

ABSTRACT

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CATEGORY	<u>Earth Science</u>	STATE REGION #	<u>6</u>
SCHOOL	<u>Queen of the Rosary</u>	IJAS SCHOOL #	<u>6096</u>
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EXPERIMENTAL INVESTIGATION

MARK ONE:



DESIGN INVESTIGATION ☐

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* If this project is awarded a monetary prize, the check will be written in this scientist's name, and it will be his/her responsibility to distribute the prize money equally among all participating scientists.

PROJECT TITLE Gone With Water

I. Purpose:

The purpose of this experiment is to see which material out of a selected group, will erode the most at certain angles. Our hypothesis is: if testing different materials erosion rates, then the smallest aggregate size will erode the most.

II. Procedure:

We put various samples of aggregates on an aluminum ramp that was clamped to a mounting structure at various test angles. We allowed water to run into the top of the ramp for one minute, allowing the water to flow through the samples. We weighed the material that eroded away and recorded the data.

III. Conclusion:

Our hypothesis was not proven correct. Silt, although the smallest aggregate, got sticky when wet and it held in place. It eroded less than expected. Peat moss (the 4th smallest), eroded the fastest because it was light and it floated.

- 1) Limit Abstract to 3 paragraphs (about 200 words or less). a) Purpose - what you set out to investigate; b) Procedure - how you did it; c) Conclusion - based on your results. Label each paragraph.
- 2) Must be typed, single-spaced on the front of this form. Do not write on the back of this form.
- 3) Three copies of your complete paper are required at the State Science Project Exposition. Four copies of your complete paper are required for the State Paper Session Competition.

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SAFETY SHEET

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Directions: The student is asked to read this introduction carefully, fill out the bottom of this sheet, and The science teacher and/or advisor must sign in the indicated space.

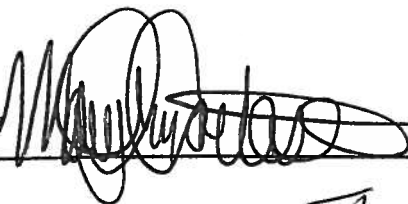
Safety and the Student: Experimentation or design may involve an element of risk or injury to the student subjects and to others. Recognition of such hazards and provision for adequate control measures are responsibilities of the student and the sponsor. Some of the more common risks encountered in research are the electrical shock, infection from pathogenic organisms, uncontrolled reactions of incompatible chemicals, eye from materials or procedures, and fire in apparatus or work area. Countering these hazards and others with safety controls is an integral part of good scientific research.

In the box below, list the principal hazards associated with your project, if any, and what specific precautions you used as safeguards. Be sure to read the entire section in the *Policy and Procedure Manual of the Illinois Academy of Science* entitled "Safety Guidelines for Experimentation" before completing this form.

Safety precautions taken in our experiment were as followed:

1. Plastic Latex gloves were worn to protect our hands of harmful items that may have been found in our test samples.
2. Safety glasses were also worn to protect our eyes from the dust that some of our test samples produced.
3. Disposal respirator masks were worn to help prevent the inhalation of harmful dust.
4. Our work area was kept clean, to prevent possible contamination and mishaps.

SIGNED

 Jimmy Barak, Melissa Cortese
Student Exhibitor(s)

SIGNED

 Shirley Rung
Sponsor *

*As a sponsor, I assume all responsibilities related to this project.

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GONE WITH WATER

*Mary Ann Cortese, Jennifer Banak, and Melissa
Cortese*

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Finally, we would like to thank and acknowledge our lovely science teacher Mrs. Shirley Runge. Without her help and advice none of this would be possible.

Purpose

The purpose of this experiment is to see which material, out of a selected group, will erode the most (when placed at a certain angle).

Hypothesis

If testing different materials erosion rates, then the smallest aggregate size will erode the most.

Review of Literature

Material Erosion Rates

This experiment was performed to see which material, out of a selected group, would erode the fastest, when placed a certain angle. The materials our experiment tested were fine sand, coarse sand, limestone screening, small pea gravel, large pea gravel, peat moss, silt, and dirt. Research was done on the process of erosion and each material.

Process of Erosion

“The face of the earth is a rocky surface consisting of mountains, volcanoes, and plateaus. However, the rocks are constantly being broken down into smaller fragments and transported to other places along Earth’s surface. At the same time, new surface features are being built up by other forces. Thus, the Earth’s surface is constantly undergoing change.” (Coombs, 2002)

Erosion is the process that breaks materials down. In geography, erosion is the break-down of rocks over a certain period of time. Denudation is the process of erosion, which is the overall effect of breaking down and weathering. In nature, large substances are made smaller by the processes of weathering and erosion. Both weathering and erosion happen in a downhill direction. (http://www.geography4kids.com/files/land_erosion.html [online].)

Some agents of erosion are wind, glaciers, and running water. Wind is the main agent of erosion in dry areas. Wind-driven particles of sand and dust cut into the rock and wear it away. This constant action of the wind decomposes the weaker particles of the rock, causing the rest of the rock to wear away. Sand storms and dust storms carry the sand from one place to another. (Heart-Davis, 2009)

Glaciers are huge sheets of ice that can be hundreds of feet thick. Glaciers move very slowly picking up and moving sediment with them as they go. The sediment then wears away the

rock and land over which the glacier moves. Glaciers may form river valleys; round off mountain tops, and cut holes into the earth's surface which can later be filled with water to make lakes.

Glaciers form and change earth's surface. (Heart-Davis, 2009)

Running water is the main agent of erosion affecting the earth's surface. Running water carries and picks up a large number of materials, such as sand and pebbles. Running water also drags larger and heavier particles, such as gravel, along the river's bottom. As the water is flowing, these particles wear away the rock, sand, and land over which the water flows. Running water can create valleys over a long period of time. (Heart-Davis, 2009)

"In earth science, deposition is the dumping of a load carried by a river, glacier, or the sea. Deposition occurs when the river, glacier, or sea is no longer able to carry its load for some reason, for example shallowing of gradient, decreasing speed, decreasing energy, decrease in the volume of water in the channel, or an increase in the friction between water and channel. Glacial deposition occurs when ice melts. Many types of deposition are found along the course of a river." (<http://www.talktalk.co.uk/reference/encyclopaedia/hutchinson/m0097882.html>[online])

Deposition is the natural process in which material is laid down. Sediment is deposited in bodies of water, and other low lying areas. In these places, sediment may be pressed and cemented together by minerals dissolved in water to form sedimentary rock. (Kaska, Clay & Bruton, etal, 2007)

When the agents of erosion drop the materials they have been carrying, the deposits form new physical features on the Earth's surface. As parts of Earth's surface wear away over time, new parts are being formed. (Heart-Davis, 2009)

Wind carries sand and dust. When wind loses its velocity or hits another obstacle in its path, the wind deposits the material it had been transporting. Over time a mound of sand, or a

sand dune, is built. Sand dunes are found along coastal regions and on shores of lakes. Sand causes great damage when transported by wind. The Dust Bowl is one example of the harm and devastation sand and dust storms may cause. (Rothery, 2008)

Glaciers carry rocks, sand, and clay. Glaciers travel long distances and carry large amounts of rocky materials with them. When a glacier reaches a region of higher temperatures, the glacier melts and deposits its load over a wide area. Glaciers can cause damage by depositing loads of rock and boulders in fertile soil. Glaciers can also form flat stretches of fertile land, called plains. (Rothery, 2008)

Ground water carries dissolve lime stone. Ground is water absorbed by the Earth. If ground water containing carbon dioxide flows over limestone, the limestone will dissolve and be carried away by ground water. Eventually over time, this constant process may form caves. Water containing dissolved lime stone may drip from the ceilings of caves and form icicle like formations of solid limestone, called stalactites. Smaller formations of limestone, stalagmites form on the floors of caves. (Heart-Davis, 2009)

Running water carries sand, pebbles, and rocks. When the speed of running water is slowed, the water will deposit its sediment. When deposited, the larger particles settle at the bottom, the smaller particles lay on top of that, thus producing the layers of sediment. Deltas form when a river deposits its sediment in a quiet body of water. A delta may continue to build up into a large piece of land. Deltas are composed of very fertile material, making this land a very great agricultural area. Flood plains are created when heavy rains or the melting of snow and ice, results in an increased amount of water carried by the river, causing the river to flood or overflow. The speed of the river is then reduced, and the fine, fertile material is deposited over

large areas on both sides of the river. These regions are also rich agricultural regions. (Coombs, 2002)

“Water deposits its material in a definite order: first rocks, second pebbles and sand, and finally the fine particles of clay.” (Coombs, 2002)

Weathering is the process by which rocks are being broken down into smaller fragments by the atmosphere. There are two types of weathering: Chemical weathering and mechanical weathering. (Rothery, 2008)

Weathering

Mechanical weathering is the breakdown of rock in which no change in chemical composition occurs. Temperature change is an example of mechanical weathering. The sun heats rocks during the day and they cool off at night. During the day, the outside of the rock expands more than the inside of the rock. This unequal expansion and contraction causes the rock to split and break apart. Frost action occurs when water sometimes seeps into the pores or cracks of rocks and later freezes. When the water freezes, it expands and causes a force great enough to split the rocks into smaller pieces. The roots of plants may find their way into small cracks in rock. When the roots grow they make the cracks larger, eventually causing the rocks to split. (Rothery, 2008)

Chemical weathering is the breakdown of rock in which a chemical change occurs. The most common types of chemical weathering are oxidation, hydrolysis, and carbonation. Carbon dioxide mixed with water also is an example of chemical weathering. This is called acid rain. (<http://www.kidsgeo.com/geology-for-kids/0067-chemical-weathering.php>[online])

“Weathering is making rocks and soil into smaller pieces. Weathering is caused by water, ice, and growing plants.” (Riley, 2007)

Weathering and erosion come with effects. Weathering and erosion can cause changes in the slopes and texture of rock structures, hills, and valleys, landslides, buildings, statues, and roads to wear away, can wash soil, pollutants, and harmful sediment from the roads and farms into waterways, materials to oxidize (or rust), and reduce the area of a beach or a shoreline.

(http://siemensscienceday.discoveryeducation.com/support-center/pdf/5-Minute_weatheringanderosion.pdf[online])

“Mother nature is not the only force that can cause weathering and erosion. Humans cause erosion at a rate 10 to 15 times faster than any natural processes, according to new research by Bruce Wilkinson, a sedimentary geologist. The main cause of man-made erosion is agriculture, followed by construction and mining. Reports in recent years show erosion rates decreasing in the United States, which has invested billions in improved farmland conservation practices, said Mark Nearing, a soil scientist and erosion expert for the U.S Department of Agriculture. “However, those figures do not take into account recent climate changes that are again accelerating erosion”, he said. (http://www.msnbc.msn.com/id/15993162/ns/us_news-environment/t/humans-said-have-huge-impact-erosion/#.UKmQpuTLSf4[online])

As humans we can help prevent erosion. Some ways that we, as humans, can prevent erosion are by: planting vegetation, using geotextiles, spreading mulch and some fertilizers, constructing retaining walls, and by providing proper drainage systems.

(<http://www.erosionpollution.com/ways-to-prevent-soil-erosion.html>[online])

Water

Water, or H₂O, is made up of two atoms of Hydrogen and one atom of Oxygen. It is a tasteless, odorless, and clear, at its natural state, liquid. Its freezing point is at 0°C and its boiling point is at 100°C. (Woodward, 2009)

Oceans, the world's largest bodies of water, make up 71% of the Earth's surface. Only 3% of the water on Earth is fresh water, but three quarters of it is frozen into ice. (Woodward, 2009)

The water cycle is the continuous movement of water from the ocean to the atmosphere to the land and back to the ocean. The processes that are used in the water cycle are: Evaporation, Condensation, Precipitation, Percolation, and Run Off. "Evaporation is when energy from the sun causes water from the Earth's surface to gain energy and change into water vapor. Condensation is when water vapor cools and changes into water droplets that form clouds in the atmosphere. During this process water loses energy. Precipitation is any form of rain, sleet, snow, or hail that falls from the clouds onto the Earth's surface. Percolation is the downward movement of water through pores and other spaces in soil due to gravity. Runoff is precipitation that flows over land into streams and rivers, and later into the oceans." (Kaska, Clay & Bruton, etal, 2007)

Erosion is the wearing away and removal of soil and rock fragments at the surface of the earth by wind, water, ice, or other natural agents. (Coombs, 2002)

Streams cause more erosion than all other geological agents combined. When the water's volume and velocity increase, the process of erosion speeds up. Transported sediment and rock fragments can deepen or widen the stream because they knock or rub against each other to wear them down. Also, the continuous flow of water on an object can cause it to wear down. (Rothery, 2008)

When water freezes it forms ice. When large amounts of water freeze, large pieces of ice called glaciers are formed. Glaciers are powerful erosion agents as well. As it moves, glaciers pick up sediment and rocks and they become embedded in the ice. The glaciers than transport

Clay soil is very slippery and wet. It can hold large amounts of water but when it is completely dry, it becomes very hard. Clay is normally brown or gray, but can also have many different colors. Clay is formed when other rocks become weathered. Clay becomes rich on nutrients because of this. Many trees and bushes that grow in thick clay soil have a hard time growing through the clay and can't find water. Clay also doesn't release enough water. Air cannot circulate around the roots because they cannot get past the clay. Clay particles are the smallest of the soil particles.

Cement is made up of clay, sand, and gravel. People need soil because it holds plants and these plants give us oxygen to breathe. Soil helps keep the water clean in lakes, and rivers. The soil traps harmful chemicals before they reach the water. (Aloian, 2010)

Soil doesn't always stay in one place. Wind, water, and ice carry soil from one place to another. This process is called erosion. Natural erosion and human erosion can also happen. Soil that is made up of sand or silt erodes more quickly because the particles are large and can be moved more easily. Soil takes about 3,000 to 12,000 years to reach the stage in which farmers can start to grow their crops.

Soil can also be ruined by pollution. If farmers put harmful chemicals on crops, the chemical will seep into the ground and then be picked up and dropped on another field. This field could use the insects that are killed by the chemicals.

Rain forests are also very important because they hold many trees and grasses that grow in the soil. If the forest is destroyed then the greens are destroyed too and we don't have oxygen. Loss of soil will also affect humans because if there is no soil, there is no farming and no food which would lead to starvation.

Soil pollution also hurt our water and food supplies because if there is no clean water there is no water for our body. It affects our food supply because crops need water to grow and no water means no crops. (Hyde, 2010)

Sand

Sand is a grain that is smaller than gravel but larger than mud. Sand is made of pieces of rock that have been broken down into small pieces over time. Sand can be made of shells and crystals. Sand can be many different colors. When waves crash onto beaches, they bring bits of coral and shells onto the sand. These are mixed with the sand that already has been mixed. Sand can be moved by water, wind, and ice. (Prager, 2000)

Gravel

“Gravel is made up of small rocks. It can be a mixture of sand, clay, and small pieces of rock. It is sedimentary rock and usually found near water, or where, rivers, lakes, and glaciers are. It forms when rocks have been weathered by wind or water or eroded. ”

(<http://library.thinkquest.org/05aug/00461/gravel.htm>[online])

Materials

- 120 glass baby food jars with caps (with ridges at top and smooth)
- 780g of silt
- 1,530g of coarse sand
- 1,560g of fine sand
- 1,140g of large gravel
- 1,380g of small pea gravel
- 270g of peat moss
- 780g of dirt
- 1,620g of limestone screening
- wooden support system
- Water (measurements differ for each test)
- Timer (iPod timer used)
- Tape measure
- Manual water spigot
- Digital kitchen scale (that measures in grams) (weights up to 4.53 kg.)
- 91cm by 10.5cm aluminum ramp
- 50 white computer labels
- 3 shims (wooden)
- 3 rags
- 1 roll of paper towels
- 3 (60cm by 40.5 cm) metal trays
- 2 (28, 18.9 liter) all purpose buckets

- 8 clear plastic cups (473mL)
- 8 aluminium pans (1,323mm by 23mm by 63mm)
- 8 (72g) plastic containers
- 3 tablespoon measurers
- 15cm by 15 cm sifter
- 1 wooden sample measurer
- 1 ruler (centimeters)
- 1 plastic clamp
- 1 level
- 1 ketchup bottle
- 3 pairs of safety glasses
- 3 pairs of latex gloves
- 3 dust protection masks
- 1 roll of thin, red masking tape

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11. Record the new mass of each jar after water was added.
12. Label the materials by putting half of a white computer label on the cap and abbreviating the name of the material.
13. Put the materials on the 60cm by 40.5 cm metal trays behind their label, grouped together.
14. Make a wooden sample measurer, as shown in figure 2, to make sure all the materials are put at the same place on the aluminum ramp.
15. Take the 91cm by 10.5cm aluminum ramp and make a black dot, with a sharpie, that is 1cm by 1cm that is 6cm away from the edge closest to the bucket. This is where the water will hit every time.
16. Make a brown line, with a sharpie, that is 28.2cm away from the end closest to the bucket, and another line that is 2cm away from the first one on the inside of the ramp.
17. Take the steel ramp and clamp it, at 0°, to the wooden structure so that the spigot lines up with the black dot.
18. Make sure that the structure is level.
19. Place a 60cm by 40.5 cm metal tray, with a bucket on it under the aluminum ramp, so that the extra water and waste material can flow into it.
20. Place the wooden sample measurer and place it between the two brown lines.
21. Fill it with the material. Make sure all of the material gets in.
22. Remove wooden sample measurer so that all the material is in a nice neat pile. Note: If some of the material separates or falls down the ramp, take a wooden shim and push it back into the pile. Any extra material that is left on the wooden sample measurer should be put into the pile.

Variable Table

Independent Variable	Type of material, (angle material is placed at)
Dependent Variable	Erosion rate
Constant	Water speed, time, mass of materials, amount of water used for each trial
Control Group	Dirt at a 0° angle

Results

The results of our experiment, testing the erosion rates of eight materials, showed that peat moss had the highest average erosion rate with 97.75% of erosion at all angles. Large gravel had the lowest average erosion rate with 0% of erosion at all angles.

The average results for the 20° state that fine sand had the highest average erosion rate, followed by peat moss in second, dirt in third, and coarse sand in fourth. The next four average erosion rates state that limestone screening came in fifth, silt in sixth, small pea gravel in seventh, and large gravel in eighth.

The average results for the 15° angle state that peat moss had the highest average erosion rate followed by fine sand which took second, dirt in third, and limestone screening in fourth. The next four average erosion rates state that silt came in fifth, coarse sand in sixth, with a tie between small pea gravel and large gravel of the last two places.

The average results for the 10° angle state that peat moss had the highest average erosion rate, followed by dirt which took second, limestone screening in third, and fine sand in fourth. The next four average erosion rates state that silt took fifth, coarse sand took sixth, small pea gravel in seventh, and large gravel in eighth.

The average results for the 5° angle state that peat moss had the highest average erosion rate, followed by fine sand which took second, limestone screening in third, and dirt in fourth. The next four average erosion rates state that silt came in fifth, coarse sand in sixth, and a tie between small pea gravel and large gravel for the last two places.

The average results for the 0° angle state that peat moss had the highest average erosion rate, followed by fine sand which took second, limestone screening in third, and

coarse sand in fourth. The next four average erosion rates state that dirt, silt, small pea gravel, and large gravel were tied for the last four places.

When testing peat moss, the average erosion rate at 0° was 94.25%. The average erosion rate at 5° was 100%. The average erosion rate at 10° was 96.55%. The average erosion rate at 15° was 99.43%. The average erosion rate at 20° was 88.51%. The average erosion rate at all angles was 95.75%.

When testing fine sand, the average erosion rate at 0° was 22.04%. The average erosion rate at 5° was 55.65%. The average erosion rate at 10° was 39.52%. The average erosion rate at 15° was 93.28%. The average erosion rate at 20° was 95.70%. The average erosion rate at all angles was 61.24%.

When testing dirt, the average erosion rate at 0° was 0%. The average erosion rate at 5° was 33.33%. The average erosion rate at 10° was 75.79%. The average erosion rate at 15° was 81.35%. The average erosion rate at 20° was 66.27%. The average erosion rate at all angles was 51.35%.

When testing limestone screening, the average erosion rate at 0° was 12.95%. The average erosion rate at 5° was 37.19%. The average erosion rate at 10° was 54.56%. The average erosion rate at 15° was 75.21%. The average erosion rate at 20° was 61.71%. The average erosion rate for all angles was 48.32%.

When testing silt, the average erosion rate at 0° was 0%. The average erosion rate at 5° was 12.28%. The average erosion rate at 10° was 10.09%. The average erosion rate at 15° was 50.88%. The average erosion rate at 20° was 57.02%. The average erosion rate at all the angles was 26.05%.

When testing coarse sand, the average erosion rate at 0° was 0.77%. The average erosion rate at 5° was 4.62%. The average erosion rate at 10° was 1.79%. The average erosion rate at 15° was 43.85%. The average erosion rate at 20° was 63.85%. The average erosion rate at all the angles was 22.97%.

When testing small pea gravel, the average erosion rate at 0° was 0%. The average erosion rate at 5° was 0%. The average erosion rate at 10° was 0.36%. The average erosion rate at 15° was 0%. The average erosion rate at 20° was 3.99%. The average erosion rate at all the angles was 0.87%.

When testing large gravel, the average erosion rate at all angles was 0%.

Possible experimental error is as followed:

- Steel ramp (trough) was not exactly put on incline angle line
- Water speed was not the same for each test
- Trials were done manually with a manual water spigot
- Water wasn't spread evenly through trough during trials

Experimental error was reduced by creating a scale with incline angles 0, 5, 10, 15, and 20 degrees, making sure the steel ramp was exactly placed and clamped on the exact angle line. Possible experimental error for differences in water speed was reduced by placing a mark on the manual water spigot, turning the handle to the line every time, and by using the same water spigot for every trial. To prevent the possibility of water not spreading evenly throughout the steel trough, fingers were ran across the steel trough to make the water flow evenly.

Conclusions

The hypothesis, if testing different materials erosion rates, then the material with the smallest aggregate size will erode the most at each angle, was not proven correct. Peat moss had the highest average erosion rate at all angles, but was not the smallest aggregate size. Peat moss eroded the fastest because it was the lightest and it floated. Silt, although being the smallest aggregate size, did not erode the fastest. This was due to the particles of silt being stuck together when they got wet, causing the silt to become denser and erode less. Large gravel had the lowest erosion rate at all angles. Large gravel did not erode the fastest because of its size and mass; consequently water flowed easily through the trough.

Overall, peat moss had the highest erosion rate, out of all eight materials (at all angles). Large gravel had the lowest average erosion rate, out of all eight materials (at all angles)

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