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# Project H2-Grow: From Ancient Water Empires to Modern Hydroponics

## Materials Needed

- **Growing Supplies:**
  - Nancy B's Science Club® Way to Grow Hydroponics Kit
  - Microgreen seeds (e.g., broccoli, radish, pea shoots)
  - Broccoli sprout seeds
  - Shallow tray or container for microgreens (a recycled plastic clamshell container works well)
  - Sprouting jar with a mesh lid (or a mason jar and cheesecloth)
  - Leca clay balls
  - Healthy Sansevieria (Snake Plant) with leaves suitable for cutting
  - Small pots or glass jars
  - Potting soil (for comparison experiment)
- **Plant Care & Chemistry Supplies:**
  - Countertop water distiller (or access to distilled water)
  - Liquid Castile soap (unscented)
  - Essential oil (e.g., peppermint or neem oil)
  - Small spray bottle
- **Tools & Lab Equipment:**
  - Clean, sharp scissors or pruning shears
  - Notebook or digital document for a Lab Journal
  - Access to the internet for research
  - Measuring spoons and cups

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## Introduction: The Power of Water

Welcome, scientist! For thousands of years, humans have ingeniously controlled water to grow food and build civilizations. An ancient "hydraulic empire" might seem distant, but the principles they used—managing water to sustain life—are the same ones we'll explore in modern hydroponics. In this project, you will become both a historian and a botanist. You will build your own water-based growing systems, cultivate life from tiny seeds, and discover the scientific connection between an ancient Aztec farmer and a modern-day astronaut growing food in space. Let's get our hands dirty (or, in this case, wet!).

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## Part 1: The Spark of Life - Germination Station (Days 1-7)

**Objective:** To observe and compare two different methods of germination, understanding the essential needs of a seed.

### Activity A: Microgreen Farm

1. **Setup:** Moisten a paper towel or a thin layer of soil in your shallow tray. It should be damp, not soaking.
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2. **Sow:** Sprinkle your microgreen seeds densely across the surface. Gently press them down.
3. **Incubate:** Cover the tray with a lid or another tray to create a dark, humid environment for 2-3 days. Check daily to ensure the surface is still moist.
4. **Grow:** Once you see sprouts, remove the cover and move the tray to a sunny spot. Water lightly once a day.
5. **Lab Journal Entry:** Record the date. Sketch the setup. Every day, write down your observations. When did you first see sprouts? How tall are they? What color are they? Harvest your microgreens in about 7-10 days when they have their first set of true leaves. Note their taste!

Activity B: Sprout Jar

1. **Setup:** Add 2 tablespoons of broccoli sprout seeds to your sprouting jar. Cover with water and let them soak for 8-12 hours.
2. **Rinse & Repeat:** Drain the water completely. Place the jar upside down at an angle to allow for drainage and air circulation.
3. **Maintain:** Twice a day (morning and evening), rinse the seeds thoroughly with fresh water and drain completely.
4. **Lab Journal Entry:** Why is rinsing and draining so important? (Hint: think about mold and bacteria). Record the changes you see each day. Notice the "fuzz" that appears—are these roots or mold? (They are root hairs!). Your sprouts should be ready in 3-5 days.

Part 2: Advanced Water Worlds - Soil-Free Systems (Days 1-14+)

Objective: To assemble a basic hydroponic system and research the historical context of growing plants without soil.

Activity A: The Nancy B Hydroponics Lab

1. **Build:** Follow the instructions to assemble your Nancy B's Hydroponics Kit. This is your first formal hydroponic system!
2. **Experiment:** Use the seeds provided (or some of your microgreen seeds) to conduct the experiments in the kit's journal.
3. **Lab Journal Entry:** Compare growing seeds in the hydroponic kit versus your microgreen tray. What are the differences in growth rate, root structure, and the amount of water used? Form a hypothesis: Which system do you think is more efficient for growing food in a small space and why?

Activity B: Research Deep Dive - History of Hydroponics

Use the internet to investigate the history of hydroponics. Go beyond the Hanging Gardens of Babylon (a popular but unproven example) and look for concrete evidence.

- Find out about William Frederick Gericke's work at the University of California, Berkeley in the 1920s. Why is he called the "father of modern hydroponics"?
- How does NASA use hydroponics on the International Space Station? Why is it a critical technology for future space exploration?
- Write a short, one-page summary in your Lab Journal connecting these historical points.

Part 3: The Semi-Hydro Revolution (Ongoing)

Objective: To apply hydroponic principles to houseplants by propagating a plant and converting it to a semi-hydroponic system.

Activity A: Sansevieria Propagation Challenge

1. **Take Cuttings:** With a clean, sharp knife, cut a healthy Sansevieria leaf into several 3-inch sections. Note which end is the "bottom" on each cutting—this is crucial!
2. **Set Up the Race:**
    - Place one cutting in a jar with an inch of water.
    - Plant another cutting (bottom side down) about an inch deep in a small pot of soil.
3. **Observe:** Place both in a spot with bright, indirect light. Change the water for the water-propagation every few days. Keep the soil for the other one lightly moist.
4. **Lab Journal Entry:** Create a table to track their progress. Which one shows root growth first? Which method do you think is easier? What are the pros and cons of each? This may take several weeks or even months, so be patient!

Activity B: Leca Conversion

1. **Prepare Leca:** Rinse the Leca clay balls thoroughly until the water runs clear. Then, soak them in water for at least 6 hours (or overnight).
2. **Prepare the Plant:** Once one of your Sansevieria cuttings has developed strong roots (at least an inch long), it's ready! If you have another small, rooted houseplant, you can use that too. Gently remove it from its current medium (soil or water) and rinse the roots completely.
3. **Potting Up:** Choose a pot with no drainage holes. Add a layer of soaked Leca to the bottom. Place the plant's roots on top and gently fill in around them with more Leca until the plant is stable.
4. **Watering:** Add water until it fills about 1/3 of the pot. This creates a reservoir that the porous Leca will wick up to the roots. This is the core principle of semi-hydroponics!
5. **Lab Journal Entry:** Sketch your semi-hydroponic setup. Why is Leca a good medium for this? (Hint: think about aeration and water retention). Monitor the water level and plant health over the next few weeks.

Part 4: Ancient Engineering & Modern Applications (Research Project)

Objective: To analyze the connection between ancient water management systems and modern hydroponics.

Activity A: Research the Chinampas

The Aztec civilization in the Middle Postclassic Period built an incredible "hydraulic empire." Their most famous innovation was the *chinampa* system. Research the chinampas of Tenochtitlan.

- How were they constructed?
- How did they solve the problem of growing food in a swampy, lake-based environment?
- How did this system allow the Aztec capital to support a huge population?

Activity B: Synthesize & Design

In your Lab Journal, create a diagram or a written explanation that compares a chinampa to your semi-hydroponic Leca pot.

- **Similarities:** How do both systems deliver water to plant roots without drowning them? How do they both utilize a water reservoir?
- **Differences:** What are the differences in materials, scale, and purpose?
- **Creative Challenge:** Sketch a design for a modern "kitchen chinampa" that uses the principles of both ancient and modern systems to grow herbs on a countertop.

Part 5: Plant Care Chemistry (Creative Application)

Objective: To create and test a useful, homemade solution based on simple chemical principles.

Activity A: The Science of Pure Water

1. **Distillation:** If you have a countertop distiller, follow the instructions to distill a batch of tap water.
2. **Compare & Contrast:** What is left behind in the distiller after the process is complete? This is the total dissolved solids (TDS).
3. **Lab Journal Entry:** Why is distilled or low-TDS water often preferred for hydroponics? (Hint: it relates to nutrient solutions and mineral buildup on roots). This gives you, the grower, total control over what minerals your plants receive.

Activity B: Plant Spa Day - A Gentle Pest Deterrent

Let's create a gentle "bubble bath" spray that can help keep pests like spider mites and aphids away from your houseplants without harsh chemicals.

1. **The Formula:** In your spray bottle, combine 1 cup of distilled water, 1/2 teaspoon of Castile soap, and 1/4 teaspoon of peppermint or neem essential oil.
2. **Shake Well:** Secure the lid and shake vigorously to emulsify the oil and soap. You'll need to shake it before each use.
3. **Application:** Lightly mist the leaves of your Sansevieria or another houseplant (top and bottom). Do not drench the plant. It's best to do this in the evening to avoid leaf burn from the sun.
4. **Lab Journal Entry - The Chemistry:** Research how insecticidal soap works. Why does the soap disrupt the outer shell of many soft-bodied insects? The essential oil acts as a repellent. This is a great example of applied organic chemistry!

Final Assessment: The H2-Grow Showcase

Your mission is to synthesize everything you've learned and created. Prepare a short presentation (this can be a video you film, a slideshow with photos, or a live "tour" for your family/teacher) that covers the following points:

- **Show & Tell:** Showcase your microgreens, sprouts, Sansevieria propagations, and your Leca/hydroponic systems. Explain the status of each.
- **Explain the Science:** Briefly explain the principles of germination, hydroponics, and semi-hydroponics using your projects as examples.
- **Connect the Past:** Explain the connection you discovered between the Aztec chinampas and your modern growing systems.
- **Reflect:** What was the most challenging part of this project? What was the most surprising thing you learned? What experiment would you like to try next?

Evaluation Rubric:

- **Application (40%):** Successfully set up and maintained the various growing projects.
- **Analysis & Connection (30%):** Clearly explained the scientific principles and the historical connections in the final showcase.
- **Documentation (20%):** Kept a detailed and thoughtful Lab Journal with observations, data, and reflections.
- **Creativity & Curiosity (10%):** Showed enthusiasm and creativity, especially in the "Synthesize & Design" and "Plant Spa Day" activities.

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