



IGNITE MY FUTURE

FAMILY ACTIVITY

Hydro-Garden

ACTIVITY TIME

1–3 hours, depending on level selected

MATERIALS NEEDED

- Pencil, paper, graph paper, measuring tool
- Common household materials for building a hydroponic planter:
 - Plastic bottle (water bottle or 2-liter bottle)
 - Pebbles or another growing medium (peat moss, perlite, coconut fiber, rocks, rock wool, grow rocks, or floral foam will work well)
 - Fabric for the wick (polyester is best, string can work as well)
 - Small plant or seeds
 - Plant food (liquid fertilizer, optional)
 - Fluorescent light (or natural light from a window)
 - Scissors or a utility blade (make sure you have a parent's supervision when using this tool!)
- Computer with Internet access (optional; for Advanced activity)
- TinkerCAD (optional; for Advanced activity. Free to use and accessible on Safari, Chrome, and Firefox browsers)





Background Information

What do you think of when you hear the phrase, “building models”? Do you think of model rockets or toy model cars? That might be one kind of model building, but computers allow us to build models in different ways.

Building models doesn't have to mean using glue, cardboard, and foam. By building **computer models**, your child can become more familiar with computer-aided design (CAD) software, which is a valuable skill in many different careers, such as civil engineering, material science, and architecture. Using CAD software allows us to experiment, find and fix errors, and simulate real-life events using mathematics without having to buy expensive materials. In this activity, we will explore ideas of how you can work together as a family to use computer models to build an indoor garden.

People have been growing plants as food for thousands of years. They began by growing simple grains, and over time they developed complex farming systems. Growing plants as a food source can be fun and rewarding because it provides a sense of achievement and you can eat the results!

The world's population is expanding rapidly, and most of that growth is happening in large urban areas with little farmland. Hydroponic crops can help feed families in urban areas where fresh food is scarce. Hydroponics is a farming method that grows plants without soil. In this method, a plant's nutrients are provided through the water and a growing medium, such as rocks or moss, stabilizes the plant.

In this activity, you and your family will plan your own hydroponic garden. You'll need to keep the following things in mind as you plan your garden:

- When choosing crops, consider growing herbs. Herbs are easy to grow and can elevate many dishes at home. Try homegrown **dill** in a salad made from the other vegetables in your garden. **Parsley** is delicious with cooked meat and roasted vegetables. **Basil** can be used with tomatoes and mozzarella for a yummy salad or with pasta, lemon, and cheese for a heartier meal. **Cilantro**, lime, honey, and peppers can make a tasty dressing or sauce for shrimp. **Lemongrass** makes for a refreshing tea and is often used in soups and with chicken. There are many recipes online or you may have family recipes at home that use one or more of these easy-to-grow herbs!
- Plants need anywhere from 4 to 12 hours of sunlight per day, so you'll need to put your garden in a place with plenty of sun. If you don't have access to lots of sunlight, you can use a fluorescent light.
- Hydroponic plants are grown mostly in water. That means that unlike plants that are grown in soil, they pull water into their roots using a wick.
- You will need containers for your hydroponic plants. Consider using recyclable materials such as plastic soda bottles for an easy solution that helps protect the environment.
- Plant food, or fertilizer, helps plants grow healthy and strong.
- Hydroponic crops don't need soil to grow, but you will need to use a growing medium to help the plants in your garden develop roots and stabilize. You can use any of the following materials as a growing medium: rocks, peat moss, floral foam, or even coconut fiber!

To create structures such as homes and large-scale gardens, landscape architects, civil engineers, and designers use computer-aided design (CAD) software. By modeling a design in a computer first, professionals can test and troubleshoot to avoid errors before building a structure. This is something you could try with planning your garden. This activity provides two levels to help you design a small hydroponic garden for an area in your home. The [beginner](#) level provides some basic instructions on how to plan a hydroponic garden using measurement and scale. The [advanced](#) level introduces online modeling tools that help you design your garden digitally before planting.



Blueprint for Discovery: BEGINNER Design Phase 1: Research and Design

Research the type of plant you want to grow, and determine a design for your hydroponic planter.

Materials: Garden Plan, measuring tape or ruler, and pencil

- 1** We will begin by drawing a sketch of what you want your hydroponic garden to look like. This is the computational thinking skill of building models, which helps us find and fix errors before we build.
- 2** **Decide** what you want to grow. Brainstorm foods your family likes to eat, and consider growing an ingredient from one of those dishes. A list of herbs with their planting depth, light needed, average soil temperature, and expected height growth can help you decide where to set up your planter. Selecting your vegetables before you design your garden will help ensure you have the correct amount of room and the best growing conditions.
- 3** **Review** the hydroponic planter examples provided and search for others online if you have Internet access.
- 4** **Think** of something you can use for a container, like a plastic bottle or cup. The container must have two parts: one for the water and one for the plant. The top part will hold the roots, and has holes to allow water to come up from the bottom part.
- 5** **Draw** the two-part container with the top part around the roots of plant.
- 6** **Think** of something to connect the water to the roots, or a “wick.” This can be any fabric, but polyester works best.
- 7** **Draw** the “wick” from the bottom of the container to the roots of the plant.
- 8** **Think** of something to bury the roots, called a medium, besides soil. Draw the medium around the roots of the plant.
- 9** **Revisit** the selected area in your home and sketch the planter on the [Garden Plan](#) to scale. Drawing “to scale” means to draw a picture of something with the same measurement, but possibly at a different size. If your garden is 1 foot long, draw it 12 squares long on the Garden Plan using 1 square = 1 inch.
- 10** **Sketch** on the Garden Plan the plants you plan to grow.
- 11** **Label** each plant with the plant name (for example, basil, cilantro). At the bottom of the [Garden Plan](#), write down each plant name and the measurement for the size you think it might grow (length and width).



Blueprint for Discovery: BEGINNER Design Phase 2: Build

Now it is time to create your own real planter using objects from around your house. You can also buy the plastic bottle, fabric, and pebbles at a discount store. The plant and the plant food can be found at a garden center, or you can find the plant outside. All materials per planter should cost about \$3 total. Please have an adult supervise this activity. Let's begin!

Instructions: Search around your house. See what you can find that will make a hydroponic planter.

Try to find the following items:

- Container – preferably plastic, so you can poke holes in it and cut it. Most importantly, it needs to hold water, pebbles, fabric, and a plant.
- Wick – this is some sort of fabric or string that allows water to reach plant roots from a resting source of water.
- Medium – this can be anything but dirt, such as pebbles or a sponge.
- Plants – although you can buy inexpensive small plants at a garden center, try to find some outside. Be sure to go with an adult to identify “safe” plants.
- Plant food – this is optional, but will help the plant stay healthy.
- Water

Materials:

- Pencil, paper, graph paper, measuring tool
- Common household materials for building a hydroponic planter:
 - Plastic bottle (water bottle or 2-liter bottle)
 - Pebbles or medium to plant in (peat moss, perlite, coconut fiber, rocks, rock wool, grow rocks, or floral foam will work well)
 - Fabric for the wick (polyester is best, string can work as well)
 - Small plant or seeds
 - Plant food (liquid fertilizer, optional)
 - Fluorescent light (or natural light from a window)



Blueprint for Discovery: BEGINNER Design Phase 2: Build

- 1** Poke or cut holes in the top half of the plastic bottle.
- 2** Cut the plastic bottle in half with scissors or a utility blade.
- 3** Turn the top half of the plastic bottle upside down and place it in the bottom half.
- 4** Cut the fabric into small strips, and insert the strips through the center hole (bottle opening) of the planter. Hold the fabric up for the moment.
- 5** Place a few pebbles around the fabric in the top half of the planter. Use just enough to make a single layer of pebbles.
- 6** Rest the fabric you were holding on top of the layer of pebbles.
- 7** Pull a small plant from outside, or buy one at a garden center.
- 8** Wash the dirt off the plant roots and place the roots on the fabric.
- 9** Cover the plant roots with the remaining pebbles.
- 10** Add water mixed with plant food. Be sure to read plant food directions.
- 11** When the plants have grown, use the food you've grown to create healthy, delicious meals at home!

Discuss the activity with your family, reflecting on how building models helps us think like computers in order to predict, simulate, test, and refine predictions. By building models, we make data come to life and create representations that allow us to make important changes. How could building this smaller hydroponic planter help you to plan and build a larger planter to feed the people in your apartment building, neighborhood, or community?



Blueprint for Discovery: **ADVANCED** Design Phase 1: Research, Sketch, and Design

Research the type of plant you want to grow, and determine a design for your hydroponic planter.

Materials: Paper and pencil

- 1 Decide** what you want to grow. Brainstorm foods your family likes to eat, and consider growing an ingredient from one of those dishes. A list of herbs with their planting depth, light needed, average soil temperature, and expected height growth can help you decide where to set up your planter. Selecting your vegetables before you design your garden will help ensure you have the correct amount of room and the best growing conditions.
- 2 Review** the hydroponic planter examples provided, and search for others online if you have Internet access.
- 3 Think** of something you can use for a container, like a plastic bottle or cup. The container must have two parts: one for the water and one for the plant. The top part will hold the roots, and has holes to allow water to come up from the bottom part.
- 4 Draw** the two-part container with the top part around the roots of plant.
- 5 Think** of something to connect the water to the roots, or a “wick.” This can be any fabric or string, but polyester works best.
- 6 Draw** the “wick” from the bottom of the container to the roots of the plant.
- 7 Think** of something to bury the roots, called a medium, besides soil. Draw the medium around the roots of the plant.



Blueprint for Discovery: **ADVANCED** Design Phase 2: Explore Modeling Software

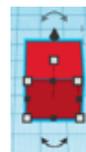
- 1 Go to www.Tinkercad.com and create an account with email or by using a social media account.
- 2 Begin learning the basic tools by following the opening tutorials, OR click "Learn" and then click on one of the basic tutorials. You can also follow the instructions below.
- 3 *Alternate Learning:* Click on the Tinkercad logo in the upper-left corner, then click on New Design.

Click on the different shapes and drag them to the "Work plane" (labeled).



For example, drag a "Box" to the work plane.

1. Use the curved arrows to rotate the box.
2. Use the black and white squares to resize the box.
3. Use the black cone to raise and lower the box.



- 4 Hover the mouse cursor over each icon to see the name of each tool, and then experiment with the following tools:

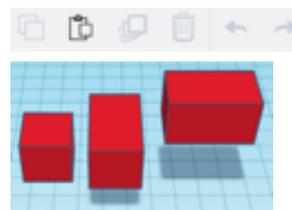
Home view, zoom in, zoom out

1. Click the house icon for home view.
2. Click + and – to zoom in and out.
3. Click and drag the cube to move the view.
4. Mouse scroll to zoom in and out.
5. Right-click and drag to change the view.



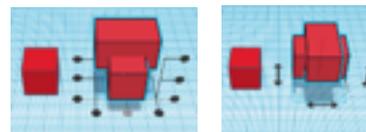
Copy, paste, duplicate, delete, undo, and redo.

1. Copy and paste the box.
2. Duplicate the box. Where is it? Move the box to one side to reveal the new boxes.
3. Raise the new boxes using the black cone.
4. Undo one of the actions.



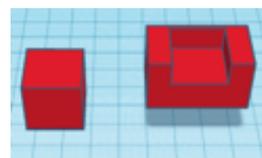
Group, ungroup, align, and flip.

1. Align two boxes – click and drag over two boxes, then click "Align." Use the black dots.
2. Group the two boxes that you aligned.
3. Flip the grouped boxes.



Create holes – select any object and click "hole."

1. Ungroup the two boxes.
2. Click one box and then click "hole."
3. Group the two boxes again.



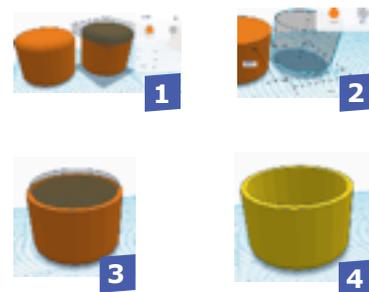


Blueprint for Discovery: **ADVANCED** Design Phase 3: 3D Model Using Modeling Software

Open a “New Design” in Tinkercad. This design will be used to model a “Plastic Bottle Hydro Planter” using one plastic bottle, pebbles, fabric, water, and plant food.

Create the bottom of the planter.

1. Drag two cylinders to the work plane. Use the “Bevel” tool to round the edges. Place a square “hole” on top of one cylinder and group them together.
2. Select the grouped object and make it a hole. Type a new number size, slightly smaller than the other cylinder.
3. Place the hole inside the other cylinder.
4. Group the objects together. This is the bottom of the planter, which is the bottom half of a plastic bottle.



Create the top of the planter.

1. Drag a half sphere to the work plane, and rotate it upside down. Place a tube on top of it, then stretch the tube up.
2. Drag a column to the work plane and make it a hole.
3. Center all three objects, then flip them upside down. Place another, slightly smaller, half sphere inside the first half sphere.
4. Combine all the objects.



Place holes in the top of the planter.

1. Drag four cylinders to the work plane.
2. Angle each cylinder, then place them in the top of the planter.
3. Combine all objects.



Add fabric, rocks, and plant.

1. Drag two blocks to the work plane and stretch them to rectangles. Combine them into the shape of a “T.” This will represent the fabric “wick” to allow water to reach the plants roots.
2. Drag many small spheres to the work plane. These will represent the pebbles.
3. Drag two trees to the work plane. They can be found in the “Community Shape Generator.” Make one tree small and turn it upside down.
4. Place fabric, pebbles, and “plant” in the planter. Scale the plant the expected mature height using information from Garden Plan to guide you.





Blueprint for Discovery: **ADVANCED** Design Phase 4: **Prototype**

Now it is time to create your own real planter using objects from around your house. You can also buy the plastic bottle, fabric, and pebbles at a discount store. The plant and the plant food can be found at a garden center, or you can find the plant outside. All materials per planter should cost about \$3 total. Please have an adult supervise this activity. Let's begin!

Instructions: Search around your house. See what you can find that will make a hydro planter.

Try to find the following items:

- Container – preferably plastic, so you can poke holes in it and cut it. Most importantly, it needs to hold water, pebbles, fabric, and a plant.
- Wick – this is some sort of fabric that allows water to reach plant roots from a resting source of water.
- Medium – this can be anything but dirt, such as pebbles or a sponge.
- Plants – although you can buy inexpensive small plants at a garden center, try to find some outside. Be sure to go with an adult to identify “safe” plants.
- Plant food – this is optional, but will help the plant stay healthy.
- Water

Materials:

- Pencil, paper, graph paper, measuring tool
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 - Fabric for the wick (polyester is best, string can work as well)
 - Small plant or seeds
 - Plant food (liquid fertilizer, optional)
 - Fluorescent light (or natural light from a window)



Blueprint for Discovery: **ADVANCED** Design Phase 4: Prototype

- 1** Poke or drill holes in the top half of the plastic bottle.
- 2** Cut the plastic bottle in half with scissors or a utility blade.
- 3** Turn the top half of the plastic bottle upside down, and place it in the bottom half.
- 4** Cut the fabric into small strips, and insert the strips through the center hole (bottle opening) of the planter. Hold the fabric up for the moment.
- 5** Place a few pebbles around the fabric in the top half of the planter. Use just enough to make a single layer of pebbles.
- 6** Rest the fabric you were holding on top of the layer of pebbles.
- 7** Pull a small plant from outside, or buy one at a garden center.
- 8** Wash the dirt off the plant roots and place the roots on the fabric.
- 9** Cover the plant roots with the remaining pebbles.
- 10** Add water mixed with plant food. Be sure to read plant food directions!

Debrief with your family that building models helps us think like computers in order to predict, simulate, test, and refine predictions. By building models, we make data come to life and create representations that allow us to make important changes. What are benefits to creating your hydroponic planter on the computer first, before you build your final design?

Garden Plan

Garden:

1 square = _____ (choose from 1 foot or 1 inch that best fits the design)

Length _____ Width _____

Plants: (add plant names and measurements)

Plant name _____ Length _____ Width _____ Plant name _____ Length _____ Width _____

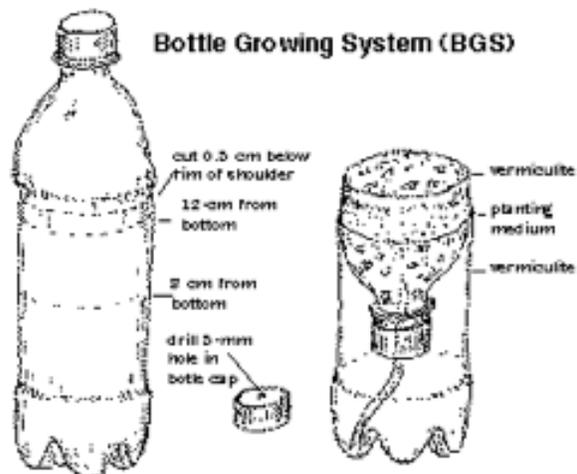
Plant name _____ Length _____ Width _____ Plant name _____ Length _____ Width _____

Plant name _____ Length _____ Width _____ Plant name _____ Length _____ Width _____

Garden Plan

Variety	Planting Depth	Soil Temperature (Fahrenheit)	Height in inches	Days to grow	Light	Growth Type
Basil	½ inch	70	12-24	70	Full	Annual
Chives	¼ inch	65	12-18	80	Full	Perennial
Coriander	3/8 inch	60	12-36	65	Partial	Annual
Dill	3/8 inch	65	36-48	60	Full	Annual
Lemon Grass	3/8 inch	70	12-24	75	Partial	Annual
Mint	1/8 inch	70	12-24	60	Partial	Perennial
Oregano	¼ inch	70	12-24	85	Full	Perennial
Parsley	3/8 inch	70	18-24	80	Partial	Biennial
Rosemary	1/8 inch	70	48-72	85	Full	Perennial
Sage	1/8 inch	60	12-48	70	Full	Perennial
Thyme	¼ inch	70	6-24	80	Partial	Perennial

Examples of Hydroponic Systems



Additional Resources:

<https://www.nal.usda.gov/afsic/hydroponics>