



Physical Weathering - Teacher's Notes

Physical Weathering

This activity can be performed in class or sent home as a Palms Parent Power project, so that parents can follow what is happening in Science this term.

It is very common for students to confuse weathering and erosion.

Weathering is the destructive process by which rocks are broken into smaller pieces whereas erosion occurs when these small pieces are moved away from the parent rock.

Weathering can be due to:

1. **Physical processes** E.g. heat from the sun in summer or cold in winter
This type of weathering only changes the size of the rock pieces. Frost can shatter damp rocks when the ice expands in cracks within the rock forcing it apart. Physical impact from other rocks or even meteorites can also break down, shatter into dust and even melt rocks.
2. **Chemical processes** E.g. when acid groundwater passing through limestone makes caverns underground.
3. **Biological processes** E.g. when tree roots growing into cracks in rocks force them farther and farther apart until the rock is broken into pieces.

Physical processes do not change the chemistry of the rocks.

Physical weathering due to cold temperatures.

Rock itself is not much affected by cold temperatures but any water trapped in cracks or pores in the rock will expand and force the pores and cracks apart. This is called "frost wedging"

ASIDE: Scientists were fascinated to discover that water actually expands when cooled. When most substances become cooler the kinetic energy of



Santos & ESWA supporting earth science education



Physical Weathering - Teacher's Notes

their molecules decreases reducing their volume. Ice crystals take up more room than water molecules resulting in what is known as "**The anomalous expansion of water**". This explains why wine placed in the freezer to cool should never be left there. The expansion of water in the freezing wine forces out the cork or cracks the bottle!

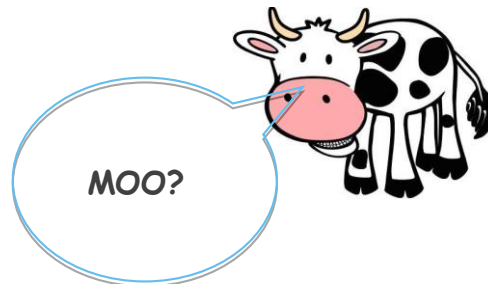
This activity requires empty cool drink bottles and a freezer. I have included a **PPP** (Palms Parent Power) worksheet for those students who can take it home and do the experiment with their parents. However, it can also be done in class or as a teacher demonstration.

It is probably a good idea to wash all the bottles in detergent or bleach before using them. Dissolved material in water causes it to freeze at a lower temperature. This is why salt is spread on road surfaces prone to freezing to reduce ice cover.

Good scientific data is observable and measurable.

To ensure this is a "Fair test" we have to ensure that the **Cow Moos Softly**

Change one thing
Measure one thing
Everything **e**lse **S**tays the **S**ame



Materials per group

- Permanent marker or masking tape
- Ruler
- Two empty clean cool drink bottles
- Water
- Freezer
- Option - calculator





Physical Weathering - Teacher's Notes

Method

1. Fill both bottles with water to a height of 10 centimetres, and write your group name on the base of each.
2. Place one bottle in the freezer overnight and leave the other in your classroom. The bottle in the classroom is the **CONTROL** against which any change due to freezing can be measured. This bottle is the **same** as the experimental bottle but will not be frozen. The bottle to go in the freezer is the **EXPERIMENTAL** bottle.

Predict what you think will happen after the bottle has been in the freezer overnight - **answers will vary**

3. The next day remove the bottle and measure the height of the ice in the bottle.

Observations

What was the one thing we changed? **Temperature of the environment the bottles were in.**

What was the one thing we measured? **The height of water in the bottle.**

Did everything else stay the same? **Yes**

Is this a "Fair Test?" **Yes**

What happened to the water level in the frozen bottle? **It rose about 1cm.**

What was the original height of water before freezing? **10cm**

What was the height after freezing? **11cm**

What fraction of the original height is this increase? **1/10 or one tenth**

Extra for experts

If we had doubled the amount of the water in the experimental bottle would the fraction of increase be twice as much? **No it would still be one**





Physical Weathering - Teacher's Notes

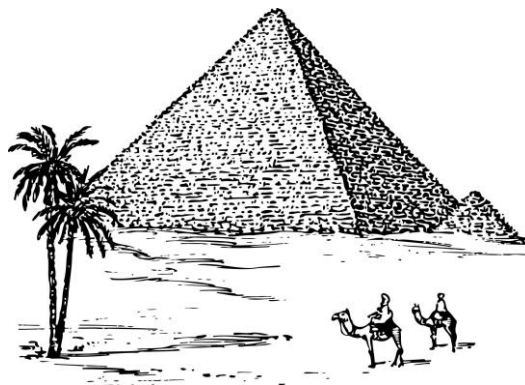
tenth of the original volume

Discussion

Water is the only liquid that expands when it gets cooler. How can trapped water freezing break up rocks?

In areas where cold weather causes frost cold can break up rocks and cause the ground to heave up and collapse on thaw. Water is the only substance that expands when it freezes. Earlier scientists would have called this "The anomalous expansion of water". When water molecules cool, unlike other chemicals, molecules rearrange so that they take on a new shape, which unusually (or anomalously) takes up more space than the original liquid. This explains "Frost Heave", when freezing temperatures causes building foundations to rise when the soil expands on freezing and collapses on thaw. Large stones, with water trapped under them slowly migrate upwards to the soil surface. Children on farms used to be sent out into the fields to pick up these stones and leave them at the sides of the fields to make spring ploughing and harrowing easier.

Ancient Egyptians poured water into channels they had chiseled into sandstone to let the cold desert nights split blocks for building the pyramids.



Santos & ESWA supporting earth science education