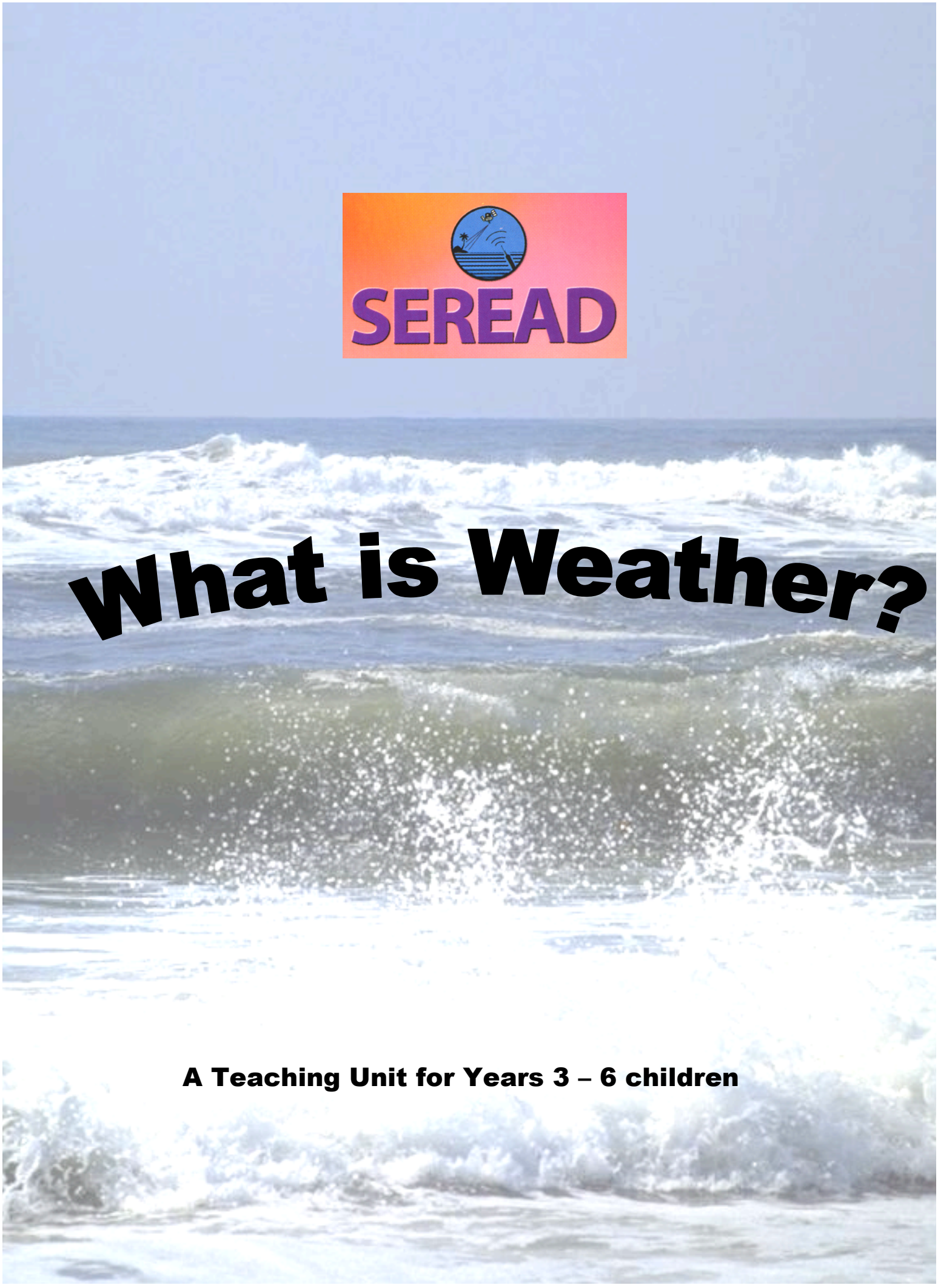


What is Weather?

A Teaching Unit for Years 3 – 6 children

SEREAD and ARGO: Concept Overview for Years 3 - 6 Teaching Programme

This is the overview for the first part of the SEREAD programme link with ARGO.

The overview progresses from low-level concepts to higher level and establish the progression between the essential concepts for this level. One of the primary purposes of this programme is to lay the foundation for linking weather to ocean matters and Argo.

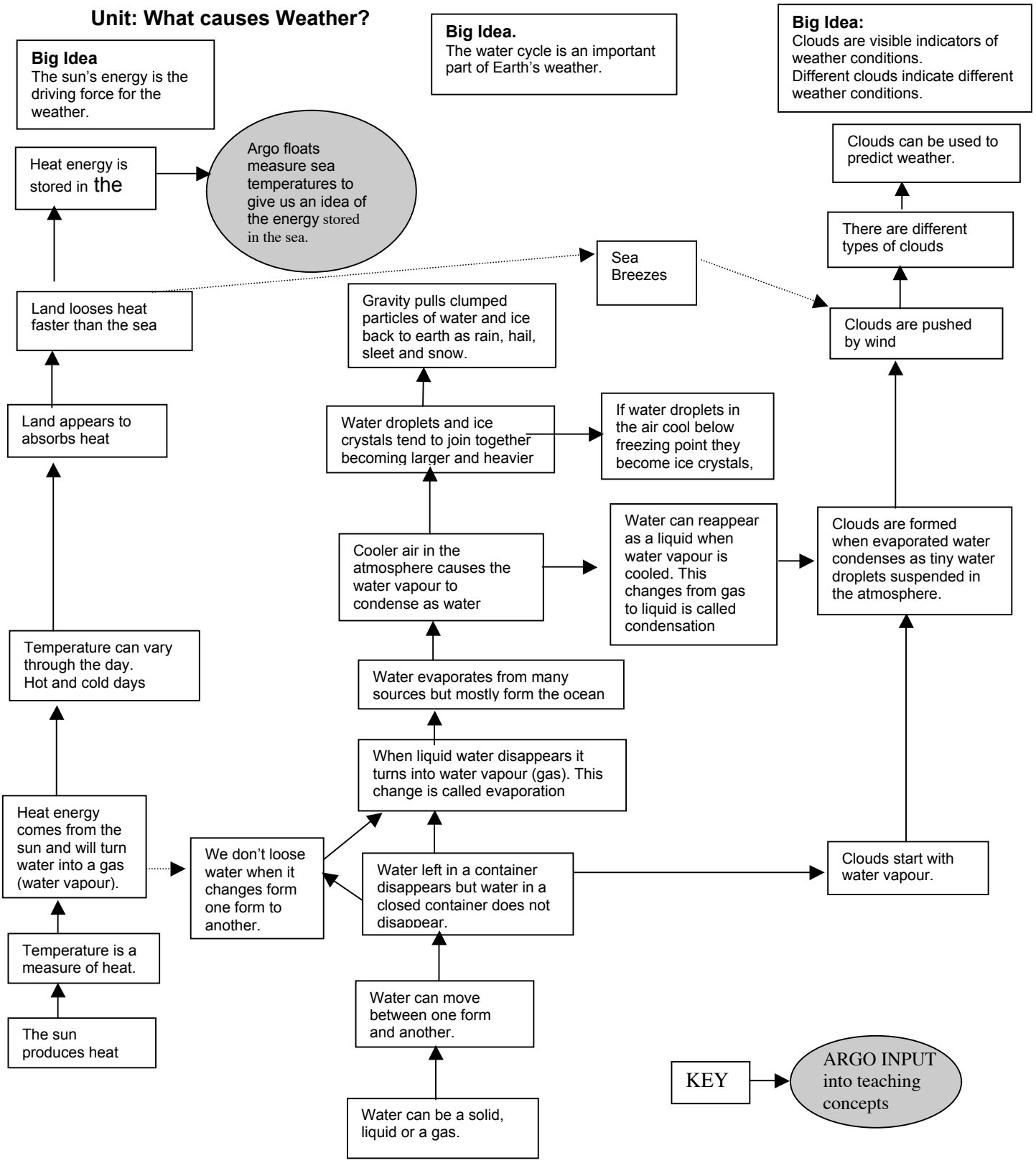


TABLE OF CONTENTS:

SCIENCE FOR THE TEACHER

ACTIVITIES FOR THE CHILDREN

This workshop and the SEREAD programme are sponsored by:

- The International Oceanographic Institute, University of the South Pacific (IOI)
- UNESCO Office Apia
- Argo Science Team
- Partnership of Observation for the Global Ocean
- National Oceanic and Atmospheric Administration. U.S.A.
- South Pacific Applied Geoscience Commission
- International Oceanographic Commission, Perth Regional Office
- National Institute for Water and Atmosphere, New Zealand.

WELCOME TO SEREAD

What is SEREAD?
SEREAD is an educational programme linked to current teaching programmes in Pacific Island schools.
SEREAD stands for Scientific Educational Resources and Experience Associated with the Deployment of Argo. The Argo Project is a series floats that move up and down vertically through the water and the information they provide is used to help understand the changes taking place in today's climate.

The Goal of SEREAD

The goal is to help generate awareness, discussion and an understanding of the ocean's role in the climate system. Climate changes can take place over months or years. The key to understanding change involves the role of the water and energy cycles in the tropical marine climate of the Pacific Islands.

SEREAD's objectives are to:

- Provide teaching resources that complement current teaching curriculum and demonstrate the value of scientific knowledge through realistic and locally relevant applications.
- Teach students about the fundamental measurements that are used to describe and measure changes in climate.
- Help teachers and students to understand how scientists use data.
- Provide opportunities for interaction between scientists and teachers.

In this Workshop the topics will be:

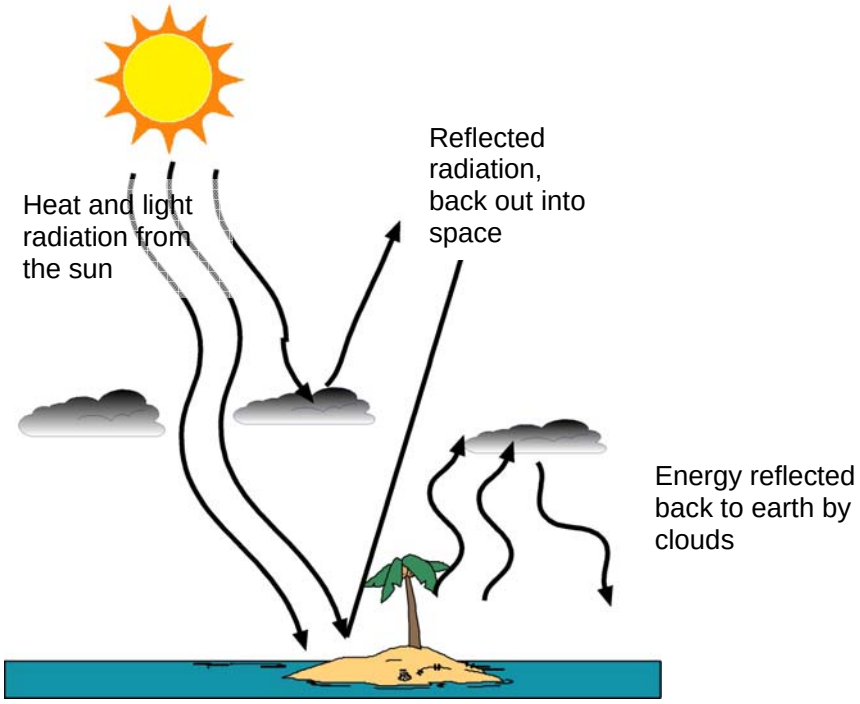
Argo floats: What they are, how they work and the information they provide.
Understanding climate change and the Island Climate Updates.
Introducing the Teaching Programmes.
Unit Studies for Primary Teaching.

Goals of the SEREAD the workshop:

To provide teachers with practical classroom materials and resources that they can take away with them for use in their classrooms.
Develop teacher's knowledge of climate change and the role of the ocean.

The Driving Force for our Weather?

The driving force of this planet is the sun.
Our planet needs two key forms of energy; heat and light. Both are needed by most living things, heat enables our body systems to operate properly whilst light energy is used by plants to make their food i.e. photosynthesis.



The sun actually gives out or radiates many different types of energy. Some of the types of energy are very strong and but do not reach earth through the protection by the upper atmosphere. Other forms of energy including light and heat do reach the surface of the earth. Some of the heat energy can be trapped inside the earth's atmosphere and this is what warms up the air, and everything on the surface of the earth including small rocks on the ground and oceans .

How do we know how warm it is getting? We can sense a warm object or how warm the water is by touch or feel on our skin. A more accurate way is to measure temperature.

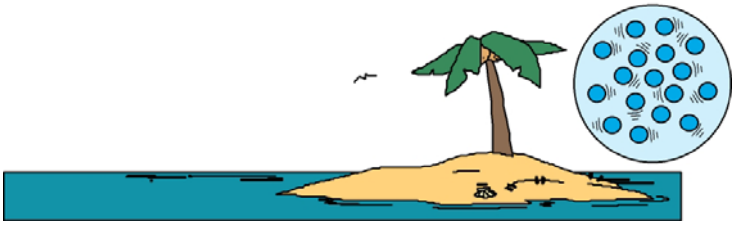
What does temperature actually measure?

But what is temperature?

Heat from the sun warms up Earth's surface through absorption of the solar radiation. The heat energy has to go somewhere and in fact the energy goes into making the particles, that all matter is made up of, move around faster.

Temperature is a measure then of the amount of movement of these particles and so relates to the amount of heat energy.

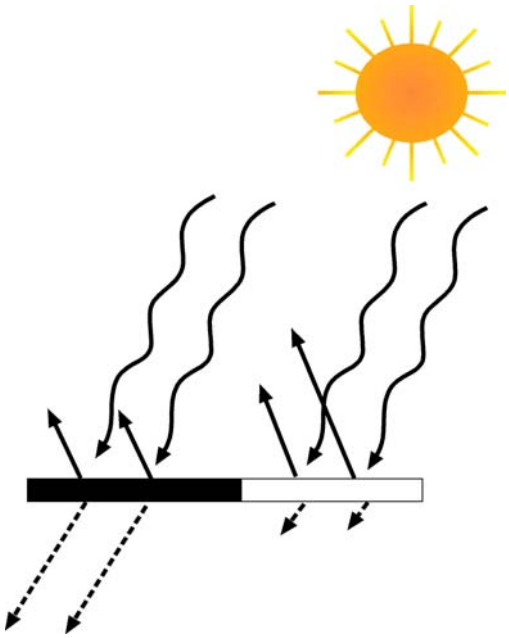
The particles in warm air move around faster.
They occupy more space, so warm air is less dense.



Particles in cool air move more slowly and are closer together. Cooler air is more dense for this reason.

Objects such as rocks and black sand on the beach, and bare soil, absorb large amounts of solar energy quickly. They feel warm, and have a high temperature. White surfaces refect heat energy, so they absorb less energy and feel cooler.

The temperature of the air around us depends on the amount of heat that is absorbed into the land below.



Recycling Water

Water is recycled by the sun's energy. When the sun shines on a puddle of water, the puddle disappears, but the water doesn't simply vanish; it changes from one from form into another.

Water can be found in nature in three different forms or states:

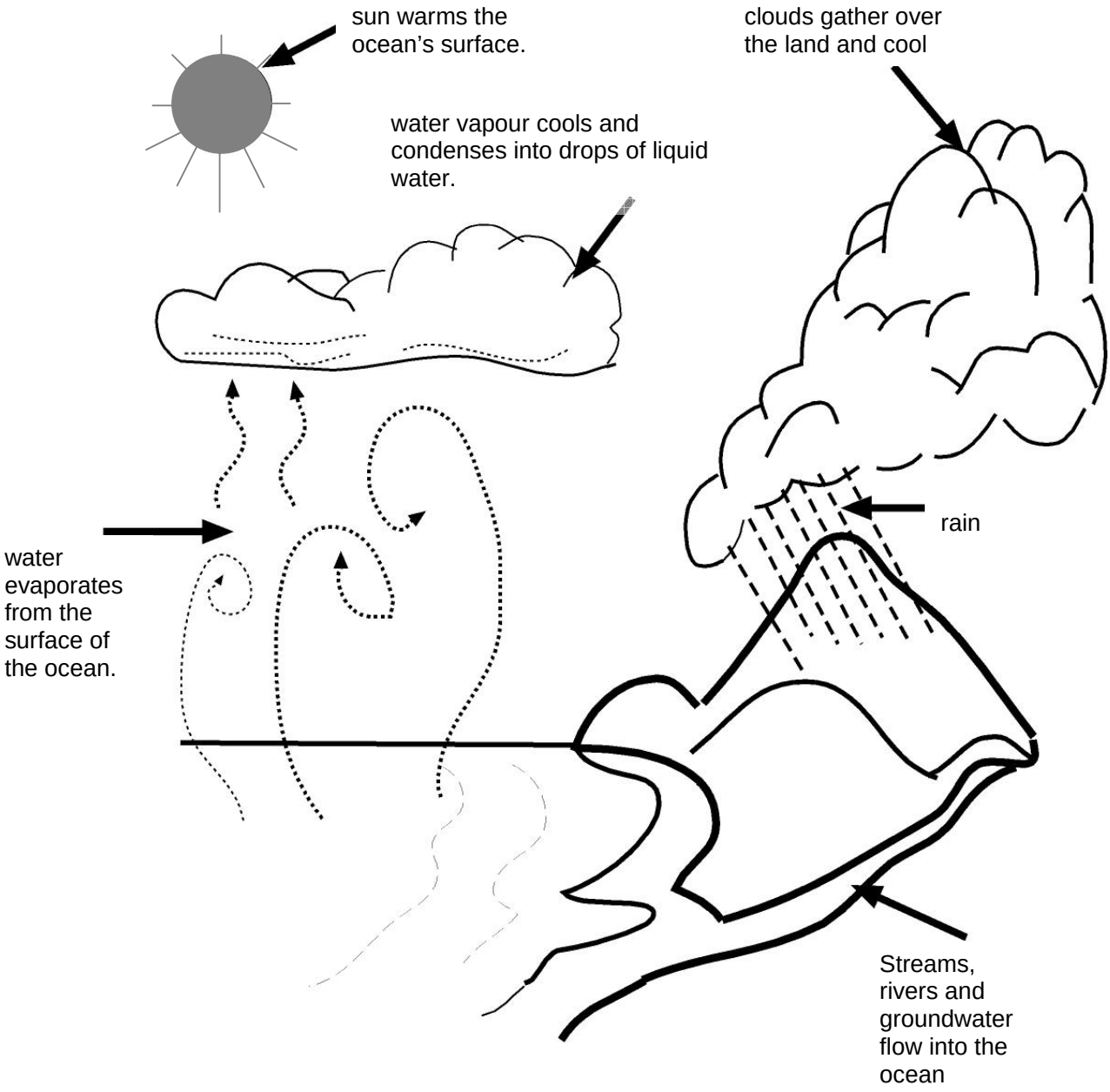
- The solid from is ice;
- the liquid form is water (confusing!)
- and the gas form is water vapour. (Not steam - we'll see why later).

Heat energy is involved when changing these states.

What makes water evaporate at different rates?

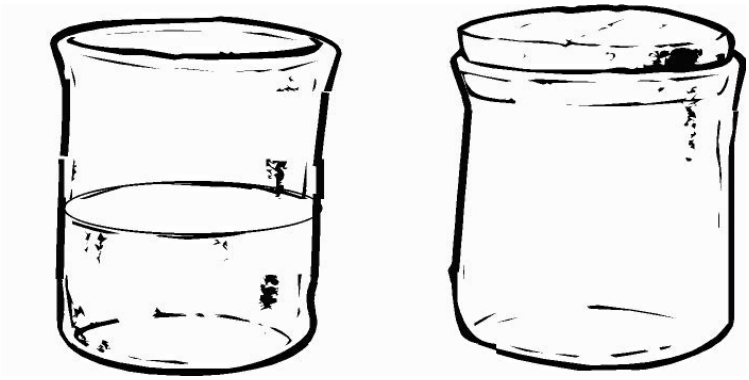
- Higher daily temperatures.
- When air pressure is low.
- Surface area. Large shallow areas of water compared to deep puddles.
- Wind. This helps moves the water particles away form the surface.
- Air Humidity: On hot sweaty days water evaporates only slowly, as there is already a lot of water vapour in the air.

The diagram is a representation of nature's water cycle. It shows us how the sun warms the oceans causing the process of evaporation.
As the water vapour cools it condenses to form clouds and eventually rain.



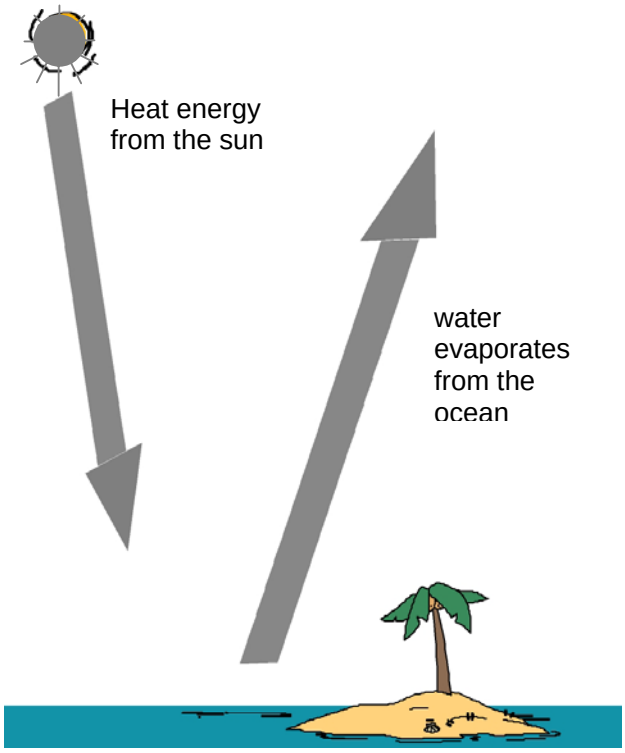
The Science of the Water Cycle

When the water is heated by heat energy the water particles absorb this energy and start to move around. Some have enough energy to escape the surface of the liquid water and become a gas, water vapour.
We can see this if we put a sealed container of water out in the sun alongside another one, which is open to the air. Water evaporates in both of them, but the water vapour in the in the sealed jar cannot escape to the open atmosphere.

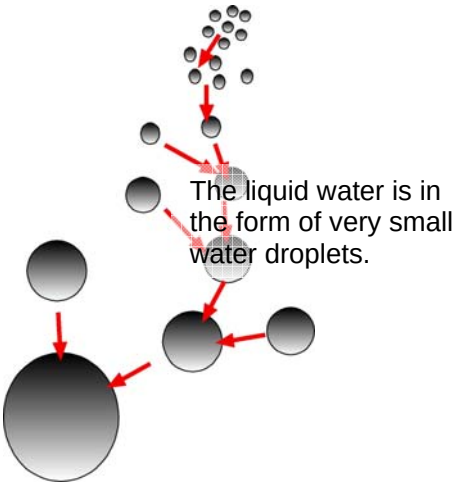


When water evaporates from the earth's surface the vapour has to go somewhere!

The water vapour is an invisible gas. The water particles rise with the warm air. Eventually high up in the earth's atmosphere they have lost most of their energy as the air cools. When water vapour cools, the water particles loose their energy and move closer together.

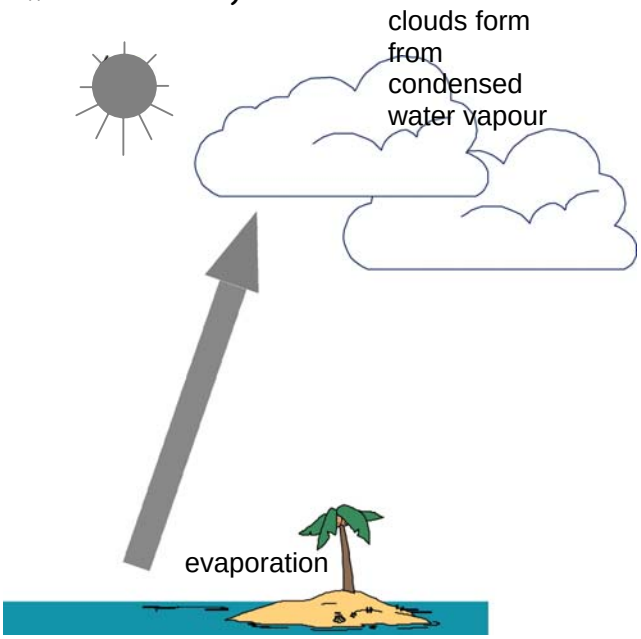


They gather around microscopic bits of dust that exist in the air, and change back into liquid water. This process of water vapour turning back into liquid water is called condensation.



The tiny water droplets get moved around by the air and end up bumping into one another. They end up joining together to form larger droplets and eventually form a cloud.

Remember that steam is not water vapour! When water is boiling the liquid water is turning into water vapour. Then as the water vapour cools we see clouds of what we call steam. Steam is condensing water vapour and what we are seeing are clouds of water droplets. (Rather warm ones at that!)



Most of the water that evaporates to form clouds and eventually rain comes from the ocean. This is nature's big recycling machine.

The amount of evaporation depends on the amount of solar energy reaching the earth's surface. This we recognise as air temperature. The temperature varies depending on what time of day it is and the angle of the sun in the sky. A sun that is overhead appears to put out more energy into the land and sea than when it is just coming over the horizon. The amount of heat that is arriving onto the earth's surface also depends on the amount of cloud cover. Cloud cover acts as a barrier reflecting the sun's radiation back up into space. So naturally down below the cloud cover where the sun is not getting through, it remains cooler.

Also the temperature depends on the time of year, and the seasons.

The water droplets collect in the clouds getting bigger and bigger. The process of forming these drops is called coalescence. (In cooler regions of the world the water droplets freeze as the air temperature drops below freezing point to form ice crystals as well.) These large droplets remain up in the clouds until they become too heavy for the air currents to keep them there, and gravity pulls them back to earth as raindrops.

Sometimes the clouds reach the surface of the earth. This we call fog or mist. These 'surface clouds' form when the cold air lying directly on top of the cold surface of the earth cools the moist raising air. This could be either land or sea. The only real difference between mist and fog is the thickness of the cloud. A more dense surface cloud is called fog.

Lets talk Heat Energy.

Water and land do not treat heat energy the same way.

Down on the beach, we know that the sand and coral on the beach heat up a lot faster than the water during the day, it feels warmer! That means it is at a higher temperature than the water even though both of them are being exposed to the same amount of the sun's radiation.

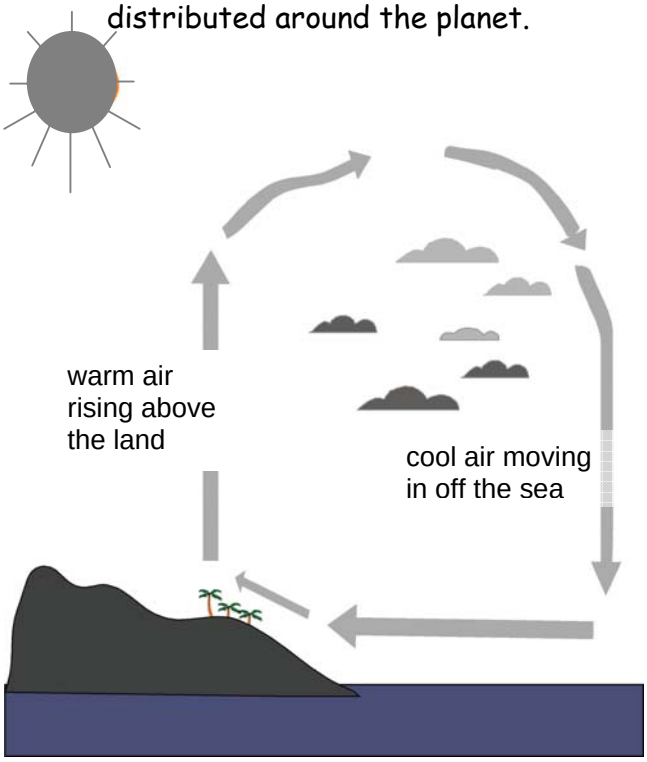
Why does this happen? The temperature of the land falls and rises much more quickly because the sun's energy is trapped within the first few centimetres of material. Down on the beach the top five centimetres are the hottest, once we dig down further the sand cools down considerably.

In the oceans the sun's energy can be carried lower as the water is mixed up by the action of the winds like the trade winds stirring up the water's surface. This creates waves. The mixing carries the heat energy deeper and it is distributed more evenly through ocean waters.

When evaporation from the sea takes place, heat energy is removed from the sea. This is similar to the process as when our sweat evaporates from our skin. We cool down as the heat is removed form our bodies.

When the water vapour formed from the evaporation of the ocean, it condenses back into water droplets the heat energy used to create the water vapour is released back into the atmosphere.

This process is obeying one of the fundamental laws of nature, Conservation of Energy. That is that energy can neither be created nor destroyed. That is: What goes in must come out. The winds are not only carrying water but also heat energy from evaporation from the sea. This way water and heat are distributed around the planet.



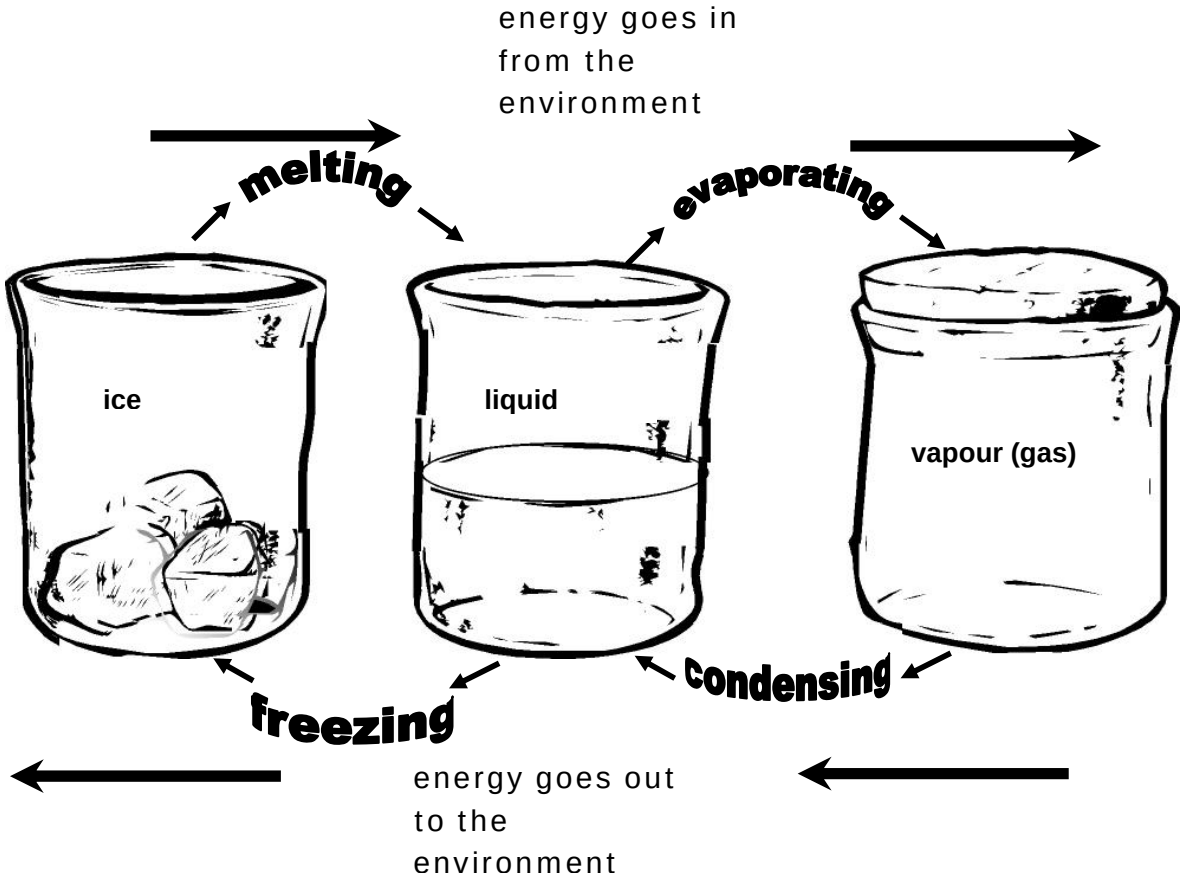
Perhaps one of the most obvious effects of the way the land and sea behave in absorbing the heat's energy, besides those afternoon showers, are the formation of daytime sea breezes.

During the day the top few centimetres of land absorbs heat energy. This is transferred into the air sitting above it. The warm air rises up into the atmosphere. That air has to be replaced. The cooler air that exists above the sea moves in to replace this air. The result is the cool sea breeze that blows in from the ocean.

By night the situation is reversed. Since the land cools quickly the air over the land starts to sink and is pushed out to sea.

Water, the energy storehouse.

If we go back to the behaviour of water we can link this to heat energy. What we are looking at are the physical states that water naturally exists as and relating to this the amount of heat energy required to change each state.



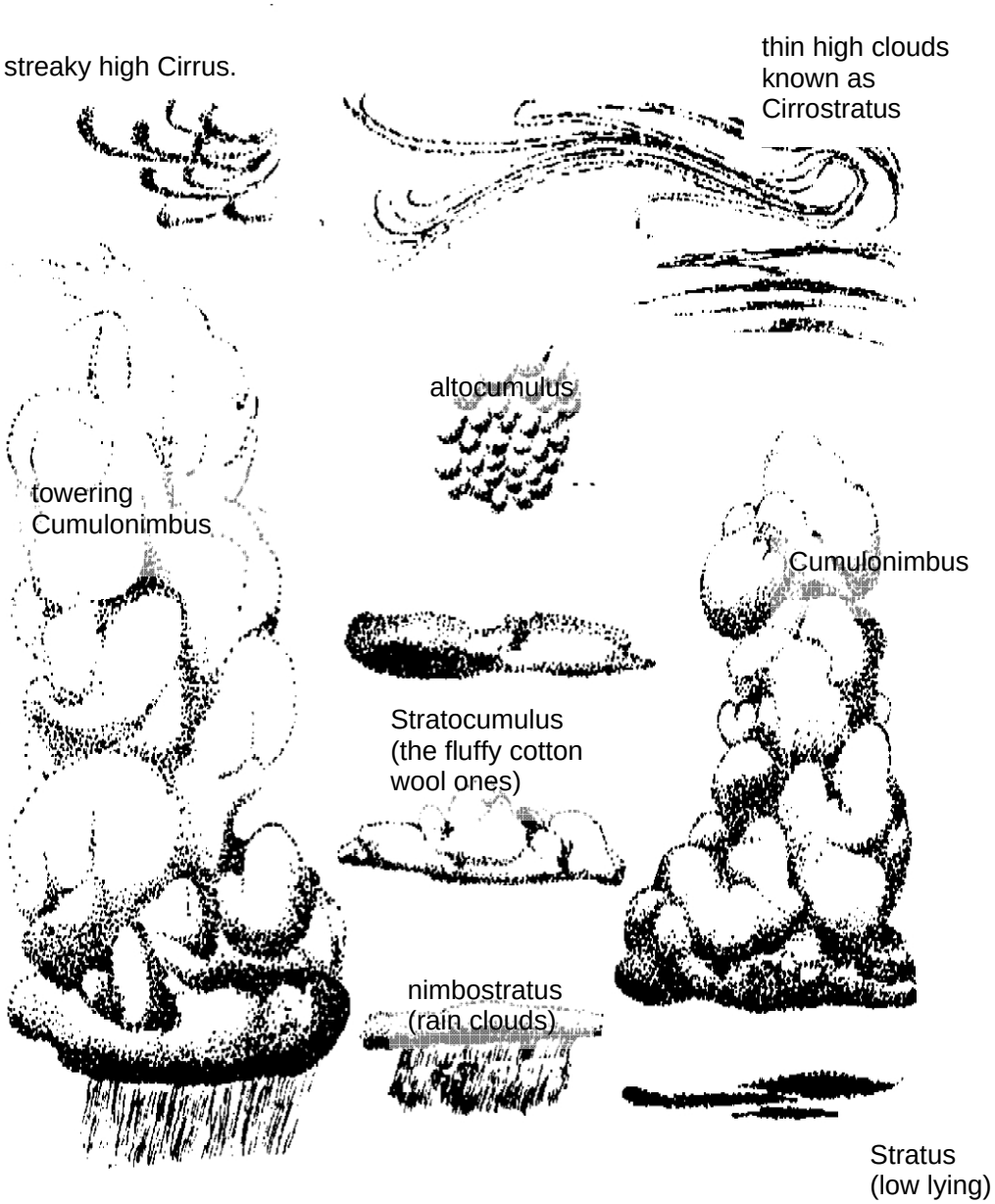
Energy has to go into changing the state (form) that the water is in and then that same energy is released when the water changes back
Water can act as an energy storehouse. When you consider the amount of ocean on the planet, there is a lot of heat energy that can be stored and then released into the atmosphere.
This is one of the reasons why monitoring is being carried out to measure the ocean's temperatures.

Keeping a track of ocean temperatures indicates the changes in energy taking place and the effect this will have on the atmosphere above.

Think of the ocean as a big heat energy sink. This energy passes into the atmosphere as evaporation from the surface of the ocean. Both the sun's radiation and the sea control our weather and in the long-term climate.

Clouds.

With the breezes come clouds. These clouds are made up of water droplets, which could lead to rain. Some of these clouds form very high up in the atmosphere, others much lower. Some form quickly while others build up slowly. It all depends on the conditions at the time. Clouds can tell us what weather to expect. Cloud observations are another important and very practical tool in understanding the weather conditions and changes taking place.



ACTIVITIES

Section 1:

What ideas do children have about water?

Starter: What are all the things we can think of about water?

Purpose: To get children thinking about the importance of water in our daily lives. It is just a general discussion starter. Use drawings, Children can work in groups to draw pictures of their associations with water.

Some ideas:
What does it feel like?
What does it look like?
What does it taste like?
Where do we get it?
Where does it come from?
Where does it exist?
Who needs water?
What do we do with it?

For the teacher: What to look for?
Children recognise how important water is to our existence and the sources of water eg sea, river, well, rain…….

Activity 1.1. What do you understand about freezing?

What I need: Water, Ice Block Tray, and Freezer.

What to do:
Put water in an ice tray.
Get children to write down their observations about the water.
Get children to write down their predictions about what will happen to the water if placed in the freezer overnight.
(What will it look like? What will it feel like? Does it become larger or smaller?…….)
Next day write down all their observations.
Compare these with their predictions.

Write up a wall chart with their predictions and observations.

What we want the children to learn:
That water changing into ice is called **freezing**.
That the process is reversible.
Ice warmed up turns into liquid water.
This process is **melting**.

Question: Does it matter how many times this is done? Will the water become any different other than ice or liquid water?

Activity 1.2. What do you understand about evaporation?

What I need: Water, Paper towels, or Cotton material, Pen.

What to do:
Get the children to draw a line around their hand to make a handprint on the paper towel or cloth.
Wet the hand.
Place the wet hand on the towel (or cloth) inside the outline.

Observe: What do they see on the paper towel (or cloth).
How do they think the handprint was formed?

Predict: What do they think will happen to it? Write down all the possibilities.

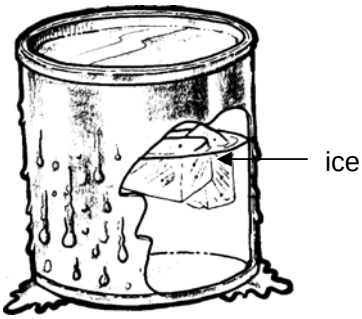
Observe: Leave the handprint for a period of time.

Explain: What happens to the handprint? Write down all the possibilities.
Why is the towel no longer wet? Where did the water go?

What we want the children to learn:
Children understood that the water has changed into gas form.
The process is called **evaporation**.

Activity 1.3: What do you understand about condensation?

What I need: A metal can with lid, cold water and ice cubes.



What to do:
Get the children to feel the outside of the can. It should be dry.
Put some cold water and ice cubes into the can. Put the lid on the can.

Predict: What do they think will happen to the outside of the can? Give reasons.

Observe: Leave the can for a while at room temperature. Get the children to have a look at the outside of the can. Is it wet or dry?

Explain: Compare the results with predictions. How can they explain what has happened.
Draw a wall chart to share ideas.
Where did the water come from?
Where was it before it appeared on the surface of the can?

What we want the children to learn:

That the water was in a gas form in the air around them.
It is often called water vapour.
Cooling turns the gas into liquid water.
This is called **condensation.**

Section 2:

More ideas about changing from one form to another.

Activity 2.1: Does ice loose weight when it melts?

What I need: A large block of ice or several ice cubes, a large jar and lid to hold the block of ice, a set of kitchen scales.

What to do:
Place a block of ice in the jar, put the lid on it. Put the jar on the scales. Weigh it.

Predict: Write down what the children think will happen? What do they think they will see happen to the ice block? What will happen to the weight measurement on the scales?

Observe: Allow the ice to melt. What happens? What is the reading on the scales?

Explain: Compare the observations with the predictions. What explanations can they give?

What we want the children to learn:
We do not loose water when it changes from one form to another.

Activity 2.2: Puddles.

What I need: Water, a concrete surface. (or somewhere where water will not soak through).

What to do.
Create a puddle of water.
Draw a chalk line around it.

Predict: Make some predictions from what the children think might happen.

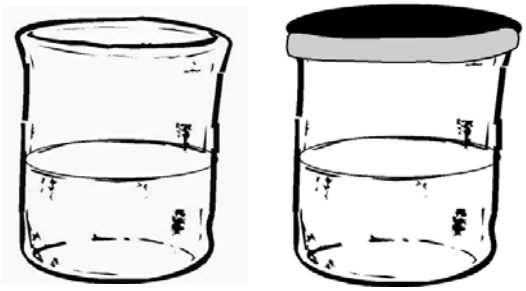
Observe: Observe what happens over a period of time. Each time the puddle is checked, draw a new chalk line around it.

Explain: Get children to draw pictures of what happened and write their explanations about what they think happened.

What we want the children to learn:
They can use the words liquid and gas or vapour.
They use the word evaporation for the change from liquid to gas.

Extend to different conditions: e.g. cloudy, windy.
Does the speed the water disappears at, ever change?
What do the children think happens out in the ocean?
Where does the rain come from that makes the puddle?

Activity 2.3: Where does the water go?



What I need: 2 glass jars, (one with a lid,) some water, and a marker pen.

What to do:
Put the glass jars in a sunny place. Put the same amount of water in each. Put the lid on one of the containers.

Predict: What do the children think will happen over the next few days? What effect will the lid have, if any?

Observe: Get the children to mark on the sides off the jars the level of the water.

Explain: Get the children to answer the question: Where has the water in the open jar gone? Where has the water in the closed jar gone? Why is there a difference?

What we want the children to learn:
The children draw out pictures to explain, "Where does all the water go when evaporation happens."

Activity 2.4: Is there water in the air?

What I need: 2 dry glass jars. A puddle. Access to a fridge.

What to do:
Put a glass jar upside down over a puddle of water.
Put the other empty glass jar with the lid on it in the fridge. Leave them in place for a while.

Predict: What do the children think will happen over the next few hours?

Observe: What happens to the inside of the jars?

Explain: Why do they think this has happened?

What we want the children to learn:
The children can explain what they think happened using pictures.
Introduce the word condensation for water vapour changing to liquid water.
The children can draw pictures to explain, "Where does water come from when condensation happens."

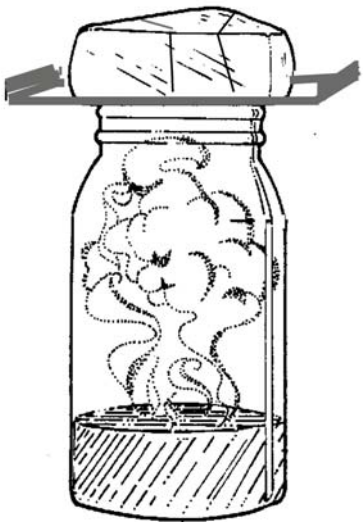
Section 3:

Water in Nature.
This is attempt to put together the ideas of water existing as a solid, liquid or vapour, and utilise the terms evaporation and condensation.

Review ideas about evaporation and condensation.
Where does rain come from?
What is the effect of the sun on puddle of water?
What would be the effect of the sun's heat on the ocean?

Activity 3.1. Making Clouds

What I need: Ice cubes, metal tray, large glass jar, and warm water.



What to do:
Pour about 2 cm of warm water into the glass jar. (Do not use boiling water, as this will crack the glass jar.)
Put some ice cubes on the metal tray and put this on top of the jar of warm water.

Predict: Get the children to predict what is likely to happen.

Observe: Watch what happens as the moist warm air in the glass jar rises and reaches the cold metal tray.

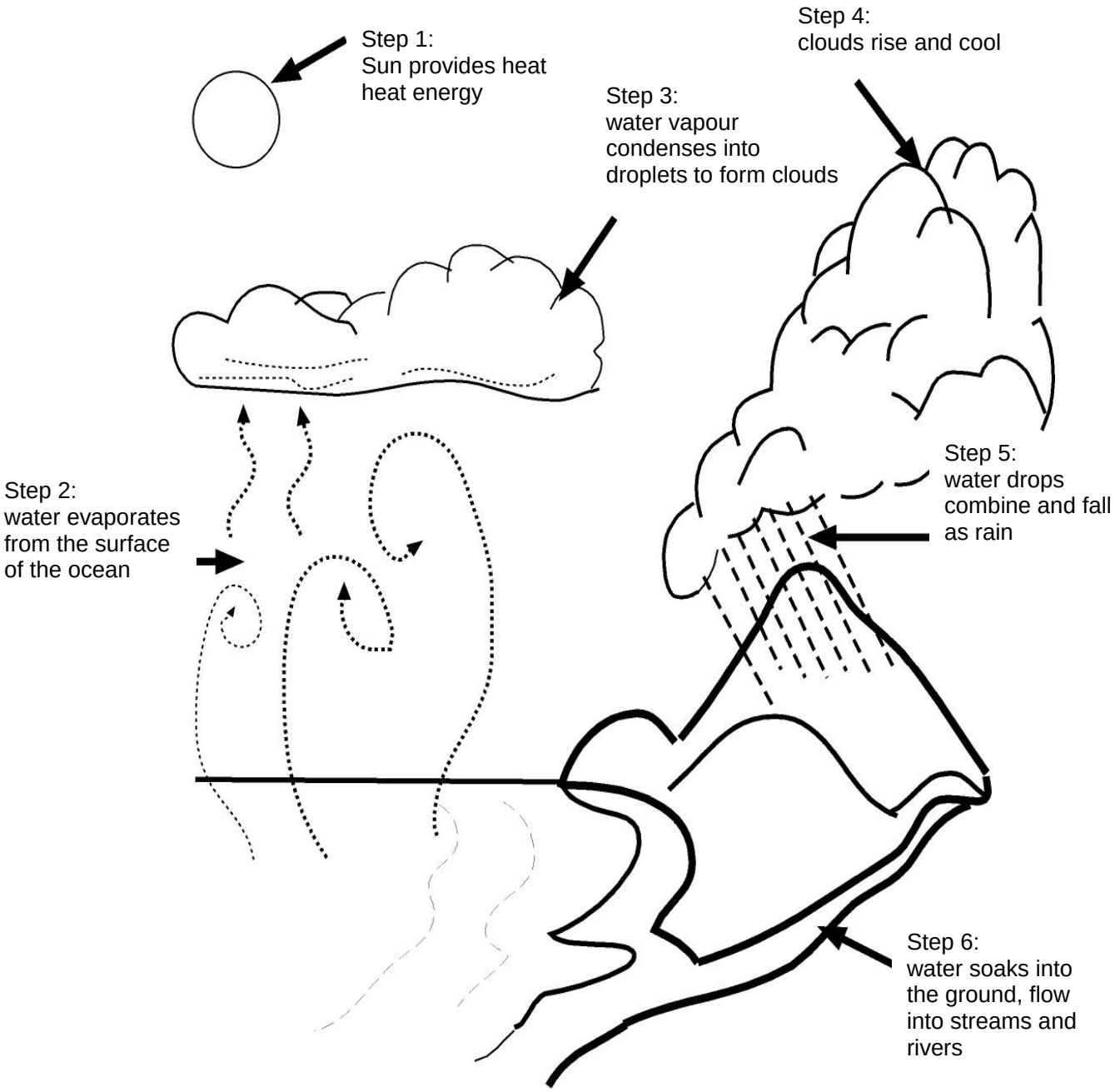
Explain: Get the children to draw their observations and write an explanation.

What we want the children to learn: Use the words evaporation and condensation.
This activity can be linked to water evaporating off the sea and cooling high in the atmosphere.
When the water vapour cools, small drops of liquid water form. These collect together to form clouds.

Activity 3.2 The Water Cycle.

What I need: Large sheets of paper and plenty of colouring pencils, pens etc.

What to do: Relate this as a story or even get the children to write a story of a water drop, after they have been through ideas about the water cycle, and become familiar with the terms.



The Story:
The story of the water cycle is all about how water is being dried up by the heat of the sun. It is happening all the time, and just keeps on going on.

STEP 1.
Heat from the sun dries up the liquid water that is on the earth's surface. The water can be in rivers, lakes, puddles, streams, plants and the ocean.
The sun dries up a lot of water from the oceans, because they are so large. Two thirds of the earth is covered in ocean.
The liquid water is turned into an invisible gas, which we call water vapour.

STEP 2
The water vapour rises into the air. As it gets higher the water vapour cools. It changes back into tiny drops of liquid water.

STEP 3
Slowly the tiny droplets of liquid water start to crowd together. This is when they form a cloud.

STEP 4
The clouds are blown over the ocean by wind. When they reach land they are forced higher into the sky. The higher the clouds go the colder it gets.

STEP 5
As the cloud gets colder the tiny droplets of water join together. They become so heavy that they cannot stay up there. They fall down to the ground as rain.

STEP 6
When the water reaches the ground, it soaks into the soil. Plants get some of the water. Some of the water ends up in puddles. A lot of the water ends up in streams, which flow into rivers. The rivers then flow into the oceans.

STEP 7
The sun warms up the water in the oceans again. It changes into water vapour and floats up to make a cloud.

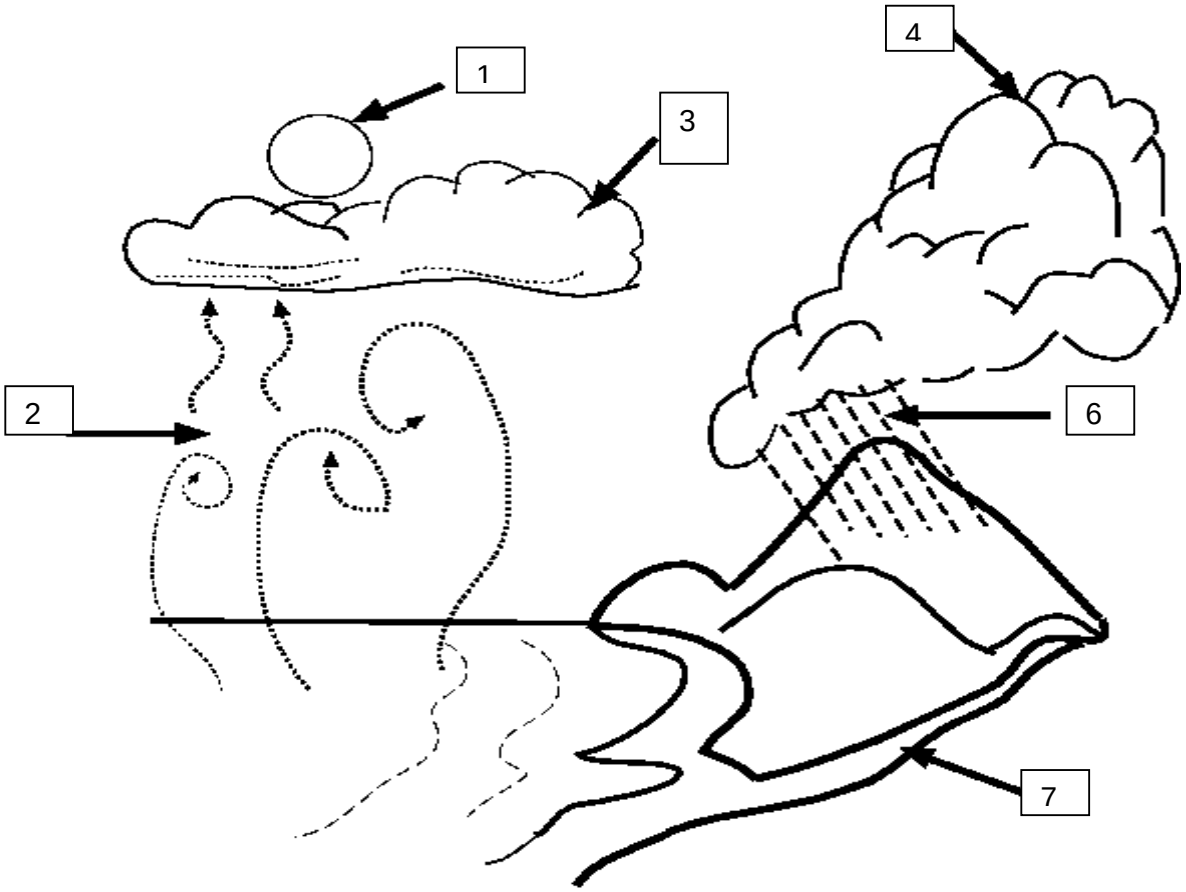
And so the cycle repeats itself.

ACTIVITY SHEET

Fill in the words to tell the story of the water cycle.

1. Heat from the …… dries up …… from the oceans.
2. The invisible …… vapour rises into the air.
3. The cool air changes the water vapour into tiny droplets of floating ……
4. The tiny droplets join together to form a ……
5. The wind blows the …… towards the land.
6. The rain soaks into the ground and ……
7. The rivers flow into the ……
8. The water …… has started all over again.
9. It never …….

Use the information to complete the diagram of the water cycle.



Question: What do they think will happen to the amount of evaporation if the seas are warmed up by global warming?

What effect could this have our weather?

Activity 3.3: Do plants give us water?

What I need: Plastic drink bottle, pot plant.

What to do:
Water the plant in its pot and tie a plastic bag over the pot and around the base of the plant to stop water evaporating from the pot soil.
Carefully cut the bottom off a large drink bottle. Keep the lid on the top of the drink bottle.
Put the plant on a flat plate.
Put the drink bottle over the plant and seal around where the bottom of the bottle and plate meet. (Use something like Blu-Tack).

Predict: Have the children write about what they think will happen.

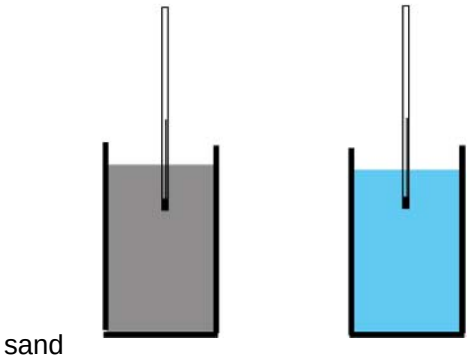
Observe: Leave the plant for three days and look at the inside of the drink bottle.

Explain: Where has the water come from?

What we want the children to learn:
Children can draw the plant experiment and write their explanations. They can use the words evaporation and condensation.

Activity 3.4 Heating Land and Sea

What do I need:, A jar three quarter full of sand, a jar three quarter full of water, two thermometers, a sunny spot



What to do:

Set up the jars with water and sand.
Put one thermometer into the sand and the other thermometer into the water.
Place in a sunny spot sheltered from the wind.

Predict: Which jar will heat up the fastest? Which jar will cool down the quickest?

Observe: Which jar heats up the fastest over a period of 60 minutes?

Explain: Ask the children if they can explain why this has happened? Get them to write down their ideas and compare with others.

What we want the children to learn: The land heats up quicker in the sun than the water.

Extension:
Put an umbrella over the jars. Take the temperature every 15 minutes.
Can you think of an explanation for what you have seen happen.

Checkpoint: What do the children think now?

Do the children now recognise the meaning of the words:

Melting, Freezing, Evaporation, Condensation.

Can they recognise that water exists in three states: solid, called ice, liquid water and water vapour (a gas)?

Can they draw pictures and use the correct words to show the changes between each state?

Can they draw pictures to show examples of the process of evaporation or condensation happening in everyday life?

For example: Clothes drying in the sun, hair drying, water on the outside of cold cans of drink…

Section 4: Weather Watch

Starter: What makes weather?

An activity that children can do in groups and then come together as a class. Make up a wall chart of their opinions.

Give five reasons why weather is so important.
Name and explain four things that make up weather.

Some information for the children:
The weather can change from day to day. We go through wet seasons and dry seasons.
The weather changes because the air is moving, we call this wind.
To get an idea of the weather patterns we build up observations of day to day weather. We can use this information about weather and make measurements.

Question: What sort of things do you think we need to record? Write down your ideas.

Teacher notes:
Hopefully the children will come up with some of the following ideas;
Sun
Cloud
Showers
Rain
Wind
Thunderstorms
Hot or Cold
Amount of rain

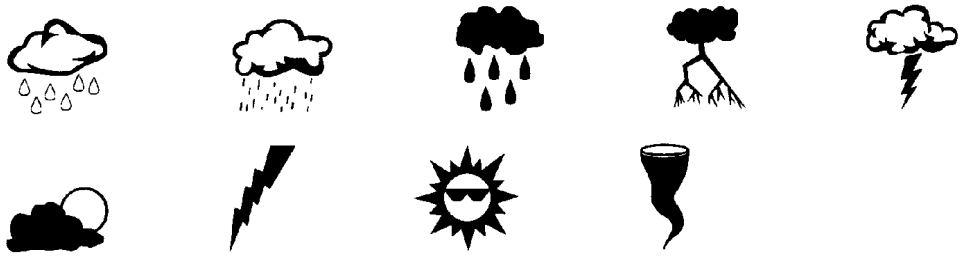
Do they need to consider what time of day they make their observations?
Does it have to be the same each day?

Allow the children to design their own wall chart to record their observations.
Have the children design their own pictures for each of the things they want to measure.

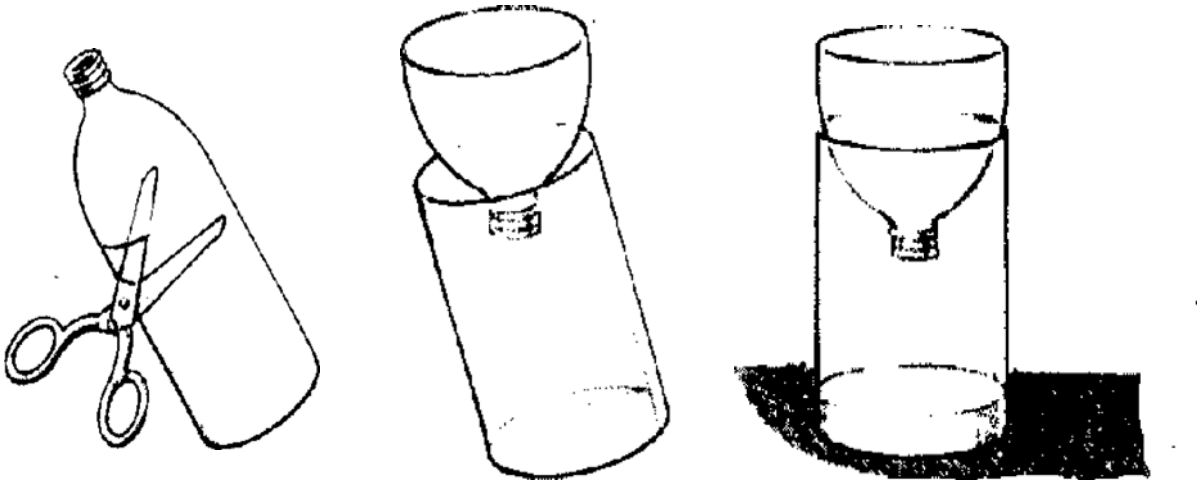
What we want the children to learn;
That building up a picture of the weather requires regular observations.
This information can help tell us if the weather is changing on a year to year basis.
Scientists use this information along with information from satellites and Argo to help explain why the changes are happening.

Some suggestions for the weather monitoring:

Some symbols that are used:



Design for a rain gauge. Requires one plastic drink bottle and a knife or scissors.
Set the rain gauge on a post or on the ground out in the open away from trees and buildings.



Thermometer: Put the thermometer in a open place, but not in the direct sun. On the sunny side but under a veranda will do fine. It should be in a place where it is open to breezes and weather. Courtyards can be a problem as the air can be quite still in these areas.