

Lesson Two – Growing Plants with Hydroponic Systems

Lesson Overview

Learn about plant life and how a seed becomes a plant. Actively start the growing process and learn about proper techniques for growing with a hydroponic system.

Lesson Objectives

After completing this lesson, participants will be able to:

- Define a plant's structure
- Describe photosynthesis, respiration, and transpiration
- Learn what nutrients help plants grow and how to measure them.

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• Projector and projector screen • <i>Introduction to Hydroponics</i> slide presentation • <i>Plant Structure</i> worksheet • <i>Plant Structure – Answer Key</i> • <i>Seed Selection and Germination Activity</i> • <i>Hydroponics User Guide</i> (optional) • Computer and internet • Germination tray with hood • Seeds • Rockwool • Water	1. Print/photocopy and the <i>Plant Structure</i> worksheet <i>Seed Selection and Germination Activity</i> (one per participant) 2. Prepare the <i>Introduction to Hydroponics</i> slide presentation for viewing	30 minutes
LEARN	• Projector and projector screen • <i>Introduction to Hydroponics</i> slide presentation • <i>Plant Growth Activity</i> worksheet • Germination tray with sprouted seeds	1. Print/photocopy <i>Plant Growth Activity</i> worksheet (one per participant); multiple copies of this worksheet may be needed as data collection occurs 2. Prepare the <i>Introduction to Hydroponics</i> slide presentation for viewing	30-45 minutes
REVIEW	• <i>Plant Growth Results and Reflection</i> worksheet	1. Print/photocopy <i>Plant Growth Results and Reflection</i> worksheet (one per participant)	30-45 minutes

Lesson 2 – Growing Plants with Hydroponics

FOCUS: Seeds and Plant Structure

30 minutes

Purpose:

Participants learn about the structure of most plants. They will learn about different plants through crop selection research. Participants will also begin to germinate seeds.

Materials:

- *Introduction to Hydroponics* slide presentation
- *Plant Structure* worksheet
- *Plant Structure – Answer Key*
- *Seed Selection and Germination Activity*
- Computer and internet
- Germination Tray with Hood
- Seeds
- Rockwool
- Water
- *Hydroponics User Guide* (optional)

Facilitation Steps:

1. Prepare slides 37-41 of the *Introduction to Hydroponics* slide presentation.
2. Hand out the *Plant Structure Notes* worksheet and have participants take notes as you present.
3. After the presentation, have the participants either keep the notes or turn them in for a grade.
4. Hand out the *Seed Selection and Germination Activity*.
5. Give participants time to research and select the proper seeds that they are interested in planting.
NOTE: This may be for current planting or future planting depending on whether you have seeds ready to plant or not.
6. Have participants research different websites on types of seeds (see Seed Notes Area) and answer any questions to help them make clear decisions about what type of plants they would be interested in planting.

NOTE: After picking the best plant seed to grow in the hydroponic system, you will need to decide to order them online or find them locally. Once

this is done, you can then start the next part of the lesson.

7. Once the participants have the seeds, you can start doing the germination part of the *Seed Selection and Germination Activity*. Have participants work individually or in groups for this activity.
8. Have participants get the needed material, seeds, rockwool, and germination tray with hood. Have them do the planting of their seeds.

SEEDS NOTE AREA:

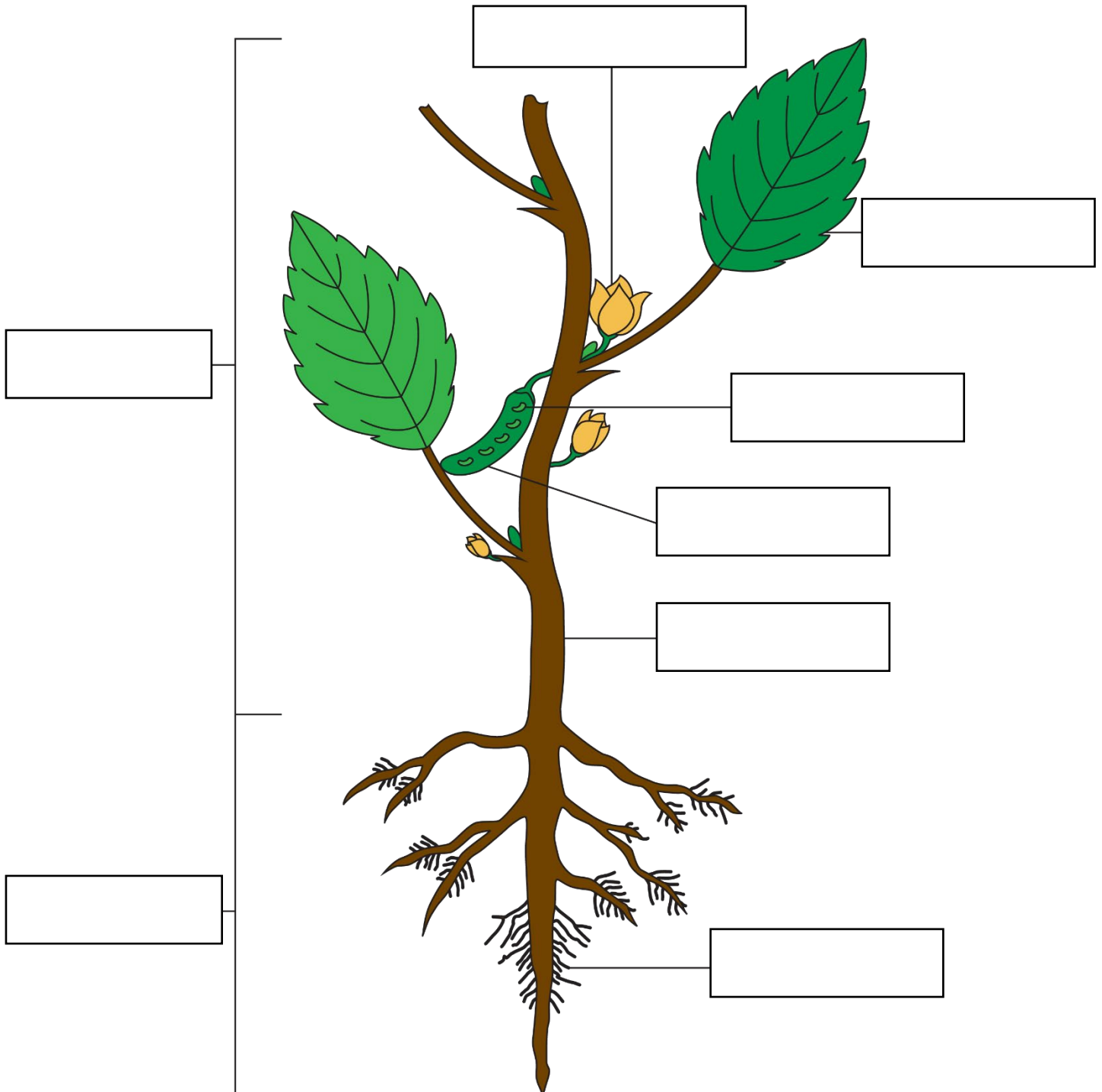
Below are 14 seed companies for online resources, purchasing seeds, and/or plant research. This is just a taste of different seed companies to help with research purposes. Feel free use any local, regional, or national supplier of seeds as you see fit:

1. [Johnny's Selected Seeds](http://www.johnnyseeds.com) Winslow, ME
2. [Seed Savers Exchange](http://www.seedsavers.org) Decorah, IA
3. [Baker Creek Heirloom Seeds](http://www.rareseeds.com) Mansfield, MO
4. [Burpee Seeds and Plants](http://www.burpee.com) Warminster, PA
5. [Territorial Seed Company](http://www.territorialseed.com) Cottage Grove, OR
6. [Seeds of Change](http://www.seedsofchange.com) Rancho Dominguez, CA
7. [Ferry-Morse Seed Company](http://www.ferrymorse.com) Fulton, KY
8. [Southern Exposure Seed Exchange](http://www.southernexposure.com) Mineral, VA
9. [High Mowing Organic Seeds](http://www.highmowingseeds.com) Wolcott, VT
10. [Fedco Seeds](http://www.fedcoseeds.com) Waterville, ME
11. [Nichols Garden Nursery](http://www.nicholsgardennursery.com/store) Albany, OR
12. [Botanical Interests](http://www.botanicalinterests.com) Broomfield, CO
13. [Renee's Garden Seeds](http://www.reneesgarden.com) Felton, CA
14. [Peaceful Valley Farm & Garden Supply](http://www.groworganic.com) Grass Valley, CA

Name: _____ Class: _____

Plant Structure

Below is a diagram of a typical plant. Fill in the missing information.



Introduction to Hydroponics Curriculum

Define the following words:

1. Roots:

2. Stem:

3. Leaf:

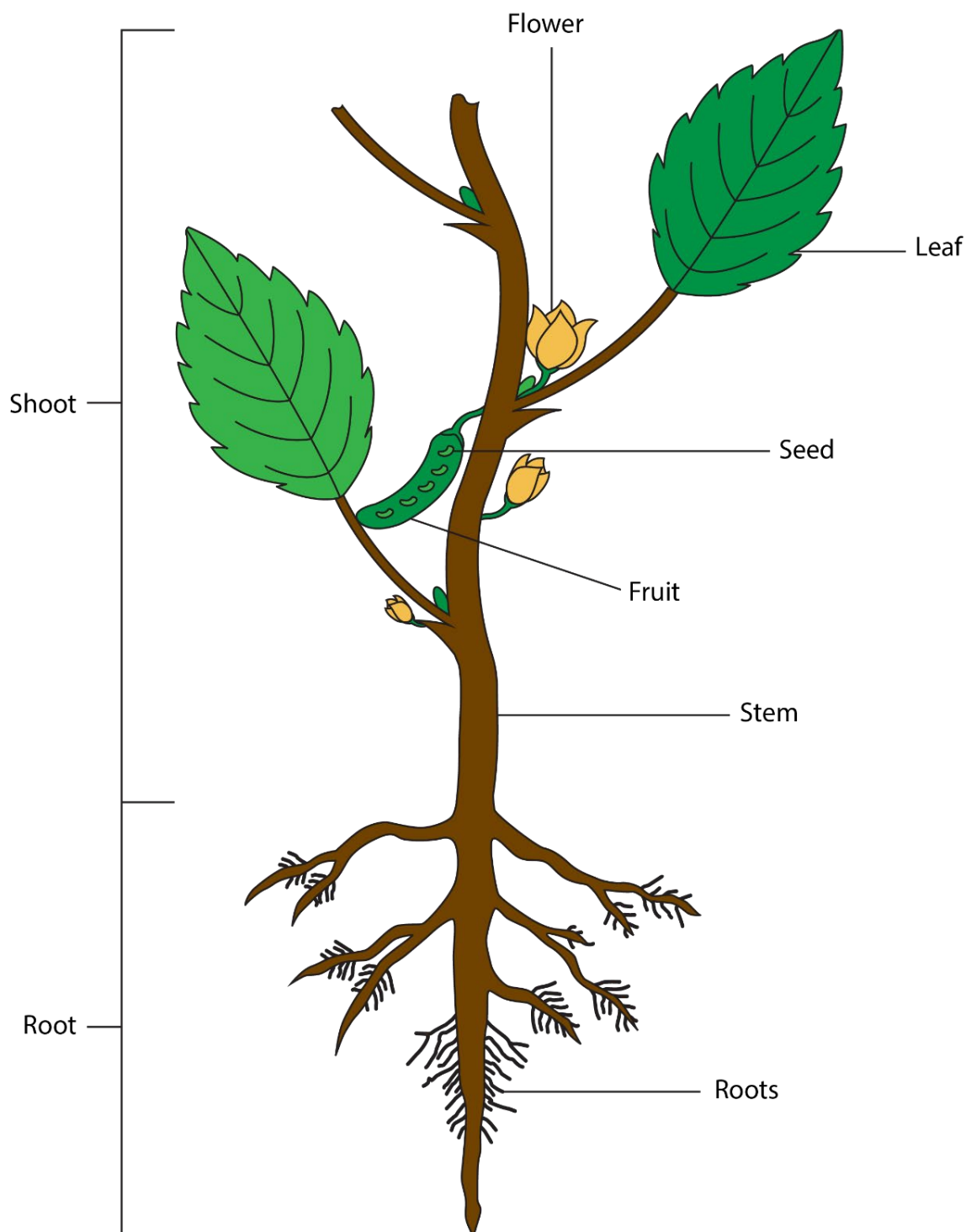
4. Fruit:

5. Flower:

6. Seed:

Plant Structure– Answer Key

Below is a diagram of a typical plant. Fill in the missing information.



Introduction to Hydroponics Curriculum

Define the following words:

1. Roots:

- Pull water and nutrients from the surrounding environment (soil or water) to feed the plant
- Help keep the plant securely situated

2. Stem:

- Trunk structure that holds the roots to the leaves
- Works as a support structure but also is where water and food are transferred to the leaves
- Branches are also considered part of the stem structure

3. Leaf:

- Flat structure that is attached to the plant's stem, used to collect sunlight for photosynthesis
- Where transpiration takes place
- When healthy, usually green in color

4. Fruit:

- Seed-bearing structure that is from the flowering plant

5. Flower:

- Structure that produces the seed-bearing fruit
- Consists of reproductive organs to reproduce fruit

6. Seed:

- Embryonic plant that is covered with a hard shell or outer covering
- Like a baby plant (embryo) ready to be born
- Seeds include:
 1. Embryo
 2. Cotyledons: the stored food supply
 3. Seed coat: protective outer layer
 4. Endosperm

Name: _____ Class: _____

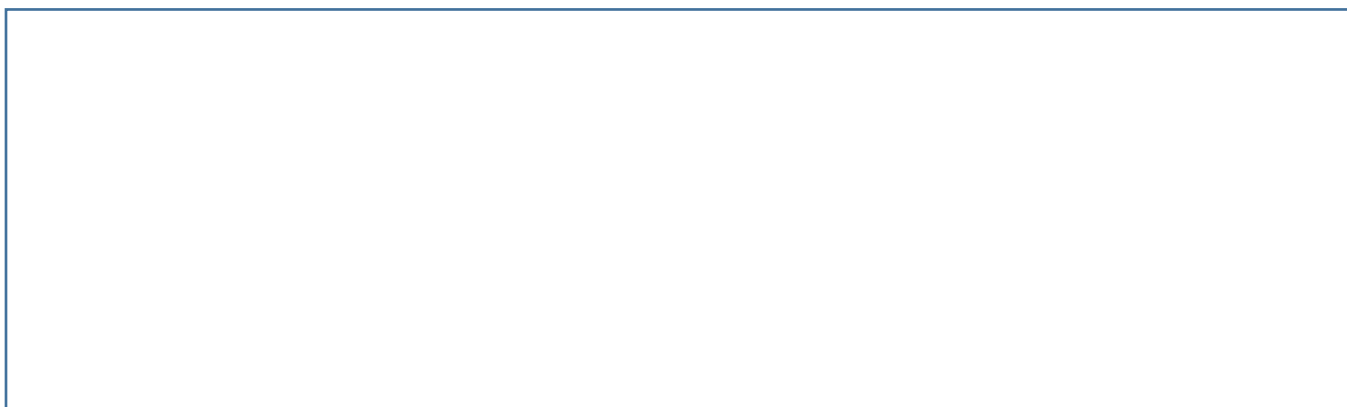
Seed Selection and Germination Activity

Selecting Seeds: By yourself or in a small group, study a seed catalog to learn more about the plants that you may want to grow. There are several online options in the chart below to help you pick one. Investigate the topics on this sheet. Once you have completed your research, you may want to work with your instructor on ordering this type of plant and using it with the hydroponic system. Note that some plants are not very conducive for hydroponics, so be selective in your seed choices.

SEED SELECTION:

Seed to Research: _____

Specifications on your seed/plant: (Tell as much information on it as possible. Height, width, grow temperature, growing information, best harvest times, length of growth time, growing tips, etc.)



Picture or drawing of your full-grown seed:



Seed Company Research Options:

1. Johnny's Selected Seeds: www.johnnyseeds.com
2. Seed Savers Exchange: www.seedsavers.org
3. Baker Creek Heirloom Seeds: www.rareseeds.com
4. Burpee Seeds and Plants: www.burpee.com
5. Territorial Seed Company: www.territorialseed.com
6. Seeds of Change: www.seedsofchange.com
7. Ferry-Morse Seed Company: www.ferrymorse.com
8. Southern Exposure Seed Exchange: www.southernexposure.com
9. High Mowing Organic Seeds: www.highmowingseeds.com
10. Fedco Seeds: www.fedcoseeds.com
11. Nichols Garden Nursery: www.nicholsgardennursery.com/store
12. Botanical Interests: www.botanicalinterests.com
13. Renee's Garden Seeds: www.reneesgarden.com
14. Peaceful Valley Farm & Garden Supply: www.groworganic.com

Seed Selection and Germination Activity

RESEARCH EXAMPLES: Below are several examples of the best seeds to grow using a hydroponic system. Use these examples to lead you to the best seeds to research and grow with your hydroponic systems.

Arugula

Lettuce

Basil

Chives

Fennel

Dill

Cucumbers

Tomatoes

Green/Sweet
Peppers

Peas

Strawberries

Eggplant

Radishes

Cabbage

Kale

Seed Selection and Germination Activity

Your teacher or leader should have seeds for the crops that you will be planting. If the seeds are not the ones you researched, that is fine. The importance of this activity is to learn the seed germination process and to start to grow your plants. Learn by doing!

INSTRUCTIONS:

Prepare Rockwool

- The seeds will be started in blocks or cubes of an insulation called rockwool. Rockwool holds moisture well, fits into the openings of the hydroponic baskets, and does not rot or break down easily.

Add Water

- Soak the cubes of rockwool in water for 15 minutes to 2 hours. Drain the rockwool. If there is excess water, shake the cubes out, but never squeeze them. Once this is done, put about 1 inch of water into the germination tray where the rockwool will be located.

Plant Seed

- Make a depression in the top of the rockwool. Place one seed in each cube of rockwool that you decide to plant.

Cover Tray

- Cover the tray and place in a warm, dimly lit location like a windowsill or a shelf in the hydroponics system. Keep the cover on tight and maintain about 1 inch of water in the germination tray. Check the rockwool daily and mist the seeds/seedlings with a mister when the top of the rockwool dries out.

Check for Growth

- Once roots emerge out of the rockwool, it is time to put them into the hydroponics system. This can take 5 -10 days, but do read the seed package, as time will vary from species to species.

Lesson Two – Growing Plants with Hydroponics

LEARN: Plant Growth & Nutrients

30-45 minutes

Purpose:

Participants work in groups or as individuals to start understanding the growing of plants. They will use the seedlings they are growing to create a grow chart and start collecting data on how their plants grow, giving them good opportunity for analysis on how to best grow plants in the future.

Materials:

- *Projector and Projector Screen*
- *Introduction to Hydroponics* slide presentation
- *Plant Growth Activity* worksheet

Facilitation Steps:

1. Prepare the *Introduction to Hydroponics* slide presentation (slides 42-51), which focus on plant growth and nutrients.
2. OPTIONAL: Print off slides 48-49 for your participants to have a tangible reminder of the pH balance and plant nutrient needs.
3. Go over the slides with the participants as they listen and prepare to do the *Plant Growth Activity*. Remember that this activity is to be used with actual plants and should be done when you have picked your seeds and have done the seedling growing.
4. Hand out the *Plant Growth Activity* worksheet to participants as you go through the *Introduction to Hydroponics* slide presentation.
5. Have participants work as individuals or in groups to create their plan on what and how they will collect data on the growth of their plants. They will use the growth chart to collect data on the speed and quality of growth. Talk with the participants about a good amount of time to collect data (everyday, once a week, twice a week, etc.).

6. Give participants time to chart out the placement for their plants and put them in the hydroponic unit.
7. Print and add additional *Plant Growth Activity* worksheets as needed. Participants will be using these to chart the growth over several days as the plants grow in the Hydroponic system.

Name: _____ Class: _____

Plant Growth Activity

Introduction:

Plant growth focuses on the variables that can affect the growth of a plant. These variables include sunlight, air flow, nutrients, water, and the plant itself.

With hydroponic systems, the variables of sunlight and air flow are covered with the use of grow lights and fans. Variables of water and nutrients are things you need to continually monitor. Follow the manufacturer recommendations. Once you have monitored those variables, it is time to chart your plant growth.

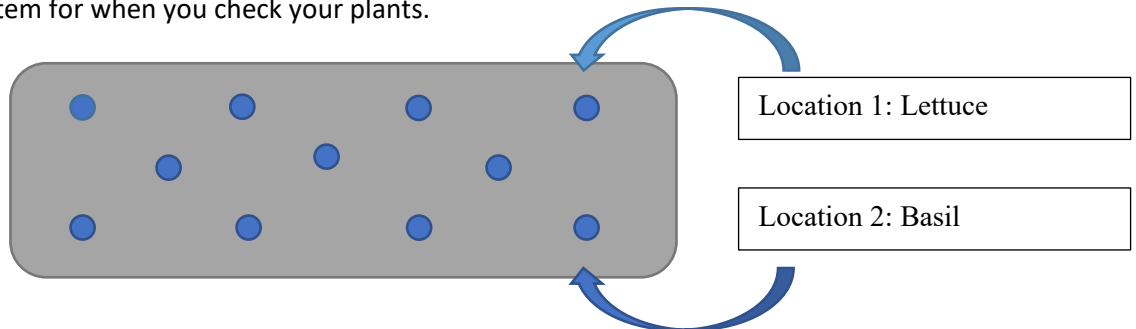
STEP 1: CREATE A PLAN

What are you going to focus on in relation to plant growth? There are many different things to observe and report concerning growth, so you will want to choose just a few. In this case, we will focus on the following.

- Measure plant height and width
- Count number of leaves

You will want to chart the following information and also create a graph that helps you view how the growth has happened. Before you start your measurements, you will want to mark both the type of plant and a measurement system for when you check your plants.

EXAMPLE:



Once you have the plan in place and your plants have sprouted, move your plants from the germination tray and move them into your hydroponic system. Start to chart the outcome of their growth.

STEP 2: PLANT PLACEMENT

Draw circles for each plant spot location, then write in number location and the plant type.

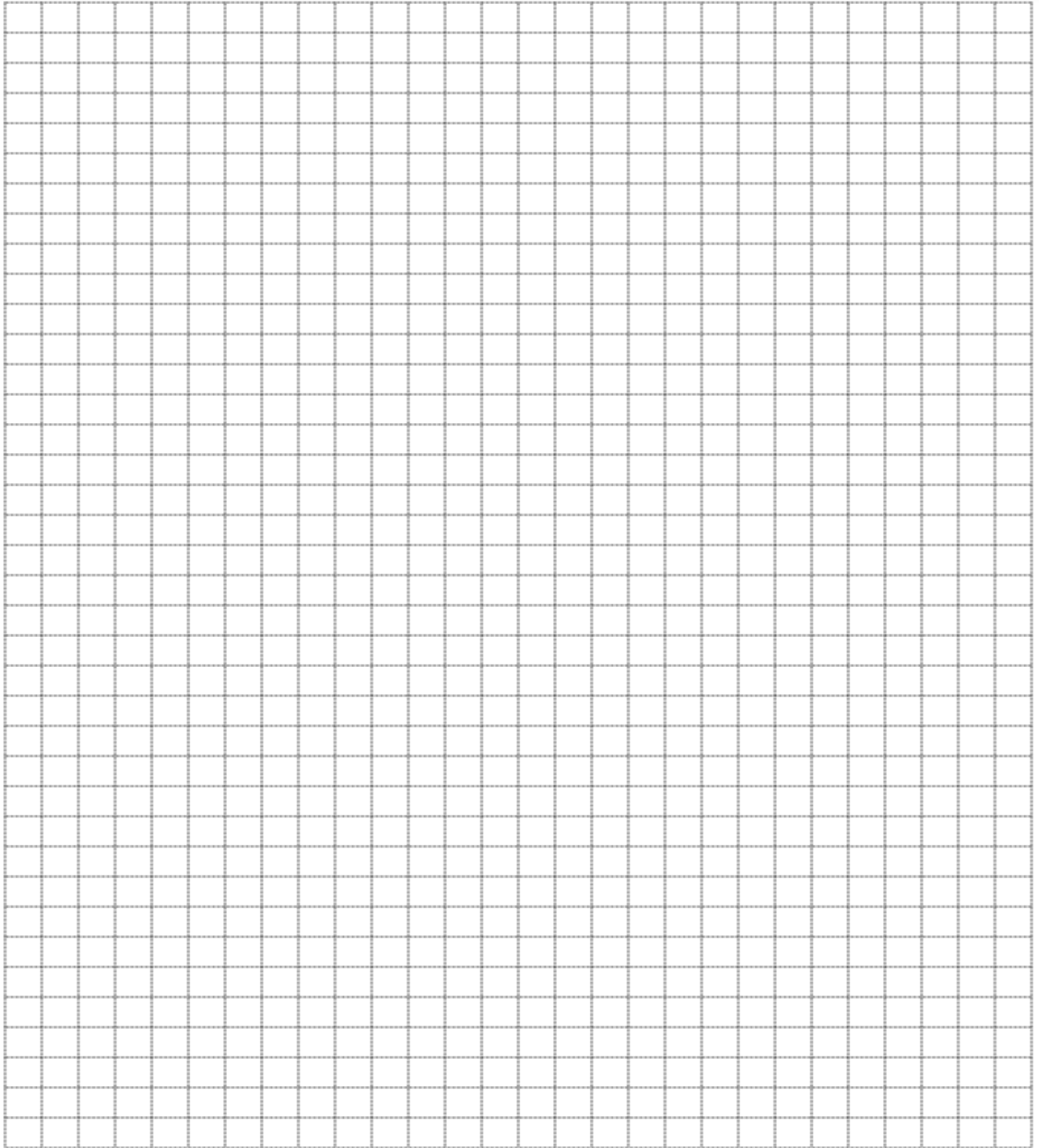
STEP 3: GROWTH CHART

Place your measurements and observations below.

Date	Location	Plant Height	Plant Width	# of leaves	Observations

STEP 4: Create a grow graph with the following requirements:

- Line the graph to chart growth, including plant height, width, and number of leaves
- Use different colors to identify each plant
- Label the axis appropriately
- Create a key showing which colors represent each plant



Lesson Two – Growing Plants with Hydroponics

REVIEW: Plant Growth Results

30-45 minutes

Purpose:

Participants will work in groups or individually to gain knowledge and understanding of plant growth. In this review, participants should work to grow successful plants. This can be proven by healthy leaves, produce, or another focus, depending on the goal.

Materials:

- *Plant Growth Results and Reflection* worksheet

Facilitation Steps:

1. Have participants finish their data collection and harvest the plants that they have been growing.
2. Hand out the *Plant Growth Results and Reflection* worksheet and have participants answer the questions about what they saw as positive and negative when growing plants in a hydroponics system.
3. Choose whether to have participants turn the worksheet in for credit or keep them for their own personal reflections.

Name: _____ Class: _____

Plant Growth Results and Reflection

Instructions: Reflect on what you have learned through the growth of your plant.

Seed Info:

- What plant seed did you pick?
- How long did it take to sprout?
- Did the seed germinate in the expected timeframe? How was it different or similar to what you thought it would be?

Growth Info:

- What was the growth expectation from for this type of plant (growth from germination to harvest?)
- How did your plant compare to that of an "average" plant? Did your plant grow quicker/slower, larger/smaller, etc?
- What issues did you have with your growth? What would you do different in future growths of this plant?

Harvest Info:

- How many days from seeding did the plant take to harvest?
- How did the harvest go, was there any issues with harvesting the plant?
- Did you run into any unexpected issues with the harvest?
- What will you do differently next time you grow plants in the hydroponics system?

Sources

1. Warner, Philson A.; Rakow, Donald A.; Mazza, Charles (1993). *Grow with the Flow*. Retrieved from <https://ecommons.cornell.edu/handle/1813/3283>