Log Book

November 28th, 2024:

Science fair topic ideas:

- What colors do cats prefer?
- Using radio waves to harvest energy
- How food packaging affects food spoiling
- Does the 5-second rule work?
- Misophonia and the effects
- Can what we see change what we taste?
- How hydrogels can help save water in farming

December 7th, 2024:

Chosen topic: *How Hydrogels can help save water in farming*

December 9th, 2024: *Beginning of background research — Questions to research*

What are Hydrogels?

Hydrogels are a type of material that can absorb and retain large amounts of water. They are attracted to water and get a gel-like consistency when absorbing it. They act like a trap for the water. Hydrogels are great at trapping in water. They are soft, flexible, and are biodegradable. Lastly, they can retain high swelling points.

How can Hydrogels help save water?

Irrigating fields can take thousands of litres of water, with a portion of it being evaporated from the unused water in the soil. Not only that, but plants transpire around 95 - 98% of their water that they suck up through their roots, meaning they only use around 2-5% of their water. This means that the hydrogels can slowly release the water which can conserve the water and give the plant what it needs. The roots can also grow towards the hydrogel when they need water, so they always have a supply when needed. Lastly, the hydrogel can absorb the water in the soil faster than the plant, so it can always keep the plant moisturized.

Hydrogels can help save great amounts of water by absorbing it and then releasing it during times of dryness. There are many types of hydrogels, such as agar, alginate, chitosan, sodium polyacrylate, etc.

December 10th, 2024: *Continuing Background Research*

Hydrogels Effects

Hydrogels are already used for many things. For example, they are used in contact lenses, hygiene products, and wound dressings. They also can be used for drug delivery and tissue engineering. It is also used in plant biology as it holds plant nutrients and vitamins. Agar also contains all the nutrients that the new cells or tissues need to grow and become seedlings.

Agar hydrogels hold hormones in order to stimulate optimal development. Some of these hormones include:

- Cytokinins (helps the plant produce mitos, which splits a cell into 2 identical cells, leading to plant growth)
- Auxins (helps with new root growth and increases cell division)

December 11, 2024: *Sources being used*

Hypothesis

Hydrogels can absorb water because of the materials they consist of. If they are added to the soil, the soil will get more moisture and hold more water. It will need to be watered less because the hydrogels can absorb the water and release it slowly over time. This can greatly improve farming efficiency.

December 12, 2024: *Steps on how to make our Presentation*

Ordering Our Time

Testing My Hypothesis

Gather my Materials: Make a logbook, Print it out

Write a procedure: Write down the steps and instructions.

Identify my variables: Independent variable, Manipulated variable, Controlled variable.

Testing: Do the experiment more than once.

Collecting my data: Organize my data into tables, charts, and graphs

Science Journal: Record observations, Collect the research, Draw and label them.

Right Tools: The right tools and materials.

Tables, charts, and diagrams: Keep track of data and always have labels.

Accurate and neat: I am going to print it out, so the judges can read it.

Use the right graphs: Pie charts, bar graphs, line graphs.

The conclusion tells what happened in the end.

Variables

Manipulated:

- Type of hydrogel
- Different hydrogel used

Dependent:

- Water absorption
- Water holding time

Controlled:

- Container with soil
- Soil type
- Water amount
- Temperature

December 13, 2024:

Next Research

1. Moisture in dirt can also reach the plant than in hydrogels

Hydrogels chosen

- Agar
- Cornstarch
- Agar + Cornstarch

These 3 hydrogels were chosen because they are easily obtainable at many stores and are suitable for testing.

December 20, 2024:

Materials

- Agar powder (60 grams)
- Citric acid (30 grams)
- Heat-resistant measuring cup
- Kitchen scale
- Cornstarch powder (60 grams)
- 90 x 15 millimeters petri dishes
- Potting soil without water holding agents
- Seedling pots (16)

- Seeds
- Trifold
- Kettle
- Water (500 ml)

December 28, 2024:

Gathering materials to conduct the experiment.

January 2, 2024 - January 16, 2025:

Experiment beginning:
Step 1: Make hydrogels
Combine agar with citric acid
Boil 500ml water separate from the hydrogels
Put boiled water into the agar and citric acid
Put into petri dish and leave to dry for 24 hours

Step 2: Put water over the hydrogels to see how much they absorb
Observe over many days.

January 6, 2025:

Observations:
Too early to see results in hydrogel accumulation

January 1-3:
Tiny white bubbles are still visible
Agar hydrogel hardened but was moist. It was also transparent.
Cornstarch hydrogel was opaque and tiny grains were still visible inside.
Cornstarch + Agar: It was opaque and was somehow expanding outwards.

January 4 - 6, 2025:
Hydrogels were cold and were turning sticky
Agar: Hard and sticky but still moist
Cornstarch: Losing water on top and was a little dry and hard
Agar + Cornstarch: Very big and almost reached the lid

January 7-9, 2025:
Some hydrogels have cracks
They have become dry and shriveled up.

January 10, 2025:
All hydrogels are slowly shrinking.
Hydrogels have reached maximum absorption.

Sources summary

Science buddies helped with most of the background research. Britanica helped with explaining the experiment.

Citations

- ScienceDirect (https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hydroxyethyl-cellulose).

- Science Buddies (https://www.sciencebuddies.org/science-fair-projects/project_ideas/AgTech_p013/agricultural-technology/water-conservation-hydrogels)
- Britannica (https://www.britannica.com/science/polyHEMA)

Conclusion

To conclude, all the hydrogels absorbed the water. Our hypothesis was correct, as hydrogels can help to save water and to increase farming efficiency. The agar hydrogel was the best one, the cornstarch coming in second, and the cornstarch + agar was last.

January 12, 2025:

Print everything and glue it onto the trifold.

January 13, 2025:

Finishing touches to trifold and rehearsing for the talk.
Making Cue cards.

January 20, 2025:

Future Directions

If we were to do this project again, we would include more hydrogels (such as alginate or HEC), try to experiment with more advanced hydrogel applications, and observe data over a longer period.

We would also try to plant more plants to go with the more advanced hydrogels. Finally, we would try to add more different types of plants such as tomatoes, grass, and also others such as spinach and radish these are all the fastest growing plants to save time and these plants grow at good speeds.

The term polymer is a composite of the Greek words poly and meros, meaning “many parts.” Polymers are large molecules made of small, repeating molecular building blocks called monomers.

Molecule Definition:

A molecule is a group of two or more atoms that bond together. Atoms are the basic building blocks of matter. You might have seen a picture of an atom before. Atoms have electrons that float around the nucleus. A good way to think about atoms and molecules is to think of the letters that make up a word.

Hydrogel Definition:

Hydrogels are a type of polymer (a long chain of molecules) that can hold a large amount of water but don't dissolve. They are hydrophilic, which means they attract water molecules – and when they do, they can swell to many times their original size. There are also hydrophobic polymers that repel water.

Sources

https://study.com/academy/lesson/molecules-definition-lesson-for-kids.html#:~:text=A%20molecule%20is%20a%20group,that%20make%20up%20a%20word.

https://kids.britannica.com/students/article/polymer/276496#:~:text=The%20term%20polymer%20is%20a,molecular%20building%20blocks%20called%20monomers.

https://www.sciencefriday.com/educational-resources/water-loving-hydrogels/#:~:text=Hydrogels%20are%20a%20type%20of,hydrophobic%20polymers%20that%20repel%20water.

January 29, 2025:

School science fair preparations:

- Highlighting key points
- Presentation practiced very thoroughly

Hydrogels are water absorbing polymers widely used in industries and the environment. Synthetic (artificial ones) have replaced the natural ones due to their better absorption, durability, and availability. Research focuses on how they can be used innovatively in the fields to help save water.

Hydrogel products constitute a group of polymeric materials, the hydrophilic structure of which renders them capable of holding large amounts of water in their three-dimensional networks. Extensive employment of these products in a number of industrial and environmental areas of application is considered to be of prime importance. As expected, natural hydrogels were gradually replaced by synthetic types due to their higher water absorption capacity, long service life, and wide varieties of raw chemical resources. Literature on this subject was found to be expanding, especially in the scientific areas of research. However, a number of publications and technical reports dealing with hydrogel products from the engineering points of view were examined to overview technological aspects covering this growing multidisciplinary field of research. The primary objective of this article is to review the literature concerning classification of hydrogels on different bases, physical and chemical characteristics of these products, and technical feasibility of their utilization. It also involved technologies adopted for hydrogel production together with process design implications, block diagrams, and optimized conditions of the preparation process. An innovated category of recent generations of hydrogel materials was also presented in some details.