Modelling the water cycle

Children understand concepts better when they are actively involved in building their own knowledge of the concept. Hands-on investigations are good learning experiences for this reason. Another alternative successful learning strategy is to have students act out processes –those that are too big or too small to be investigated easily. When students have done investigations into condensation and evaporation, they can put the water cycle together by acting it.

Materials

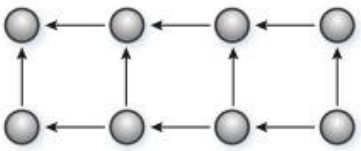
For 20-30 students:

- a space about the size of a classroom. This can be inside the classroom or outside on the ground;
- chalk if you have a concrete floor, otherwise a long piece and short piece of rope or a stick to draw lines on the sand or dirt.

Start

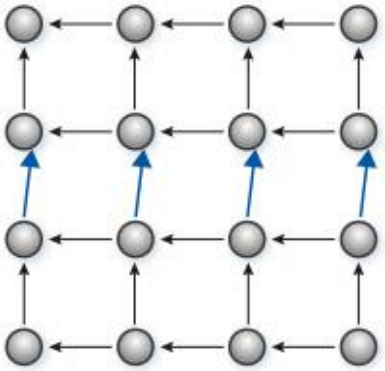
1. Call four to 6 students up to the front and stand them in a line with their left arms on the next person's right shoulder.

2. Ask 4 to 6 more students to stand in a row behind them with their right arms on the right shoulder of the person in front and their left arms on the next person's right shoulder.



3. Now line up the class behind these two rows.

4. Explain that they are all individual molecules of water.



Questions

▶ Ask the students if they know what they represent when linked together this way.

If no one knows then explain that they are molecules of water in a rigid shape, an ice crystal. Then ask the following questions.

1. Are you moving?

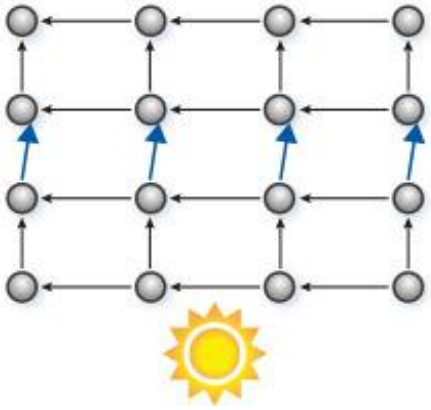
If they don't know then demonstrate how they are shivering while staying joined together as they have very low energy levels. Link being cold and shivering with the actions of the molecules.

2. What is in the spaces between the molecules?

Air is in the spaces between the molecules. This is important for later when they discuss melting ice but it is better not to go into details at this time.

3. a. What will happen if we add energy in the form of heat?

Draw a line on the floor or use desks as the boundary of their container and pretend to add heat. The bonds will break, first the ones closest to the heat source, and the molecules will move apart. The heat source could be the sun above them.



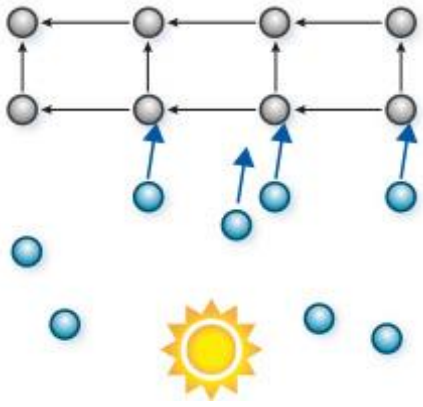
3. b. What do water molecules do?

Have them move relatively slowly, bouncing off the walls of the container and each other.

4. What will happen to the molecules when you add more heat?

Introduce/remind them about evaporation. Talk about water vapour rather than steam, then add the energy. Have some molecules move up out of the container – evaporation, then all molecules become water vapour.

Students will be running around the room at this stage – and could escape out of any open doors!

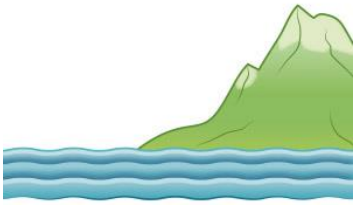


5. Explain that they need to keep this information in their heads as they are still individual water molecules.

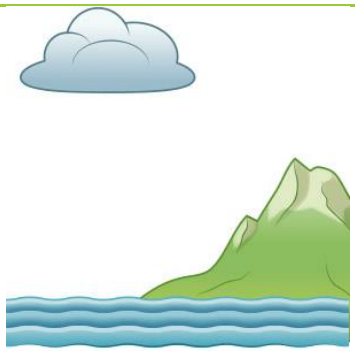
Follow-up

The following numbers are for a class of 24. Adjust the numbers in proportion if there are more or less children in the class.

Draw a line about 5-6m long on the ground. This represents the sea. Alternative: use a rope.

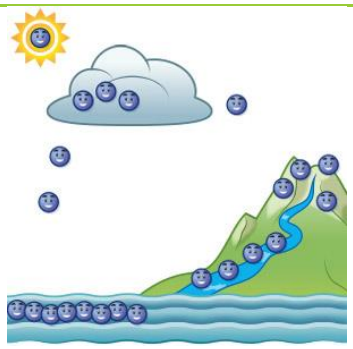


Now add another line about 3m long running up from the sea. This will represent the land and the mountain inland.



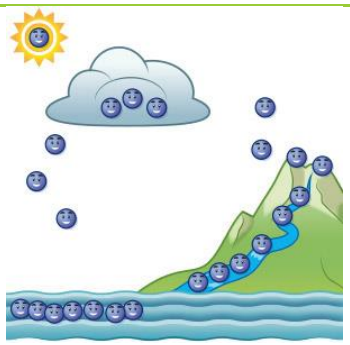
Draw a cloud shape above the sea and higher than the land. It should be large enough for 4 to 6 children to stand in.

Now draw a river leading to the sea. Draw a sun in a corner. 1 child stands as the sun.



Now place the children in the following positions on the picture.

- 3 children stand in the cloud
- 2 children are precipitating from the cloud to the mountain
- 4 children stand on the mountain
- 4 children stand in the river
- 8 children stand in a line in the ocean
- 2 children are evaporating from the ocean to the cloud

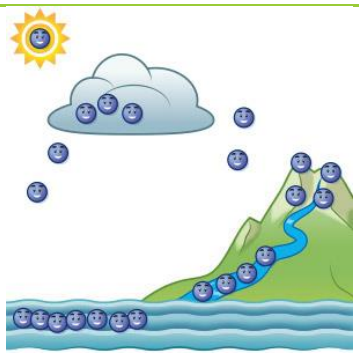


Trial run:

The energy that drives the water cycle comes from the sun. The sun's heat warms up the water.

The 'sun' beats their arms up and down once. This represents one packet of heat energy.

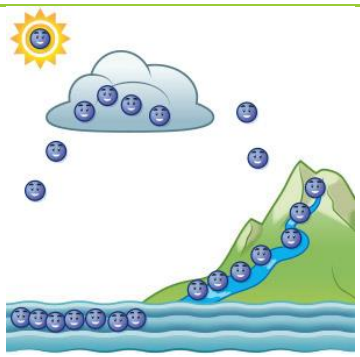
All the students except those in the cloud take 1 step to their left. *This gives them the idea of what movement and direction they have to take.*



Back in the original positions, the sun beats their arms one cycle.

All the students in the sea step to their left except the students in the cloud (they stand still).

Note: *It pays to do this very slowly at first.*



Next beat of the sun:

The students in the sea take another step to the left. This time the student at the very end moves up towards the cloud.

One extra student is added to the cloud. No one in the cloud moves.

The rest of the students also take a step to the left.

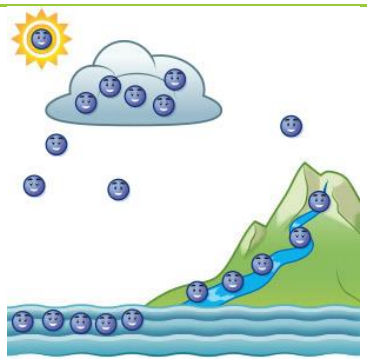
Water is now moving off the mountain into the river.

Water is flowing down the mountain.

Rain is falling onto the land.

Freezing on the mountain top.

Melting as it moves down the mountain.



Next beat of the sun:

The students continue their movement.

There are five students in the cloud.

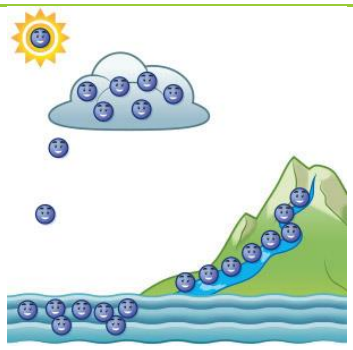
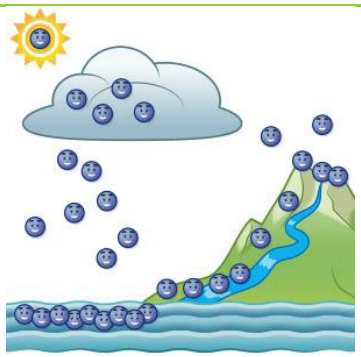
Two students are stepping up towards the cloud.

One student is now on the mountain top.

Students are moving down the mountain along the river.

Some are melting snow.

Students in the river are taking steps into the sea.

		
The sun beats. Everyone takes a step. The cloud now has 6 students.	**The sun beats.** Everyone steps. The original 3 students in the cloud now step out of the cloud one at a time and move towards the hill. The students on the mountain take a step towards the river. The students on the river move one step onto the sea.	**The sun keeps beating.** For each beat the students take one step. *Let the students continue for another two cycles so they can get an understanding of what they have to do.* *It is important that they remember that a total of six students have to be in the cloud to move and then only three of them can move out.*

Adding the language

▶ Go around the circle and ask the students what they are doing at each stage:

evaporating, condensing, precipitating, freezing, melting, flowing.

▶ Send them around once or twice saying these terms out loud.

Adding the science

▶ Introduce the actions of the molecules – **what do they think they would be doing as molecules at each stage?**

- Evaporation - moving fast with lots of energy, not necessarily in a straight line.
- Condensing - shivering/shaking with loss of energy. Slow movement.
- Precipitating – trickling down as rain or snow
- Freezing - shivering/shaking on the spot
- Melting - warming up, moving slowly
- Flowing - swimming down the river

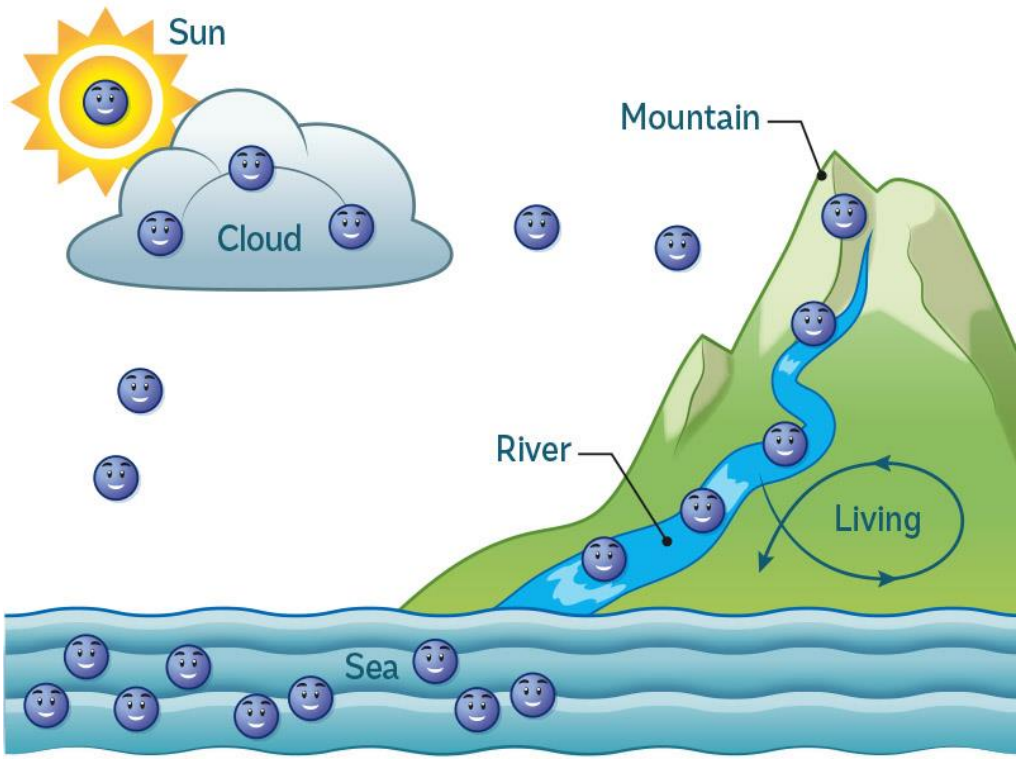
• Sea - slowly swimming

The final cycles will be very noisy and have lots of student action which they will enjoy.

▶ Then ask a question – **does all the rain that falls flow straight back to the ocean?**

No. A lot of water goes into living things – our bodies are 70% water.

Introduce another circle going in an anticlockwise direction from the river. Every second participant coming down the hill will go around this circle and say "living" as they go.



QUESTIONS

1. Where did the energy for the water movement come from?

The sun.

2. Where did the water molecules spend most of their time?

In the ocean.

Note: This cycle takes about 100 years. It can take a lot longer if the water falls as snow or ice. It takes about 10 days for evaporated water molecules to condense in a cloud. Water can stay in the ocean up to 3000 years before evaporating.

Something extra

Try the same activity with the sun being brighter – bigger movements – and relate this to the seasons with the sun directly overhead.

- The students in the sea take 2 steps per beat.
- The cloud fills to 4 then loses 2.
- The students on the mountain take 2 steps per beat.
- The river movement stays the same.

Similarly, the action can be slowed for the cooler seasons.