

Science

Fair

Logbook

By: Jiya

Sidhu

Science Fair Ideas

- How can soil erosion be prevented?
- What colour light helps plants grow the best?
- Which door handle has the most bacteria?
- Does a light switch, door knob, or a tap handle have the most bacteria?
- How does temperature affect the growth of mold on bread?
- Does hand sanitizer or hand wipes clean more bacteria?
- Which toothpaste is most effective?
- What is the most effective surface spray brand?
- Is sanitizer or hand wipes more effective?
- Which brand of detergent removes stains the best?

Big Question: Dec 7, 2023

How can soil erosion be prevented? I want the answer to this question because I want to protect our environment and the top fertile layer of our soil.

Research Questions:

1. What is soil erosion?
2. What causes soil erosion?
3. Why is soil erosion damaging?
4. What are the major issues related to soil erosion?
5. Is there anything people can do to prevent soil erosion?
6. Why is it important to prevent soil erosion?
7. What is the difference between soil erosion and wind erosion?
8. Which organizations are trying to prevent soil erosion?
9. What does Weaselhead do to prevent soil erosion?

What is Soil Erosion: Dec 12, 2023

Soil erosion is a gradual process of wearing away a surface's topsoil. It occurs when rocks and soil are worn away over time with water. Water causes erosion because it removes the soil particles, although more soil will wash away if there is a sloped surface.

1. <https://crops.extension.iastate.edu/encyclopedia/soil-erosion-agricultural-production-challenge#:~:text=Soil%20erosion%20is%20a%20gradual,have%20become%20severe%20problems%20worldwide>

What causes Soil Erosion:

Soil erosion mostly occurs when dirt gets exposed to strong winds, rainfalls, and even flowing water. It can also be because there is less vegetation or mining, farming, or construction nearby. The most surprising cause is that even just human activities can remove soil particles by cutting down the vegetation when clearcutting. Soil erosion is hard to prevent as it mainly matters on the weather which is something we cannot always control.

2. <https://www.nrdc.org/stories/soil-erosion-101#causes>

Why is Soil Erosion Damaging: Dec 13, 2023

Soil erosion is damaging because land cannot be used as much for agriculture as we lose some of our agricultural land, it also pollutes waterways, the way water flows will change, and flooding can become more of an often natural disaster because of the way water flows during soil erosion. These four damages can end up being really terrible, although soil erosion sometimes has smaller effects than other times.

3. <https://www.worldwildlife.org/threats/soil-erosion-and-degradation#:~:text=The%20loss%20of%20fertile%20soilpotentially%20making%20flooding%20more%20common>

What are the major issues related to soil erosion:

Soil erosion is a process that takes a while to occur, but once it occurs there are many issues such as loss of agricultural land, water flows changing, flooding becomes more common, loss of topsoil, and soil particles get removed. Once the soil particles get removed when it rains the next time it will erode even more. We should all try to prevent soil erosion so that none of these issues occur as they can be very dangerous sometimes.

4. <https://www.ontario.ca/page/soil-erosion-causes-and-effects#:~:text=Soil%20compaction%2C%20low%20organic%20matter.accelerate%20the%20soil%20erosion%20process>

Is there anything people can do to prevent Soil Erosion: Dec 14, 2023

We can prevent soil erosion by making sure that there is perennial vegetation planted all over our land. We can help doing this by mulching or even just by placing something such as crushed stone or wood chips in places where it is hard to grow vegetation or if there is a shortage of water and they cannot water all of their plants. For something to cover the land in the winter you could also plant a cover crop.

5. <https://web.uri.edu/safewater/protecting-water-quality-at-home/sustainable-landscaping/reduce-soil-erosion/#:~:text=Y ou%20can%20reduce%20soil%20erosion,provide%20a%20temporary%20vegetative%20cover.>

Why is it important to prevent Soil Erosion: Dec 18, 2023

It is super important that we try to prevent soil erosion because flooding will become a lot more common. Heavy layers of sediment will cause the streams and rivers to stop running smoothly. Nothing will be there to make sure the river does not get out of control because then we will not be safe where we live. It will also ruin the land that we use for agriculture.

6. <https://www.wri.org/insights/causes-and-effects-soil-erosion-and-how-prevent-it#:~:text=Soil%20erosion%20decreases%20soil%20fertility,more%20likely%20to%20happen%20again.>

What is the difference between soil erosion and wind erosion:

Soil erosion is a process that happens gradually when topsoil wears away. It happens because soil particles get removed from the rest of the soil that did not erode. Soil erosion happens when there is rainfall or if the land is on a slope. Wind erosion is also a negative effect because it rolls away soil particles, although it is caused by wind instead of rainfall. Wind erosion is also very dangerous since it can also cause natural disasters such as a dust storm.

1. <https://crops.extension.iastate.edu/encyclopedia/soil-erosion-agricultural-production-challenge#:~:text=Soil%20erosion%20is%20a%20gradual,have%20become%20severe%20problems%20worldwide.>
7. <https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/wind-erosion#:~:text=It%20can%20cause%20significant%20economic,air%20to%20create%20dust%20storms.>

Which organizations are trying to prevent soil erosion:

There are many places in Calgary where soil erosion is evident and organizations such as Erosion control central, Landloc environmental products, Acre prime, and Calgary lawn solutions are trying to prevent soil erosion. These organizations are trying to find different ways to stop soil erosion and seeing if those ways are effective

Sources:

1. <https://crops.extension.iastate.edu/encyclopedia/soil-erosion-agricultural-production-challenge#:~:text=Soil%20erosion%20is%20a%20gradual,have%20become%20severe%20problems%20worldwide.>
2. <https://www.nrdc.org/stories/soil-erosion-101#causes>
3. <https://www.worldwildlife.org/threats/soil-erosion-and-degradation#:~:text=The%20loss%20of%20fertile%20soil,potentially%20making%20flooding%20more%20common.>
4. <https://www.ontario.ca/page/soil-erosion-causes-and-effects#:~:text=Soil%20compaction%2C%20low%20organic%20matter,accelerate%20the%20soil%20erosion%20process.>
5. <https://web.uri.edu/safewater/protecting-water-quality-at-home/sustainable-landscaping/reduce-soil-erosion/#:~:text=You%20can%20reduce%20soil%20erosion,provide%20a%20temporary%20vegetative%20cover.>
6. <https://www.wri.org/insights/causes-and-effects-soil-erosion-and-how-prevent-it#:~:text=Soil%20erosion%20decreases%20soil%20fertility,more%20likely%20to%20happen%20again.>
7. <https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/wind-erosion#:~:text=It%20can%20cause%20significant%20economic,air%20to%20create%20dust%20storms.>
8. Weasel head: Lisa Dahlseide and Georgia Blum

Hypothesis: Dec 19, 2023

If I grow grass then the soil will erode less than if there is only soil or if there is soil and wood chips or soil and rocks because the roots help hold the soil together. That is why vegetation is recommended to stop soil erosion. If I plant soil then it will erode the most because there is nothing holding all the soil particles together. Once it rains most of the soil will get displaced because there are no heavy items on top such as rocks or wood chips, nor are there roots holding the soil together. Wood chips and rocks will not erode a lot nor will they erode very less.

Variables:

Controlled Variables:

- Amount of soil (4 cups)
- Amount of water I pour (3 cups)
- Same brand of soil (Schultz)
- Speed I pour the water (Medium speed)

Independent (Manipulated) Variable:

- How much vegetation there is

Dependent (Responding) Variable:

- How much soil is displaced

Materials:

- 16 - 2 litre pop bottles
- 16 - 500ml plastic water bottles
- Grass seeds
- Rocks
- Soil
- Room temperature water
- Watering can
- Scissors
- Coffee filter
- String
- Scale
- Timer
- Tablespoon
- Exacto Knife
- Measuring cups



Getting materials ready:

2 litre pop bottle:

1. Cut the side of the pop bottle with scissors
2. Do step 1 to all 16 pop bottles

500 ml bottle:

1. Cut half of the bottle off with scissors - Use the bottom half
2. Cut two holes with the scissors on each side of the bottle
3. Put string through the holes
4. Do step 1 through 3 to all 16 of the 500 ml bottles

Planting: Dec 20, 2023

1. Pour 4 cups of soil in all 16 pop bottles
2. Plant ½ cup of grass seeds in four of 16 pop bottles
3. Pour 2 cups of wood chips in four of 16 pop bottles
4. Pour 1 ½ cups of rocks in four of 16 pop bottles
5. Pour 2 cups of water at first in all the pop bottles
6. Pour 2 tablespoons of water in all of the pop bottles every other day
7. Continue step 6 for 16 days

Experiment:

1. Gather materials
2. Pour 4 cups of room temperature water with a watering can
3. Start 2 minute timer
4. Pour water and soil into the coffee filter
5. Measure how much soil poured into the coffee filter with measuring spoons
6. Weigh the soil that came out
7. Record data
8. Repeat steps 2 through 7 for all the pop bottles doing four trials

Dec 23, 2023

Today I went to different stores and got materials that were needed for my science fair project.

Coffee Filter = Dollarama

String = Dollarama

Soil = Walmart Supercentre

Grass seeds = Walmart Supercentre

Wood chips = Walmart Supercentre

Rocks = East Lake Elementary school playground

Observations: Dec 24, 2023

Today I planted rocks, wood chips, grass, and soil. I also poured 2 cups of water in them with a measuring cup. These pictures are from before I watered them. I planted everything and I observed that the levels and weight of the bottle was different according to what I planted.



Observations: Dec 26, 2023

These are pictures of wood chips, grass, rocks, and soil on day 3 after I watered them. I observed that the grass started to have minimal growth and all the other things I looked the same as the day I planted them.



Observations: Dec 28, 2023

These are pictures of wood chips, grass, rocks, and soil on day 5 after I watered them. I observed that the grass started growing quite a bit as well as the wood chips started to get a little moldy because of all the moisture coming from the water.



Observations: Dec 30, 2023

These are pictures of wood chips, grass, rocks, and soil on day 7 after I watered them. I observed that more and more grass was growing as well as mold on the wood chips. There was a severe change in growth for the grass except for one bottle.



Observations: Jan 1, 2024

These are pictures of wood chips, grass, rocks, and soil on day 9 after I watered them. I observed that some of the rocks looked wet and others didn't as much. My third bottle caught up on growth so now they are all equally growing at the same pace.



Observations: Jan 3, 2024

These are pictures of wood chips, grass, rocks, and soil on day 11 after I watered them. I observed that the roots on the grass started to grow lots so I knew that 16 days of growing would be perfect.



Observations: Jan 5, 2024

These are pictures of wood chips, grass, rocks, and soil on day 13 after I watered them.

I observed that the grass was really tall, although the wood chips were getting really moldy.



Observations: Jan 7, 2024

These are pictures of wood chips, grass, rocks, and soil on day 15 after I watered them. I observed that all four pop bottles were ready for the experiment as the grass was tall and the wood chips stopped molding.



Experiment: Jan 7, 2024

Today I did trial 1 and recorded my data onto a google spreadsheet. In trial 1 I observed that the water in the wood chips was a lot dirtier than I was expecting. The grass water was really clean other than a little bit of soil. I think the wood chips and the rocks weighed so much because there were some rocks and wood in the coffee filter.



Experiment: Jan 8, 2024

Today I did trial 2 and recorded my data onto a google spreadsheet. I observed that the soil weighed lots and the wood chip and rocks weight varied very much because no wood chips or rocks eroded during my experiment.



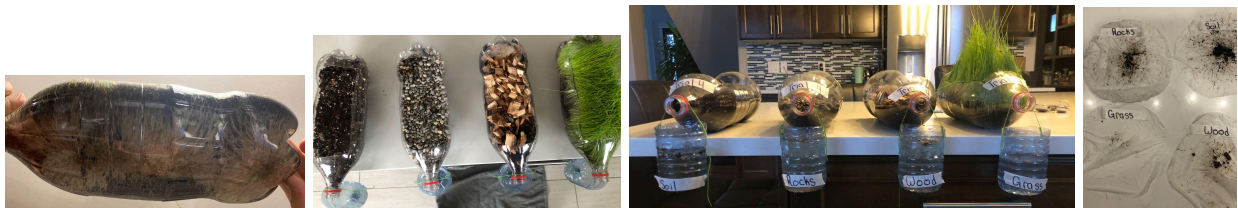
Experiment: Jan 9, 2024

Today I did trial 3 and recorded my data onto a google spreadsheet. I observed that the soil would rise to the top for most of them, although it rose more for the wood chips. This was surprising because it was only happening to the one with wood chips planted in it.



Experiment: Jan 10, 2024

Today I did trial 4 and recorded my data onto a google spreadsheet. I observed that when I looked underneath the pop bottle of the grass, I could see lots of roots which is what holds the soil together, meanwhile the others just had soil with something placed on top. Two small pieces of wood chips also eroded.



Interview: Jan 14, 2024

Today I emailed Weasel head some questions about soil erosion. These are the questions that I asked them:

- What causes soil erosion at Weasel head?
- Why is soil erosion damaging at Weasel head?
- What does Weasel head do to prevent soil erosion?
- What areas of Weasel head have the most soil erosion?

Interview: Jan 15, 2024

What causes soil erosion at Weaselhead?

The main cause observed is actually our school programs and we are aware of that. Students step off the trail, despite being instructed to stay on trail. They have caused a little side trail of erosion right alongside the paved path. Other park users also contribute to this. The main areas of soil erosion are where we take our student groups off trail... you might remember the Aspen stand location half way down the hill at the start (and end) of your field trip. That area is eroded because we stop there to teach about the Aspen stand and have done so since 1997 when our education programs began. I will address this issue more with the questions below.

Another cause of soil erosion is from the illegal trails that other park users have caused. They do not even realize these trails are illegal and the negative impacts that they cause to the park. Every foot step taken on these illegal trails contributes to the erosion and loss of plant diversity as well as soil compaction. When it rains, or when the snow melts, there is little capacity for absorbing the precipitation into the ground because of the soil compaction. The water thus runs over the dirt surface and contributes to turbidity in the water as it picks up particles of dirt and deposits it into the Elbow River or wetlands near these trails.

These illegal trails also impact park biodiversity by increasing fragmentation and something called edge effect. Some species prefer these edges and utilize these areas, but the majority of species do not prefer these areas and thus their populations are impacted with increased edge effect in the park.

The City of Calgary has also increased the water capacity of the Glenmore Dam. They improved the dam in 2020, raising the water levels by 1.5m. The increased water levels are killing off the plants on the edge of the water that are not evolved to tolerate being inundated in water throughout their growing season. We are now witnessing massive die off of both willow and spruce in the park. You will see considerable change in park habitat as a result. Soon the majority of the standing willows and spruce trees will be dead and be washed away into the reservoir leaving considerable soil erosion around the edge of the water when the water is intentionally lowered in the spring (they raise the water levels from July -December). This is going to cause significantly increased risk of flooding as these riparian plants were essential in reducing flood impacts. This was a tricky situation... The City made the decision without doing an environmental impact assessment because it was an economic decision. They were spending millions of dollars a day pulling water from the Bow River to feed the needs of the 40% of Calgarians who typically access their water from the Elbow when the Elbow was too low to supply their needs. Thus the decision to improve the dam and increase the water capacity in the Glenmore Reservoir for those in south Calgary to use. The city didn't even consider the fact that they would directly impact the entire habitat in the park and reduce flood capacity. As a result, the Weaselhead Society has created a Memorandum of Understanding with the City and a Partnership, so that they will also be consulting us with big decisions like this moving forward. They are in for a big surprise when all the plants die off and enter the reservoir and the next flood comes through!!!! The plant's root systems were responsible for maintaining that soil stability, and without them, we will be witnessing considerable erosion effects.

Why is soil erosion damaging at Weaselhead?

Some of this is answered above when discussing how soil particles have increased access to the local water bodies increasing the water turbidity. Turbidity is the murkiness of the water. This naturally happens in spring with spring runoff. However, soil erosion contributed to it even more and it is damaging to both the plants and animals in the water. The animals with gills have a particular issue with turbidity as it makes it harder for them to breathe the dissolved oxygen in the water (fish, tadpoles and aquatic invertebrates). Water turbidity is hard on plants submerged in water as the sunlight can not reach them as easily in the murky waters and thus they can not produce their own food as easily through photosynthesis and also can not thus produce oxygen in the water as easily for those animals with gills to breathe.

Another impact is invasive plant species. Invasive plants tend to establish in disturbed areas... such as areas that were eroded. This causes loss of habitat for all sorts of animals who are dependent on our native plant species as the invasive ones push them out and outcompete the native plants. We have an extensive invasive plant program in the park that works to control their spread and prevent them from establishing.

What does Weaselhead do to prevent soil erosion?

We have tried to distribute our school groups to different areas to allow for areas like the aspen stand to recover. However then we realized we were actually increasing soil erosion to more areas by doing so. So we have decided we will keep the school groups in those areas as there is already extensive erosion that would take years to recover.

However, we are now avoiding the meadow (center of the park, maybe you went there? There is a wooden tipi constructed by other park users in the meadow). The City of Calgary has requested we avoid that area because there are rare mountain plants that have been identified in it.

Interestingly enough the meadow has only recently started to show signs of erosion. As it is a place of ecological successional change it is dominated by what we call pioneer plants.... plants that are very hardy and resistant to erosion (strawberry, northern bedstraw and bearberry being some of these hardy plants). It took about 25 years of school groups using the meadow before we started seeing the negative effects of erosion from their use. In comparison, the trail edges started eroding as soon as students started using those areas.

We are now also working in partnership with the City of Calgary with their Habitat Management Plan and will be addressing soil erosion concerns. However, that is still at the early stages so I do not yet have information to share on exactly how the issue will be addressed.

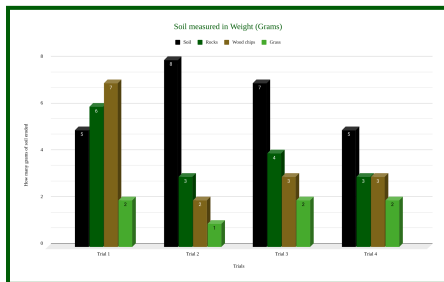
You will see the City has fenced off illegal trails, put up snow fences in areas to keep people out and fence off areas where they are trying to get plants to establish. However, humans being humans, they often just go around or over the fencing and continue causing soil erosion ignoring the Cities efforts. Legal trails are all marked by a wooden post and signs are up to help educate people. Instructions on the bylaws are available on the City website. But sadly there are no resources available to provide by-law officers in the area to enforce these bylaws.

What areas of Weaselhead have the most soil erosion?

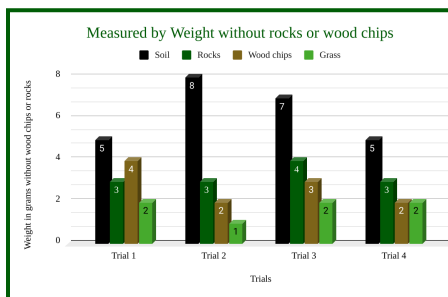
Sides of trails, Aspen stands spot half way down the hill, the meadow and the numerous illegal trails. There are also some spots with minor erosion where school groups stop along the trail, such as in the riparian forest at the bottom of the Weaselhead hill. In coming years we will see extensive soil erosion where the riparian plants are dying off from the increased water levels. We predict that another habitat will establish in those water edges and over time the erosion issue there will be naturally dealt with by mother nature and recover. However, the places where erosion is caused by human feet will not recover as easily unless the humans can be stopped from stepping on those areas... a much more difficult task than imagined.

Data:

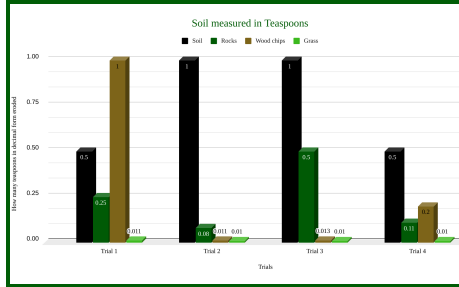
Jan 17, 2024



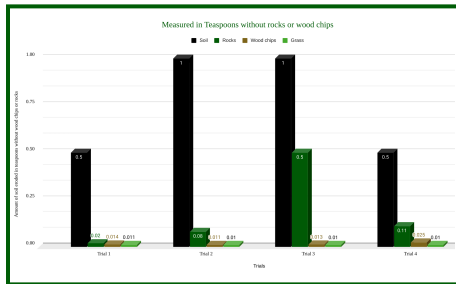
This graph shows the amount of soil that eroded in weight. I measured it by grams. I was really surprised about how the wood chips and rocks both weighed so much, but I am guessing this is because some wood chips and rocks eroded along with the soil.



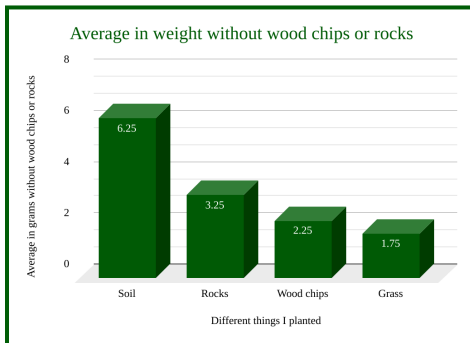
This graph shows the amount of soil that eroded in weight without any wood chips or rocks. Once again I measured it in grams. The results without rocks or wood chips changed the results a lot and they are now more of what I had expected to see.



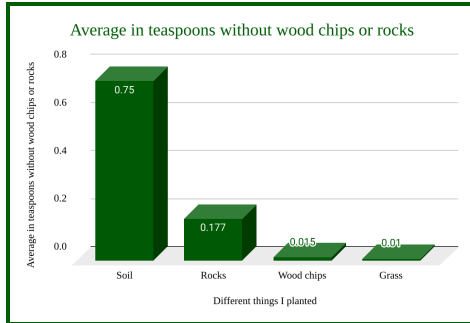
This graph shows how much soil eroded, although this time I measured it in teaspoons. I could not believe that the wood chip results in trial 1 were the same as the soil results in trial 2 and trial 3. The grass for all the trials was really low just like I had expected.



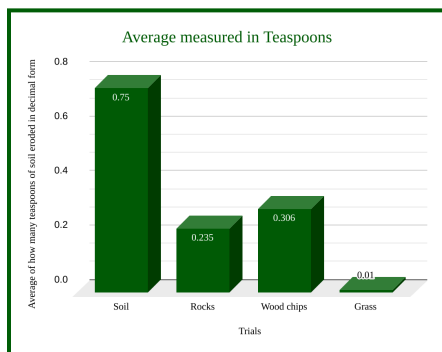
This graph is showing how much soil eroded in teaspoons without wood chips or rocks. The wood chips amount in trial 1 and 4 changed a lot. So did the rocks, but only in trial 1.



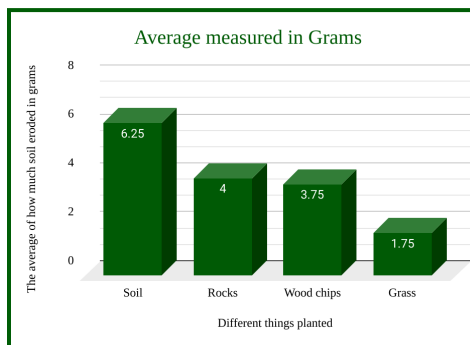
This is the average weight of soil that eroded without wood chips or rocks. This is how I thought the average weight graph would look like because the soil one eroded lots and the grass one barely eroded at all. The wood chips and rocks were in between with wood chips preventing soil erosion a little bit more.



This is the average amount of soil erosion that eroded when I measured it with teaspoons. I wanted a second way to measure soil erosion so that I could see it differently. In this graph the grass and wood chips are very similar, although the rocks and soil still have a big difference.



This graph is showing the average measured in teaspoons. In this graph the soil eroded the most, wood chips were third, rocks second, and grass was the best as it barely eroded at all. The thing that made the wood chips eroded more is because in trial 1 it was one teaspoon, so that made a big difference in average which is why I decided to make more graphs without wood chips and rocks.



This is the average amount of soil that eroded and I measured it in grams. The grass was the lowest as it was 1.75 grams and the soil eroded the most with 6.25 grams. Rocks and wood chips had very similar results as the rocks weighed 4 grams and the wood chips weighed 3.5 grams.

Conclusion:Jan 18, 2024

In conclusion when I planted grass it eroded the least by weight and teaspoons. I also thought that the water looked the cleanest when it had eroded. My bottle with only soil eroded the most for weight, teaspoons, and for a visual aspect because I could see lots of soil chunks. The results of wood chips and rocks did vary according to how I measured them. Wood chips had less weight, although when I measured it in teaspoons it had a little bit more soil eroded than rocks. Rocks had more weight, but for measuring in teaspoons it had less soil than wood chips. My hypothesis was correct because I thought that grass would erode the least and soil would erode the most. Rocks and wood chips were very similar as there were small differences in weight and teaspoons.

Sources of Error:Jan 18, 2024**Instrumental:**

My instrumental error is that my scale could have been reading incorrectly, such as if it was actually 3 grams, it might have glitched and said 4 grams. I would have recorded 4 grams because I don't know if the machine is glitching or not. This could have been changing lots of my data as it could have happened multiple times, very few times, or it might have not happened at all.

Environmental:

I only had one environmental error which was having to weigh the wood chips and rocks that would erode in some of my trials, because this was not the same substance as soil it could have changed how the scale was weighing the wood chips and rocks. This is why I thought it would be important to record more data without all of the wood chips and rocks so that it would weigh the same substance and we would be able to see what that graph would look like.

Human:

I had two human errors. The first one was that when there were really small amounts of soil that eroded I might have measured it incorrectly. This could have happened because I didn't have that small of a teaspoon to measure it. Somebody else might think that there was more soil that eroded or less soil that eroded than what I measured. This is why I also measured it by weight and looked at how dirty the water was. The second human error was that I could have been pouring the water at a different pace or in a different spot in the bottle every time. This could affect the erosion because I am pouring it really fast or at the complete front of the bottle, although I tried to keep the pace the same and spread out the water when I poured it.

What I Learned: Jan 19, 2024

I learned many things during this project. One of them was that I learned grass prevents soil erosion the most and erosion occurs more if soil is not covered. If there is drought or a water shortage, placing wood chips or rocks on top of soil can also prevent erosion. I expanded my knowledge about soil erosion as I learned what causes it, why it is so bad, and what I can do to help prevent it. I also learned from Lisa and Georgia at Weaselhead that people can cause erosion by stepping off the trails that they are restricted to stay on. After doing this project I have another idea for a science fair which could be, is grass a good filter for dirty water. I am very happy I chose this project because I got to learn a lot about soil erosion.

Future Spinoff: Jan 21, 2024

I would definitely do this project again because it was a very fun experience, although there are some things I would change if I repeated something with a similar topic. Next time I would plant more things including dead leaves, wood chips, rocks, grass, plants, and soil as well as do more trials. I would try planting my grass a little earlier because then I can give it even more time to grow. I would still measure it in all these different ways because if one has a source of error the other one also helps me form my conclusion with more true information.

Trifold: Jan 24, 2024

Today I cut out everything for my trifold so that it would be ready to glue.

Trifold: Jan 27, 2024

I glued down everything on my trifold except for my observations

Trifold: Jan 30, 2024

Today I glued down my observations. My entire trifold is done.