taranga took his ancestress' fingernails one by one, and doused them in nearby water because he wanted to see what Mahuika would do when she had no more fire to give him.

The kaikōmako tree is the main source of wood which contains the seed of fire. The traditional implements for firemaking were the hika, a pointed stick and the kauahi, a larger grooved piece of wood. The hika was rubbed along the groove in the kauahi by a specially appointed male while the female held the kauahi steady. The friction from the action of wood on wood set alight small wood particles at the bottom of the groove, which were then removed from the kauahi to a suitably prepared pile of wood.



# Discussion Guide: Mahuika - Guardian of Fire

## Pūrākau

Māui-tikitiki-a-Taranga put out all the fires in his village.

Māui went to ask his tipuna Mahuika for fire. First he established who he was and how he was related to her.

Mahuika pulled off the fingernail of her kōiti (little finger) and gave it to Māui. It burst into flames.

Māui took her fingernail and put it out in the swamp.

Pūkeko saw him do this and told Mahuika.

Māui went back to Mahuika and begged for another fingernail. Mahuika gave him Māpere (middle finger).

Māui kept asking Mahuika for her fingernails and then dousing them in the water until she only had one left.

Mahuika was infuriated and called to Whaitiri the goddess of lightning to come and help her.

Mahuika dashed her last fire child to the ground where it burst into flames that began to consume the world.

It took very heavy rain to put out all the fire, so heavy that there was a flood.

Mahuika had saved a few sparks which she threw into some of the very special trees in the ngahere for safe keeping.

## Questions that could be asked while you are reading the story or as a follow-up exercise.

Why do you think he did that?

Why do you think he did this?

What is the Māori name for your little finger?

Why do you think he did this?

Why did Pūkeko tell Mahuika what Māui had done?

Which finger is Māpere? For some reason she didn't listen to Pūkeko, what do you think that reason might be?

Which one was left? Did Mahuika finally realise what Māui had been doing? Was she happy?

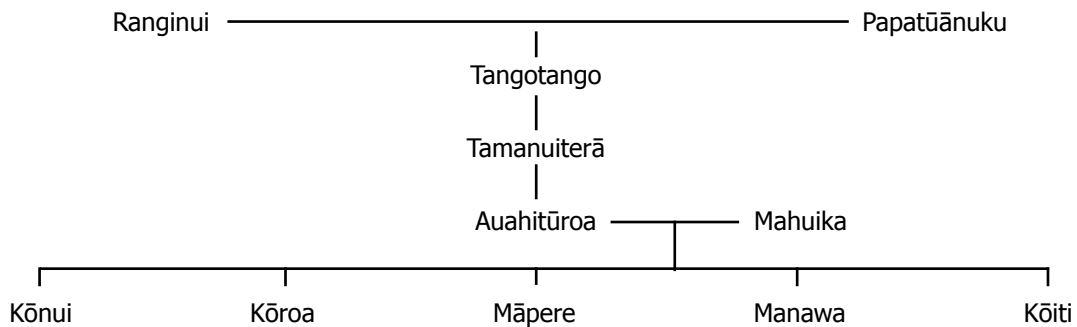
What happened when Māui asked Mahuika for Kōnui?

Who came to help Māui when all the world seemed to be on fire?

What did Mahuika do to save the last few sparks of fire that she had?

Where can we find fire today if we had to find it somewhere in the bush?

# How Fire Came To Be On Earth



the sun

### Tamanuiterā:

It wasn't so long ago that Māui and his brothers trapped me as I was getting up one morning ready to zoom across the sky and then sink into the ocean.

cloak / the Sky Father  
canoe  
flax  
houses  
kite / spinning top

They wanted me to move more slowly across the **korowai** of my grandfather, **Ranginui**, so they would have plenty of light and warmth to build their **waka** and to go fishing; to plant and grow their crops; to collect **harakeke** to weave; to build their **whare**; for the children to play with their **manu tukutuku**, their **pōtaka**; to do all the other things they needed to do each day.

tribe  
food/the trees & birds  
sea/uncultivated food/cultivated food

As you know, I did slow down my daily journey across the sky. I enjoyed watching Māui and his **iwi** doing all sorts of things. They certainly spent a lot of time collecting their **kai** from my uncles, **Tāne** and **Tangaroa**, from **Haumietiketike** and **Rongomātāne**.

fish, birds, fruit, fern root, cabbage tree  
food/fortified village/family

Kūmara, **ika**, **manu**, **hua rākau**, **rauruhe** and **tī kōuka** are just a few of the many kai they would collect and take back to the **pā** for their **whānau** to eat.

They were working so hard. I wanted to do something special for them. I wanted to give a special gift to these people and all their descendants for all of time.

grandmothers  
grandfathers

Then I decided... I could give them the gift of fire. The heat of my flames could be used to cook their kai. Then they wouldn't have to eat raw food all the time. Ika and kūmara - they would be much softer to chew, especially for the babies and those old **kuia** and **koroua**, if they were cooked. Yes! That was a great idea.

Mother Earth

It did however, take a little longer to work out a way of getting the fire down to **Papatūānuku** so the people could get it.

comet / mother of fire

I finally decided to send my son, **Auahitūroa** to marry **Mahuika**. Then their children would be the providers of fire for the iwi.

thumb/index finger/middle finger/  
ring finger/little finger

So that's exactly what Tamanuiterā did. He sent his son to marry Mahuika. Their children were called: **Kōnui**, **Kōroa**, **Māpere**, **Manawa**, and **Kōiti**.

Our hands have five fingers and five nails. These represent the children of Auahitūroa and Mahuika and remind us of the gift we received from Tamanuiterā.

## 4b.3 What Makes Them Go?

Students investigate a range of different household appliances and find out what powers them.

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### You will need

- A range of appliances or pictures of appliances
  - Torches from energy toolkit (solar, dynamo and hand shaken)
  - Energy consuming house display model and/or Energy Game activity sheet
  - Magazines – source of pictures
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- 1 Whole class discussion
- 2 Look at appliances powered by
  - electricity - including solar, wind, dynamo, battery
  - gas
  - human power (e.g. egg beater, hand drill, torches)
  - other

- 3 Discuss as a class

What does it do? What makes it work? Are there versions of this appliance which use different sources of power?" (Egg beater – hand or electric) How does it work?

Responses may include

- they all do a job for us
- some of them have moving parts
- you have to plug it in
- you have to keep turning the handle

(Remember to mention electrical safety around mains electricity)

### Evaluate/Reflect

- How are most of our appliances powered?
- How could you do the task without electricity?

## 4b.4 Play The Energy Game

### You will need

- Energy consuming house display model or photocopy sheet

Set up the house display or use the photocopy sheet of the house.

Divide the class into groups.

Use the model or sheet:

- to identify appliances in the house which use power
- to talk about which type of power is used for each (including solar)
- to find examples of human power being used in the house (snooker, also garden hand tools)
- to count and record items. Each group of students takes a group of rooms/areas of the house and counts the number of appliances in each; recording the totals on a class sheet for the overall tally

Discuss the fact that this is not a typical house but the people are all doing typical things.

### Extensions

The individual Energy Game sheets could be used to follow up on the discussion around the model. e.g.

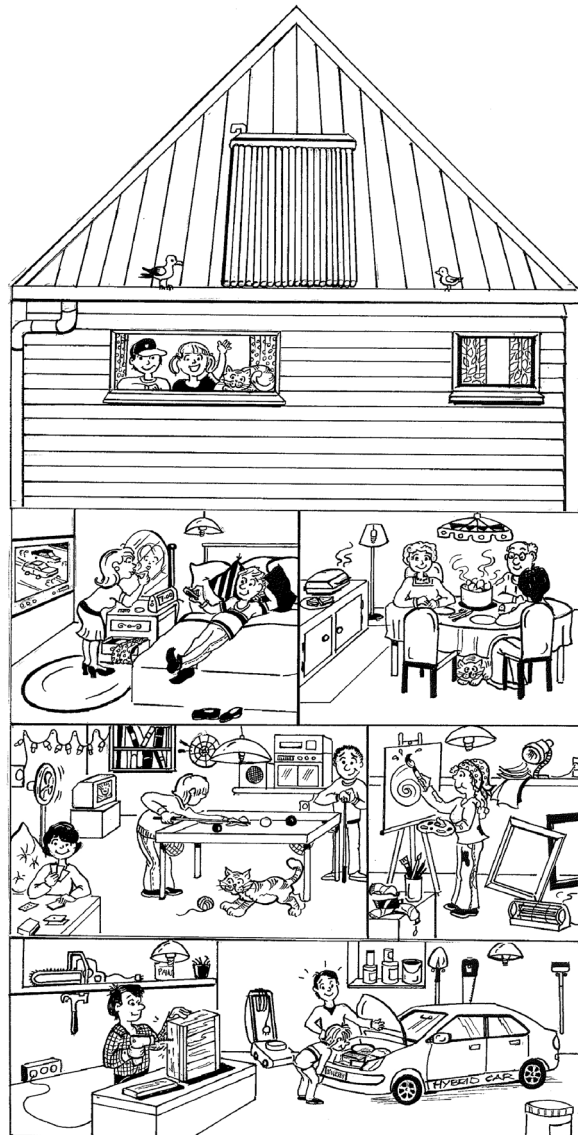
- colour in all the appliances that use energy
- label energy efficiency actions
- X any appliances that aren't being used and could be turned off

Look at where energy is being used efficiently.

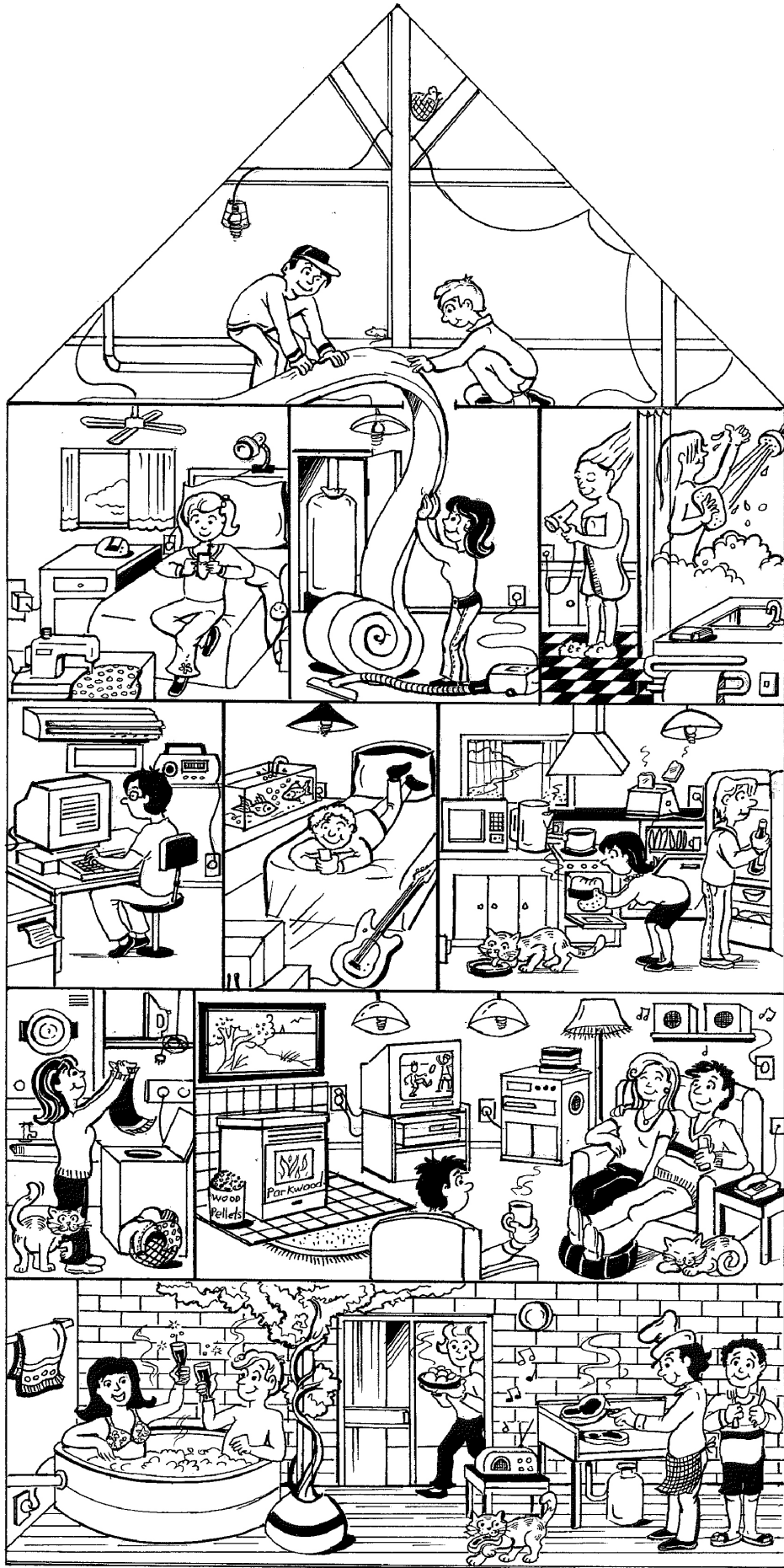
Use magazines to provide pictures of appliances. Working in pairs, students identify and cut out pictures, sort them into groups them according to "what makes them go". Make a collage or display or use a chart to show the appliances in different groups.

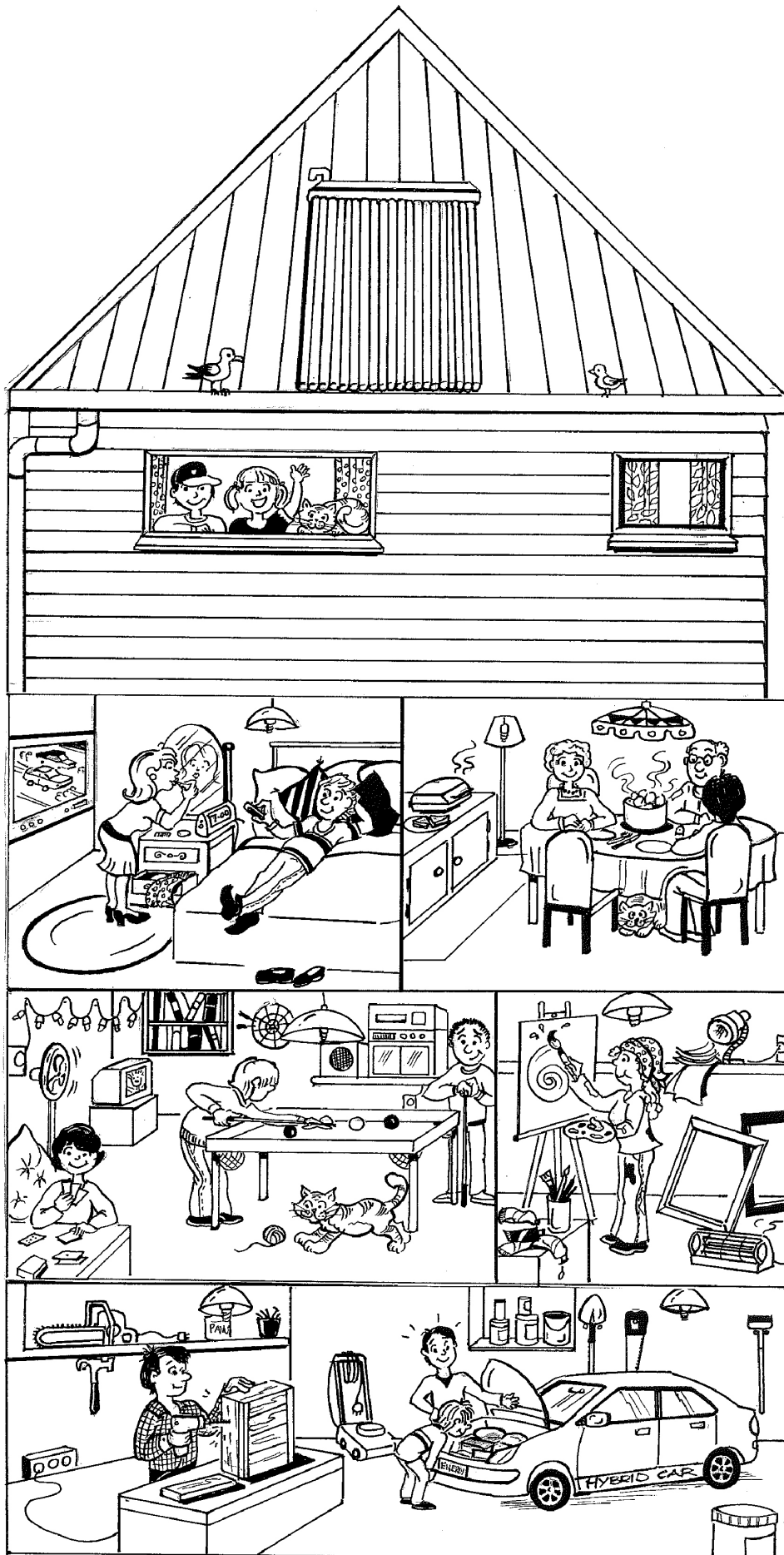
### Evaluate/Reflect

- What energy saving actions do you do at home?
- Could you do some others?









## 4b.5 Lemon Power

Making a battery from a lemon.

### You will need

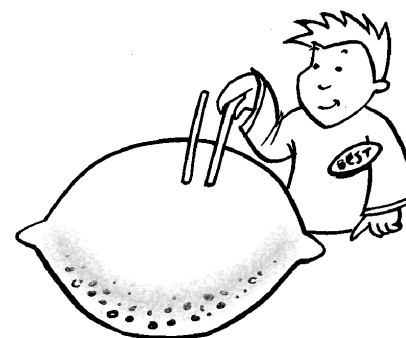
- Lemon (a large juicy one works best)
- Copper wire (or an old copper coin)
- Steel paper clip or strip of zinc (or a galvanised nail which is coated in zinc)
- Wire clippers
- Sandpaper

- 1 Ask an adult to strip 5cm of insulation off the copper wire. Cut off about 5cm of bare wire with the clippers.
- 2 Straighten out the paper clip and cut 5cm off the straightened steel wire.
- 3 Smooth any rough spots on the tips of the wire with the sandpaper.
- 4 Roll the lemon back and forth on the table or squeeze it gently in your hand. Use a little pressure but don't break the skin.
- 5 Push the two wires through the skin of the lemon. Leave about 3.5cm of each wire sticking out. Make sure the copper wire and the steel wire are as close together as possible without touching each other.
- 6 Touch the tip of your wet tongue to the ends of the wire.
- 7 Feel and taste the lemon power.
- 8 What did you experience?  
You should have been able to taste something like metal and feel a slight tingle on your tongue.
9. Why is that?  
You have just made a lemon battery.

A lemon battery is called a voltaic battery. A voltaic battery changes chemical energy into electrical energy. The copper and steel wires are called electrodes. Electrodes are the parts of a battery where the electric current enters or leaves the battery. The electrodes are in liquid called an electrolyte. An electrolyte is a solution that can conduct electricity. In your battery the lemon juice inside the lemon is the electrolyte.

When you place two electrodes into a solution of water and an electrolyte (the acid lemon juice), an excess of electrons collects at one end of the electrodes. At the same time, electrons are lost from the other electrode.

When you touched the electrodes with your moist tongue, you completed the circuit and allowed a very small electric current to flow from one wire to the other. One lemon produces about 7/10 of a volt of electricity and only about one milliamp of current.



It is safe to do this experiment with a lemon but do not play with electricity or put other wires in your mouth.

As the electrons move through the saliva on your tongue they make the taste of metal and the tingle on your tongue.

**Evaluate/Reflect**

- Were you surprised by this?
- How do you think we could use the electricity from the lemon batteries?

**Extension**

- Connect a volt meter to a single lemon cell battery. The meter tells you how many volts the lemon battery is creating (e.g. 0.906 volts). By combining battery cells you can create a higher voltage
- Find out if other fruit, vegetables, water and/or soil can be used as a battery

**Acknowledgements**

[http://hilaroad.com/camp/projects/lemon/lemon\\_battery.htm](http://hilaroad.com/camp/projects/lemon/lemon_battery.htm)