

HYDROPONICS WORKSHEET



Name(s): _____

WHY USE HYDROPONICS?

Plants can grow in more than just soil.

Hydroponic (water) and **Aeroponic** (air or mist) based systems have existed since the Hanging Gardens of Babylon.

William Frederick Gericke promoted the value of soil-free agriculture in 1929, coining the term from the Latin:

Hydro (water) + **Ponic** (work).



Soil Free, Care Free?

Hydroponic crops are grown **bigger, faster** and in **less area** than a traditional field could yield. They can be grown indoors, underground, at high elevations or even on board the International Space Station.

Maintaining a hydroponic system can be costly however, and requires **engineering** to ensure **water, nutrients** and **oxygen** are always available.

1

List two reasons a farmer would use a Hydroponic System:

A. _____

B. _____

2

Why are Hydroponic Systems so important for space travel?

Hint: It takes about seven months to reach Mars. How would you eat?

WHAT DOES A PLANT NEED TO THRIVE?

- { Light
- { Carbon Dioxide
- { Oxygen
- { Water
- { Nutrients

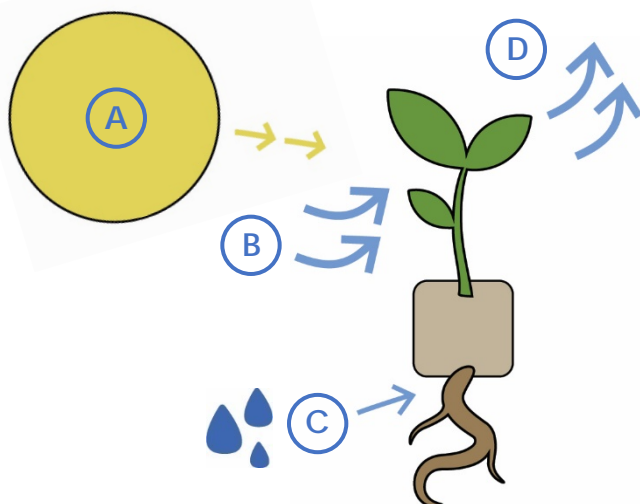


Macronutrients: Nitrogen, Phosphorus and Potassium. Plants absorb more of these than any other nutrient.

Micronutrients: Plants require less of these, including: boron, calcium, copper, iron, magnesium, and zinc.

Photosynthesis: the process used by plants to convert "light energy" into "chemical energy".

This light energy, often from the sun, is stored in carbohydrates and sugars synthesized (combined) from **Carbon Dioxide** and **Water**. Then, **Oxygen** is released as waste.
You enjoy the products of photosynthesis in food and in the air we breath!



3 Match the components of the photosynthesis process below:

Light Energy:

☐

Water H₂O:

☐

Oxygen O₂:

☐

Carbon Dioxide Co₂:

☐

HYDROPONICS WORKSHEET

Growing Media

Plants grown in **Hydroponic Systems** need only light, water, nutrients, and a growing medium (such as rockwool, coconut fiber, old wool socks or perlite).



Socks



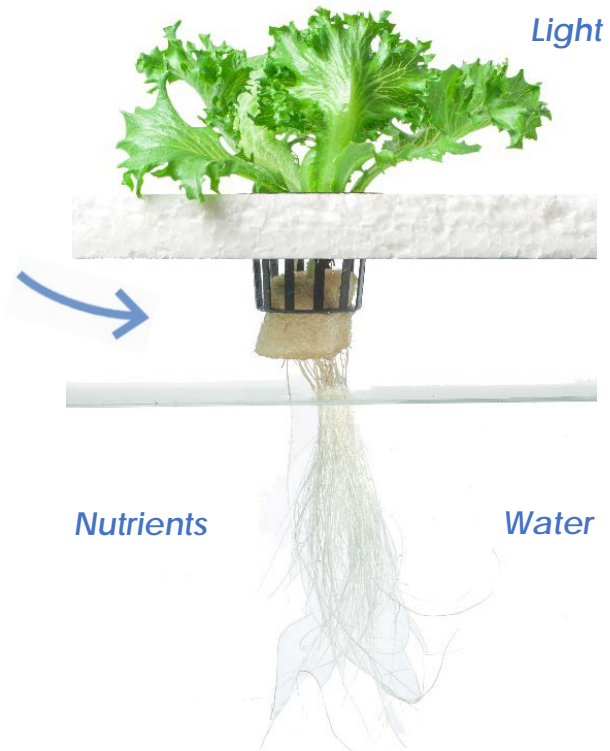
Rockwool



Cotton



Towel



Growing Medium
Light
Water
Photosynthesis
Carbon Dioxide

Chemical
Sugars
Oxygen
Proteins
Soil

Complete the following sentences:
Words may only be used once.

4 Hydroponic Systems use _____ for growing plants in place of _____.

5 Plants convert _____ energy from sunlight into _____ energy, which is stored in carbohydrates and _____ for future use. This process of _____ produces _____ as a waste product.

6 Hydroponic Systems use a _____ like rockwool or perlite.

(MICRO) DRIP SYSTEM

Drip Systems are the most used hydroponic system in the world. An automated system uses a **timer** and **pump** to drip **nutrient solution** through a small tube into the base of the plant's **growing medium**.



Recovery Drip System: excess nutrient solution run-off is collected for re-use.
Non-Recovery System: excess nutrient solution run-off is not collected.

- 7 Why does your **Micro Hydroponic Drip System** not need an automated pump to work?
Hint: What force causes mass to fall?

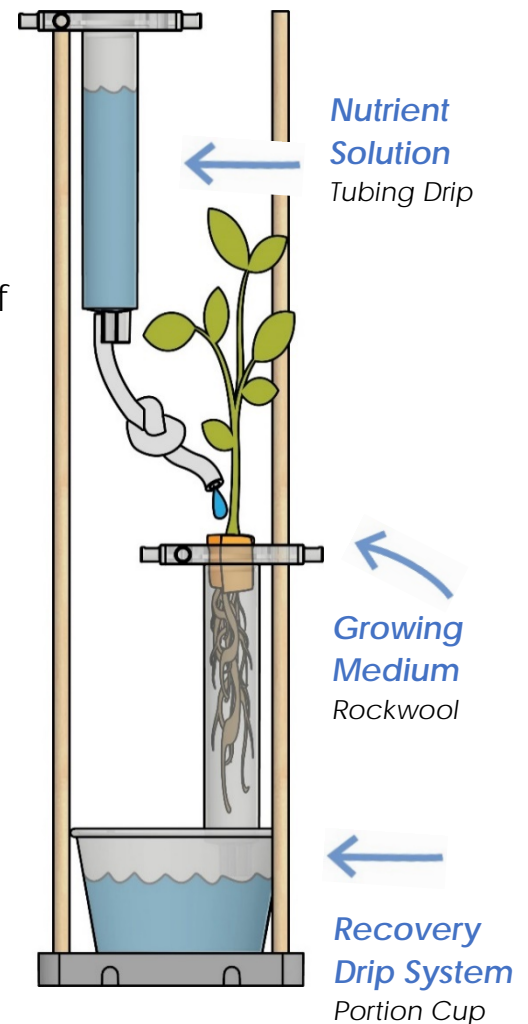
- 8 Discuss and compare the environmental impact of (A) **Recovery** and (B) **Non-Recovery Drip Systems**?

(A) _____

(B) _____



Acid Rain: rainfall made **acidic** (a **pH** less than 7) due to **pollution** in the earth's atmosphere from the burning of **fossil fuels** like coal.




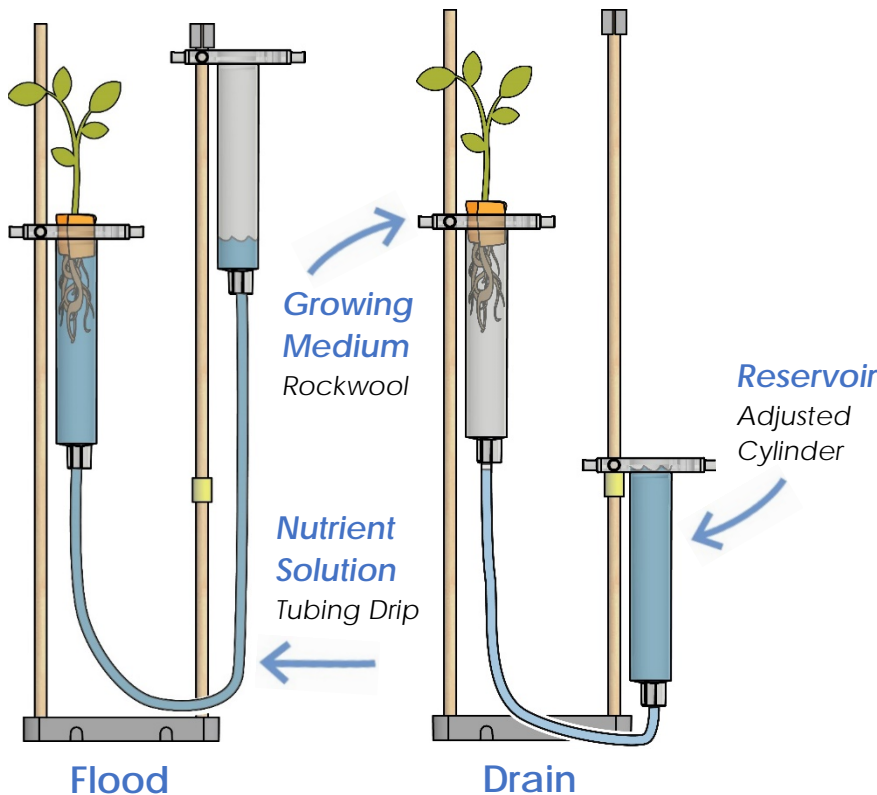
(MICRO) FLOOD & DRAIN SYSTEM

Flood and Drain Systems (also known as **Ebb & Flow**, or **Dutch Buckets**) work by temporarily flooding the plant's grow tray with **nutrient solution**, then draining the solution back into the **reservoir**. This is normally done with a **submerged pump** on a timer, and works well with gravel or **rockwool**.



In most **Flood & Drain** systems, the **reservoir** is lower than the **hydroponic system**, allowing **nutrient solution** to drain, recovered then through **gravity**.

 *How can you adjust your cylinders to add and remove water throughout the day?*

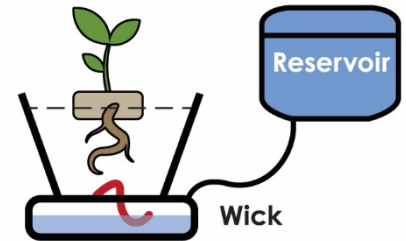


9 Ancient agriculture used the **flooding** of rivers such as the Tigris or Nile to create a fertile **silt** (nutrient solution) for crops. Why was the engineering of **dams** to control and **drain** this water so important?

TYPES OF HYDROPONIC SYSTEMS

Wick System:

A **wick** is used to draw the **nutrient solution** from a reservoir-fed dish, up into the **growing medium** (perlite, vermiculite or coconut fiber).

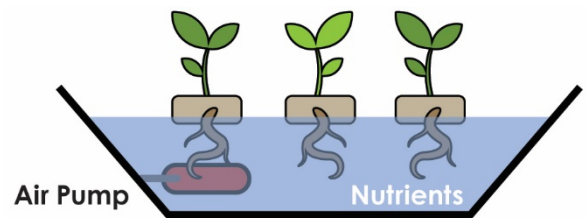


Deep Water Culture (DWC):

The simplest active system. The plants float directly on the **nutrient solution**, as an **air pump** supplies **oxygen** to the roots. Best for lettuce.

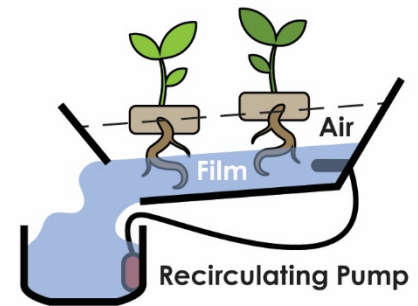


How could you add an air pump to your own hydroponic system?



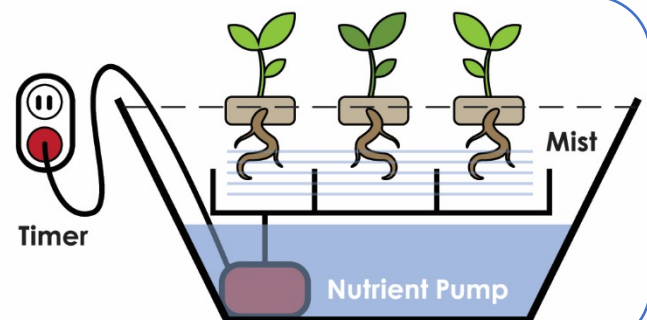
Nutrient Film Technique (NFT):

The **nutrient solution** (film) is pumped into the angled **tray** (through a tube) and recirculates over the dangling roots, draining back into the **reservoir**. The constant flow of film requires no **growing medium** other than **air**. Plants are often sensitive to interruptions in flow cycles.



Aeroponic Systems:

The most high-tech system. Like the N.F.T. system, the **growing medium** is primarily **air**. The roots dangle, **misted** with timed **nutrient solution** every few minutes. They will dry out rapidly if the mist cycles are ever interrupted.



10

Name a disadvantage of relying on an automated hydroponic system?

GARDENING ON THE MOON?

Would you live on Mars? Questions like these were once the realm of science fiction; no longer! Space travel is possible, yet **constraints** persist.

How would we grow food in zero-gravity?

The Unique Challenges of Growing Food in Space

- Zero-Gravity
- Soil-Free
- Artificial Light Source
- Limited Surface Area



11 Plants need **surface area** to expand their root systems and grow. How can **hydroponic systems** adapt to limited surface area?

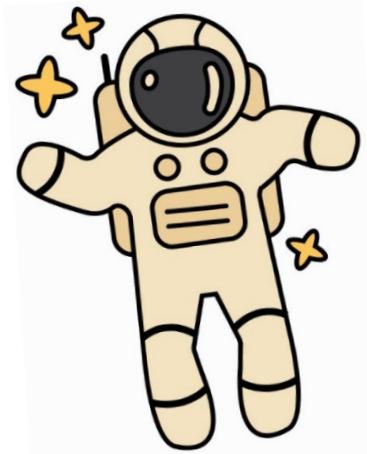
Hint: Think of your cylinders. Are they vertical? Horizontal?

12 Without soil, plants aren't limited by which direction they grow. This is a huge advantage in **weightlessness**. Briefly describe which type of **hydroponic system** you believe would work best in the small quarters of the International Space Station? The dark terrain of Mars?

GROWING PLANTS IN ZERO-G

"Lacking soil, you need some sort of substrate... I considered using an old shirt or sock but decided the Russian supplied toilet paper was best...It consisted of two layers of coarsely woven gauze. It [made] a wonderful sprouter,... [retained] water well and the seeds can be anchored under the gauze weft..."

– ISS Science Officer Don Pettit, November 2002



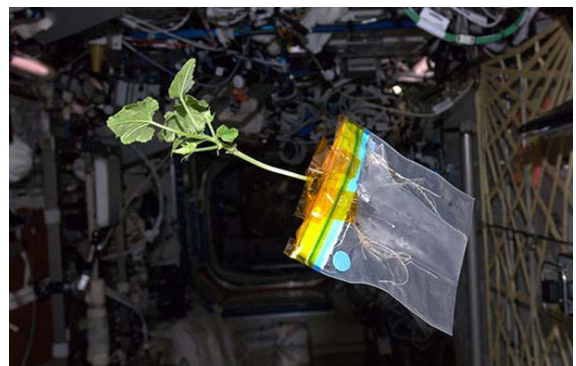
Ideal Space Plants Would Be:

- Short
- Grow quickly in low light
- Have few inedible parts
- Resist disease
- Need little water
- Need few nutrients
- Low maintenance
- Yield plenty of oxygen

13 Would the seeds used in your **Hydroponic System** be *ideal* space plants? Why or why not? _____

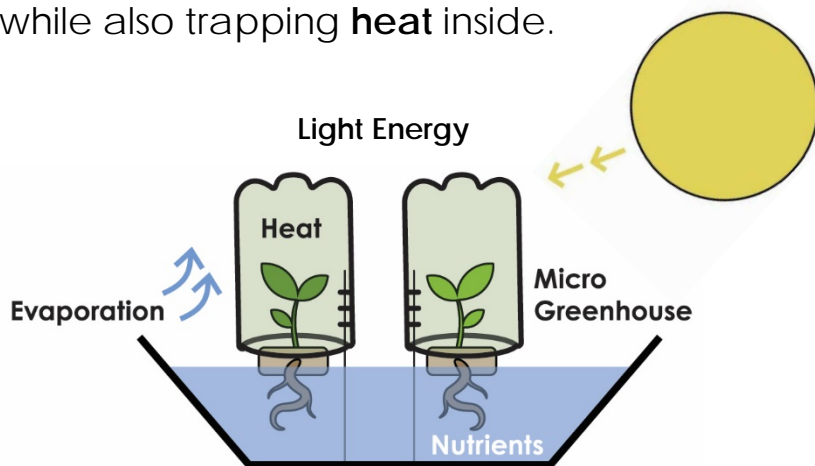


Don Pettit's
Space Zucchini



(MICRO) GREENHOUSES

Greenhouse: an enclosed glass or transparent building for gardening, allowing in **sunlight**, while also trapping **heat** inside.



Recycling With Purpose

Greenhouses are built out of all sorts of things. Plastic soda bottles make great materials to trap heat.

Greenhouse Effect: The earth's **atmosphere** acts like a giant greenhouse. **Greenhouse Gases** (water vapor, carbon dioxide, methane, ozone) absorb and trap heat, preventing the planet from freezing.



Earth needs a careful balance – too many greenhouse gases could make the climate too hot (due to **pollution**, **deforestation** and the burning of **fossil fuels**).

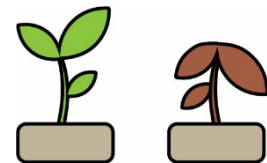


VARIABLES

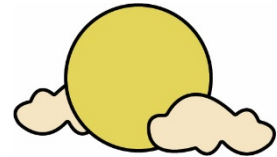
Independent Variable: The thing you change in the experiment, to test how it affects the DV. There should only be one IV for each experiment.



Dependent Variable: the thing being tested and measured as a result of the IV. There should only be one DV for each experiment.



Control: Things that should not change in an experiment. There can be many controls for each experiment.



14 What variables can you change in your Micro Hydroponic System?
(e.g. *Light, Growing Medium*) _____

15 What things may change as a result of these Independent Variables?
(e.g. *Height, Plant Color*) _____

16 What things would be controls in your Micro Hydroponic System?
(e.g. *Type of Seed Planted*) _____
