LESSON 4: CHOOSING PLANTS

TEACHER GUIDE

LESSON OBJECTIVE

To determine which types of plants will grow best in your classroom aquaponics system based on 3 criteria: the final use of the plant: for food or decoration, time needed for plants to reach maturity, and the amount of space required for growing.

LESSON MATERIALS

- 1+ cardboard patterns of a square foot (can be made from recycled boxes)

- Handout – "Choosing Plants" Chart

LECTURE WITH BACKGROUND INFORMATION

While almost any plant that enjoys a neutral pH can grow in an aquaponics system, in theory, the reality is that every system is limited by the size of it's grow bed (the space for growing plants) and the amount of time one has for growing (be it due to seasonal

changes or length of a teaching block). A third item to consider, though not as limiting but good to know when choosing plants: do you want to grow plants that you can eat, admire, or a mixture of both.

DESTINATION

Beginning with the end in mind, have your class consider what they want to do with the plants when their study of aquaponics is complete. Do you want to have a party in class and eat some of the plants that you have grown? Would you like to send the children home with flowers they grew in the classroom? Or would you like to do some combination of both?

While typically vegetables, fruits and herbs are edible plants, and flowers are ornamental. There are some flowers that are both edible and ornamental, like snapdragons, nasturtiums, pansies, roses, chamomile, and lavender to name a few.

This section is an opportunity to get kids excited about their aquaponics system, the plants they can grow and how food is celebrated in different cultures, in particular harvest celebrations.

Plant Type	Edible or Ornamental
Basil, Mint, Thyme	E
Bush cucumber	E
Bush Peas	E
Carrots	E
Flowers from seed (marigolds, impatiens, snapdragons)	O
Lettuce	E
Patio Tomatoes	E
Peppers	E
Pine Tree	O
Pumpkin	E
Radishes	E
Red Beet	E
Grass	O

TIME

Some plants grow faster than others, and since you are limited by the length of a school year or perhaps the length of a lesson block, you will want to factor in the amount of time it takes for plants to reach maturity. That is the time it takes for vegetables to ripen and flowers to blossom. Salad greens need about 8 weeks, tomatoes and other fruiting vegetables need 12 to 16 weeks; and flowers about 10-12 weeks.

It is okay to grow plants together that reach maturity at different times. Most plants grow well together in an aquaponics system. The amount of time needed to mature only means that you will be able to harvest some plants sooner than others.

Plant Type	Time
Basil, Mint, Thyme	60-70 days
Bush cucumber	55 days
Bush Peas	60-75 days
Carrots	70 days
Flowers from seed (marigolds, impatiens, snapdragons)	60-70 days
Lettuce	42-60 days
Patio Tomatoes	75 days
Peppers	75 days
Pine Tree	20+ yrs
Pumpkin	100-110 days
Radishes	20-25 days
Red Beet	55-60 days
Grass	55-60 days

SPACE

This is the hands-on part of the lesson.

Make a life-size replica of a square foot out of cardboard. (More children can participate in this activity if you make enough "Square feet" to cover your grow bed). Use your square feet to measure the size of your grow bed. One idea, give a child the stack of square feet and have other children stand side-by-side on opposite sides of the grow bed. Have the child with the cardboard square feet handout a square foot to each child standing around the growbed. One by one, let each child place their square foot in the bed side-by side until the bed is covered. Have the kids count the number of square feet to determine the square footage of the grow bed and how much space there is for growing.

Once this is done and students have figured out what type of plants they can and want to grow, use the cardboard square feet to figure out how many of each plant type can be grown. Lay the cardboard pieces on the floor in the shape of the grow bed. Let each square represent a plant type (like lettuce or tomatoes). Divide it into an appropriate number of sections, based on the number of plants that can be grown in a square foot as listed on the chart. Count how many plants you can grow.

When planting seeds, always use those from fresh seed packets to increase the odds of plants growing. Also, for each plant you intend to grow, we recommend planting 5 seeds if the seeds are small and 3 if they are large seeds. This increases your odds of getting at least one plant to grow. If more than one germinates, you can remove (thin) the extra plants when they are about 1-2 inches tall.

Let's say, for example, you are growing bush peas. According to the chart, two plants can grow in a square foot. Since peas have large seeds, you would plant 6 seeds in two groups of three seeds each within the square. Then as the plants grow, you would thin them down to 2 plants.

Plant Type	# of Plants/Square Feet (mature height)
Basil, Mint, Thyme	2 (12-18 in)
Bush cucumber	1 (24-36 in)
Bush Peas	2 (24-36 in)
Carrots	12 (12 in)
Flowers from seed (marigolds, impatiens, snapdragons)	4 (6 – 24")
Lettuce	4-6 (6-18 in)
Patio Tomatoes	1 (24 – 36 in)
Peppers	1 (18 –24 in)
Pine Tree	1/18 (18 sq. Ft. needed) (20+ ft)
Pumpkin	1/12 (12 squ feet needed) (12-18 in)
Radishes	6 (6-12 in)
Red Beet	4 (12 in)
Grass	100s (4-6 in)

If you are using grow lights another factor to consider may be the power of your lights and how tall your plants will grow. This is an FYI for teachers and not in the student section of this lesson as it may or may not be relevant.

If you are growing with lights that send a consistent, strong amount of light from 1 feet to 3 feet, then you can grow any mixture of plants you desire. However, if you are using lights that aren't as powerful and the amount of light greatly differs through the plant canopy then you should try to grow plants that will reach a similar height within a similar amount of time so that all your plants receive plenty of light to grow healthy and strong. Otherwise, the smaller plants will look leggy and anemic.

You can see some examples of height on the chart above in the "Space" section. Mature plant heights are in parentheses under the # of plants per square feet.

To be sure of the number of lumens at specific distances your lights provide, consult the information that came with your lights.

ASSESSMENT ANSWER KEY

1) **d.** - B & C

2) A mature edible plant is one whose fruit is ripe and ready to eat. A mature flowering and ornamental plant is one whose blossoms have opened.

3) **a.** - A square that is 12" on all sides

CHOOSING PLANTS

Plant Type	Edible or Ornamental	Time	# of Plants/Square Feet
Basil, Mint, Thyme	E	60-70 days	2
Bush cucumber	E	55 days	1
Bush Peas	E	60-75 days	2
Carrots	E	70 days	12
Flowers from seed (marigolds, impatiens, snapdragons)	O	60-70 days	4
Lettuce	E	42-60 days	3-4
Patio Tomatoes	E	75 days	1
Peppers	E	75 days	1
Pine Tree	O	20+ yrs	1/18 (18 sq. ft. needed)
Pumpkin	E	100-110 days	1/12 (12 sq ft needed)
Radishes	E	20-25 days	6
Red Beet	E	55-60 days	4
Grass	O	55-60 days	100s

STUDENT GUIDE – WHAT SHALL WE PLANT?

VOCABULARY

Edible – can be eaten

Ornamental – grown for beauty or decoration

Mature – when an edible plant has leaves or fruit that are ripe and ready to eat; when a flowering plant's blossoms have opened

Square Foot – A square that is 12 inches or 1 foot on all sides

Square Footage – The size of an object, measured in square feet

LECTURE AND DISCUSSION

There are 3 factors to consider when choosing plants for an aquaponics system:

- Destination
- Time
- Space

HANDOUT: "Choosing Plants" chart.

	Edible or Ornamental	Time	Plants/Square footage (height)
Basil, Mint, Thyme	E	60-70 days	2
Bush cucumber	E	55 days	1
Bush Peas	E	60-75 days	2
Carrots	E	70 days	12
Flowers from seed (marigolds, impatiens, snapdragons)	O	60-70 days	4
Lettuce	E	42-60 days	3-4
Patio Tomatoes	E	75 days	1
Peppers	E	75 days	1
Pine Tree	O	20+ yrs	1/18 (18 sq. ft. needed)
Pumpkin	E	100-110 days	1/12 (12 sq ft needed)
Radishes	E	20-25 days	6
Red Beet	E	55-60 days	4
Grass	O		100s

DESTINATION

First, consider whether you want to grow plants that you can eat (edible plants) or plants that you simply enjoy their beauty (ornamental). Edible plants mainly include fruits, vegetables and herbs. Ornamental plants include most flowers.

FUN FACT: Did you know that some flowers are ornamental and edible, like snapdragons and pansies.

ASK: What kind of plants would you like to grow?

[NOTE: You can do a combination of ornamentals and edible plants.]

ASK: Cross off those plants that do not meet our criteria.

TIME

Some plants grow quickly, like lettuce (8 weeks from seed to ready-to-eat), others may take much longer to reach **maturity**, like trees (require years to grow).

By mature, we mean the time it takes for edible plants to grow leaves or fruits that we can eat, and for flowering plants the time it takes for flowers to open.

ASK: How much time do we have to grow our plants? On your chart, cross off all those plants that will take too long to grow.

SPACE

Just as moms and dads are larger than babies, and some parents are larger/smaller than other parents, so too plants grow to different shapes and sizes as they age.

For instance, a full-grown lettuce plant takes up a lot more space than its seed, and a full-grown pine tree takes up more space than a full-grown lettuce plant.

Here is one square foot (hold up cardboard pattern of square foot). It is a square that is 12 inches, or 1 foot, on all sides.

Plants require a certain number of square feet to grow. So we must figure out how many square feet are in our grow bed, to determine which type and how many plants we can grow.

ASK: How many square feet do you think are in our grow bed?

[Put the square foot patterns in the grow bed, side by side. Count how many there are.]

ASK: Now look at the plant chart. Cross-off those plants that need more square footage to grow than is available in our grow bed.

ASK: What plants remain?

These are the plants that we can grow.

ASK: Of these, which ones would you like to grow?

[Using the square footage patterns and the spacing requirements listed on the plant chart, work with the class to determine, specifically, which plants and how many of each you will grow.]

EXTENSIONS

SCIENCE & ART: To deepen your understanding of how plants grow, track their growth through drawings. Choose a plant (seed) and every week draw a picture of it, illustrating how it changes from week-to-week.

Draw the plant emerging from the seed and it's first leaf (or leaves), the **cotyledon (**also known as the seed leaf). How many cotyledons are there?

FUN FACT: Counting cotyledons is one way botanists classify flowering plants. Those with one cotyledon are called monocotyledonous and those with two are called dicotyledonous.

In about another week the plant will sprout it's first "true" leaves (these are the leaves with the characteristic shape of the plant). Notice the difference in shape and color between the cotyledons and true leaves. What happens to the cotyledons as the true leaves grow?

FUN FACT: When the plant has cotyledons, it is living off the energy of the seed. Once the true leaves emerge the plant is now getting its energy from the sun, a process known as photosynthesis.

As the weeks pass, look for sudden explosions of growth. The plant will seem to double or triple in size in one week.

If you planted flowering or fruiting plants, observe the buds. How many weeks passed from the moment you first saw a bud emerge until the flower opened? Other than its size, how did the bud change?

If it's a fruiting plant, like a tomato, notice how the color of the fruit changes as it grows and ripens. How many different colors did you observe? How long did it take the fruit to ripen?

HISTORY: Explore how harvest-time is traditionally celebrated around the world. Each culture on every continent has it's own way of celebrating the bounty. Each student can choose a culture and write a report on how the harvest is celebrated. The class can choose which tradition they most enjoyed and replicate the celebration when it's time to harvest their plants.

CONCLUSION

Go over the "Choosing Plants" chart and review the 3 factors to consider when choosing plants and why they are important:

- *Destination* – Your intention for the plants: to eat them or admire their beauty.
- *Time* – The number of days will it take to grow the vegetables so that we can eat them or, with flowering plants, see them blossom.
- *Space* – The amount of square footage needed to grow plants.

Name_____ Date_____

ASSESSMENT 4 – CHOOSING PLANTS

· Which of the following are edible plants:

A. Pine Tree
B. Tomato Plant
C. Basil
D. B & C

· In your own words, explain what it means when a plant is "mature."

What is a square foot?

A. A square that is 12" on all sides
B. A triangle that is 6" on all sides
C. A circle that is 12" across