Hydroponic Activity Cards

A collection of 10 activity ideas to support learning about Hydroponics.

The hydroponic smart garden is a key resource for hands-on learning and child observation from the early years up. This advanced system supports children's understanding through close observation of plant growth from seed to maturity without soil. This process is ideal for educational gardening, as it is water efficient and there is no need for pesticides.

You can use these cards in order or choose the aspects you want to learn about to create your own Hydroponic Learning Journey.

With many thanks to **Dr Diane Boyd** for creating these activities.

Dr Diane Boyd has worked in HE for the last 18 years. She supported students in understanding child development and teaching experiences with a strong education for sustainability focus. Diane was involved with the DfE leading up to COP 26 and was personally invited to the launch of the DfE Sustainability and Climate Change Strategy. Diane has worked with Eco Schools England developing their Early Years platform and resources. Diane is currently promoting early childhood sustainability through the DfE Stronger Hub for the Northwest of England. She is an Honorary Research Fellow at Hull University.

1. An Introduction to Hydroponics

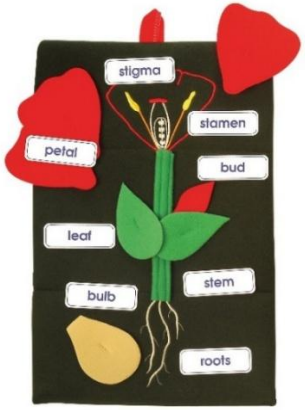
Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
Name the parts of a plant, such as: - stem - root - leaf - flower - fruit - vein	An A3 sized thinking note/art pad for recording and drawing scientific observations.	- SDG 2 Zero Hunger - SDG 3 Good Health and Wellbeing - SDG 13 Climate Action - SDG 15 Life on Land

Information

What is Hydroponics?
Hydroponics is when you give all the required nutrients for a plant to grow by supplying them in water rather than traditionally through soil.

Why is this helpful to gardeners or farmers?
With Climate Change comes droughts and floods so there is a need to be able to grow food in smaller and more self-contained containers and it also enhances and quickens the growing time. This enables farmers and gardeners to grow food in parts of the world stricken by Climate Change where nutritious soil, water and/or agricultural land may be in short supply.

What is special about a Hydroponic Unit?
The hydroponic unit features seven individual compartments, which allows you to grow a variety of different produce at the same time. The fully extendable arm can extend up to 33cm, providing sufficient height for taller plants. This feature ensures that plants have ample space to grow and thrive within the garden. The hydroponic unit allows you to observe the different stages of a plants development, different rates of growth and to learn more about biology, science and our ecological world.



Task

Start a 'Science Thinking Pad' which you will use to capture your learning throughout these activities.
In your thinking pad start with the following:

- Closely observe a plant and draw it, including all of the features and parts that you can see.
- Label all of the features.
- Look closely at the veins on the leaves and the strength of the stem – how do the veins and stem impact the plant?

2. Learning about the Hydroponic Smart Garden

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- Hydroponic (growing plants without soil) - Seeds	Hydroponic Smart Garden Pens and paper A3 thinking pad (from previous activity)	- SDG 2 Zero Hunger - SDG 3 Good Health and -Wellbeing - SDG 4 Quality Education - SDG 7 Affordable and Clean Energy - SDG 12 Responsible Consumption and Production - SDG 13 Climate Action - SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

Task One

Before you start any experiments with your hydroponic unit, it is important to understand the unit itself. Use your senses to explore the unit.

In your group observe the features:

- How many compartments does it have?
- How many seeds/plants can be grown in the unit?
- How does the unit allow different seeds and plants to be grown?
- Locate the extendable arm and measure the distance it can raise to. *(33cm)*
- How is the water added to the unit? *(locate the handy opening)*
- How can you observe the plant growth from seed to maturity?
- How does the unit close?
- How does the unit support the growing plant?

Task Two

Using your Thinking Pad, draw a diagram of the hydroponic unit. Try to draw all the specific parts and components.

Draw labels for each part and include as much detail about the functions of these parts.

3. An Experiment to Explore How Plants Grow Without Soil

To investigate how plants grow using only water and nutrients in a hydroponic system, and to observe the differences between hydroponic and soil-based growing.

Key Vocabulary	Resources	
- **Hydroponics –** Growing plants without soil using water and nutrients - **Nutrients** – Substances that help plants grow strong and healthy - **Roots** –The part of the plant that usually grows underground and takes in water and nutrients - **Observation** – Watching something carefully to learn more about it. - **Prediction –** What you think will happen before you test or try something	- TTS Hydroponic Unit - Seeds (e.g. lettuce, basil, or spinach – fast growers) - Measuring jug - Clean water - Labels and marker pens - Observation diary or printed record sheets Optional Additions: - Small plant pots with soil for comparison - Rockwool or foam seed plugs (if needed) - Liquid plant nutrients	

Now that you understand all the features of the hydroponic, you can setup your own experiment to grow plants using the Hydroponic System.
You may want to follow this method:

Method

1. **Set Up the Hydroponic Unit:**
   - Fill the hydroponic unit with clean water up to the marked line.
   - Add the correct amount of liquid nutrients as per the bottle instructions and stir gently.

2. **Prepare the Seed Plugs/or seeds:**
   - Place a seed into each Rockwool/foam plug/section of the hydroponic.
   - Insert the plugs/seed into the holes on the tray so the bottom of each plug touches the water.
   - Label each plug with the name of the plant and the date planted.

3. **(Optional) Set Up a Comparison/parallel experiment:**
   - Plant the same seeds into small pots with soil.
   - Place them in the same area as the hydroponic unit to ensure equal light and warmth (controls).
   - Make predictions, such as: Which do you think will grow faster – the plants in water or in soil? Why do you think that?

4. **Observe and Record:**
   - Observe the plants daily. Record the following: Date, Length of shoots, Number of leaves, Colour and health of the plant.
   - You could use drawings, photos, or sentence stems such as: “Today I noticed…” or “My plant has grown…”

5. **Maintain the System:**
   - Top up water and nutrients as needed.
   - Ensure the light on the hydroponic unit is on daily (if it includes one).

Conclusion Questions:

- Which plants grew the quickest?
- What differences did you notice between the plants in water and those in soil?
- Did anything surprise you?
- What do you think plants need most to grow?

Extension Ideas:

- Try different seeds to see which grow best in the hydroponic system.
- Test growth with and without nutrients to see how important they are.
- Use a ruler to graph the plant heights over time.
- Add a reflective backing to boost light exposure and compare growth.
- Add a time lapse camera to record the experiment over time.

4. Exploring Roots

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- Roots - Soil - Water - Nutrients	Hydroponic Smart Garden Pens and paper A3 thinking pad (from previous activity)	- SDG 1 No Poverty - SDG 2 Zero Hunger - SDG 3 Good Health and Wellbeing - SDG 4 Quality Education - SDG 6 Clean Water and Sanitation - SDG 7 Affordable and Clean Energy - SDG 12 Responsible Consumption and Production - SDG 13 Climate Action - SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

Task One

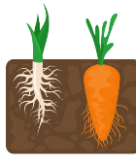
Discuss together: What do seeds and plants need to grow?
Hydroponic units use water with the right balance of **nutrients** that go directly to the plant's roots, which will ensure the plants are able to work efficiently concentrating all their energy to grow the leaves and fruits.

In your science thinking pad, draw and label the necessary requirements plants need to thrive and where they come from (soil, water, air and sunshine).

Task Two

The roots need to remain upright and strong. The hydroponic unit must give the roots the oxygen they need in the water.

There are two types of root systems - **taproots and fibrous roots.**
Research the difference between the two types of roots. Draw and record in your thinking pad.



Taproots

Fibrous roots

Task Three

Set up a science experiment to grow a plant in soil. This could run parallel to an experiment using a hydroponic unit (card 3) so that you can compare the two methods. Use a clear glass or plastic pot so that you can see extensive root system in soil as the growing plant searches for water and food. Study the soil root system as the plant begins to grow.

Task Four

Discuss how the two methods compare, a) using a hydroponic with nutrient water and b) using soil.
- Which plants grew faster? - Do the plants look the same? - Are the leaves fatter/wider/greener or healthier in water or soil?

5. Homemade Hydroponic

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- Root system - Hydroponic - Homemade - Recycled	Hydroponic Smart Garden Clear drinking straws Recycled Bottles Seeds for growing A3 thinking pad	- SDG 2 Zero Hunger - SDG 3 Good Health and -Wellbeing - SDG 4 Quality Education - SDG 7 Affordable and Clean Energy - SDG 12 Responsible Consumption and Production - SDG 13 Climate Action - SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

Information

The hydroponic smart garden is water efficient and there is no need to use pesticides when growing.

Reflect upon this from a climate change perspective.

Why would this be useful?

Task One

Reflect upon your previous learning:

- What does a plant need to live?
- What are the different types of root system?

The roots of a plant draw the nutrient water up through their roots.
Use a clear drinking straw to suck up juice. Think – how does this represent how a plant root sucks up water?

Task Two

Using recycled bottles, work together to make a water based hydroponic system.
Set up two different growing experiments. One with your homemade recycled hydroponic unit and the other with the hydroponic unit. Then explore and discuss the following:

- Compare the speed/size and health of the two experiments as the plants grow.
- Which is more efficient?
- How do they work the same/differently?
- If using seeds for edible plants, which has the nicer taste?

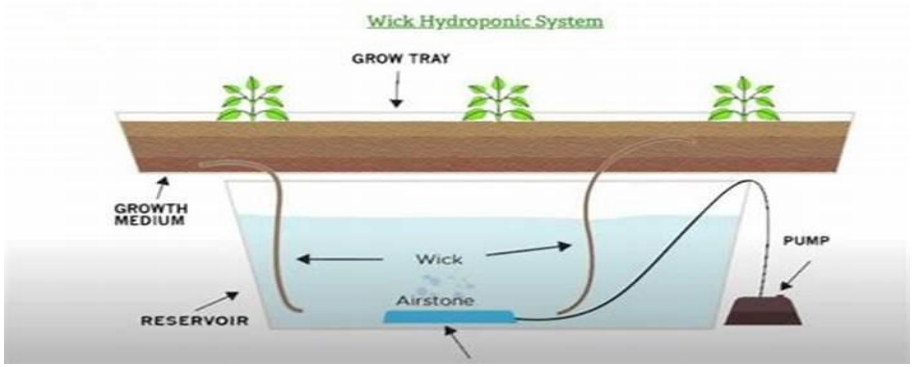
6. Different types of hydroponic system

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- passive systems - active systems - aeration - Media-Based Systems - Water-Based Systems	Hydroponic Smart Garden Pens and paper A3 thinking pad	- SDG 1 No Poverty - SDG 2 Zero Hunger - SDG 3 Good Health and Wellbeing - SDG 6 Clean Water and Sanitation - SDG 7 Affordable and Clean Energy - SDG 12 Responsible Consumption and Production - SDG 13 Climate Action - SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

Information

There are two types of Hydroponic systems – Passive and Active Systems.

Passive systems.
Passive systems need a 'wicking' material to support the plant to draw up the liquid nutrients or the plant is suspended in the solution allowing air to circulate around the roots.



Active systems.
In this hydroponic system an electric pump moves the nutrients into the root zone and provides the necessary aeration. Evidence tends to show the active system produces healthier plants over the passive.

Task One

- Research the two types of systems. In your scientific thinking pad, draw and record the differences and similarities between the two systems.
- Draw a passive and active system to help explore and explain how the root zone accesses the nutrients effectively.

Information

Media-Based and Water-Based Systems
Hydroponic systems can rely solely on water, or they can be media-based.

In contrast to the water based hydroponic unit, media-based systems use materials, such as gravel, perlite, or rockwool to support the plants and the roots in the nutrient solution. These materials provide a strong reinforcement for the roots system.

Task Two

- Revisit water-based systems that only use water. Remember they require a support material such as wire mesh to keep the plants from drowning. What would happen to the roots if they were not supported?
- Consider and research which plants do well in water-based systems – For example how do leafy crops such as lettuce and herbs do compare to cucumbers, tomatoes and peppers?
- Record these differences in your thinking pad.

7. Different types of soil

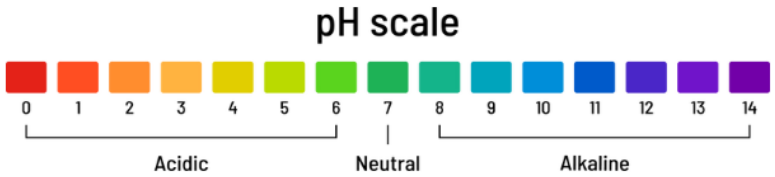
Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- soil - PH scale - photosynthesis	Hydroponic Smart Garden Pens and paper Different types of soil. A3 thinking pad	-SDG 6 Clean Water and Sanitation - SDG 7 Affordable and Clean Energy - SDG 13 Climate Action - SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

Information

With soil, nutrients come from tiny minute pieces of rock, decomposing mineral and organic matter. The nutrients are “held” by the soil particles and dissolved in the surrounding water.

In a water-based hydroponics unit, the nutrient solution is sucked in directly by the roots (think of that straw again) and are transported throughout the plant via the stem.

The pH of the nutrient solution is an important factor in a water-based hydroponics unit. Most of the plants in your classroom hydroponics projects grow best when the pH of the nutrient mix is between 5.8 and 6.5.



Information

These nutrients or minerals are not real food like in soil, but elements which are vital in helping the growing plant draw on the sugars (the real food) that it produces during photosynthesis.

Task One

Research what the word photosynthesis means. In your scientific thinking pad, draw and demonstrate your understanding using marks, pictures or words. *This will be developed further in a later activity.*

Task Two

- Take a closer look at and examine some soil.
- What does it feel like? What can you see in the soil?
- If possible, examine different types of soil and describe what they look like and how they are different. Types you might want to consider include Sandy soil, Clay soil, Slit Soil, Loam soil and peat soil. If not possible to examine the different soils. research them and discuss what you find out.
- Consider how soil differs from gravel, perlite, or rockwool which can all be used in media based hydroponic units.

Task Three

- Become familiar with the PH scale and the sliding scale of colours.
- If possible, measure the different PH levels in the different types of soils. If not able to measure the PH levels, research the standard PH levels of the different soil types.
- Investigate which soil is better for different seeds.

8. Temperature and Chlorine

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- hydroponic - nutrients - thermometer - Fahrenheit - Celsius/centigrade	Hydroponic Smart Garden Dried and Liquid Nutrients Thermometers Pens and paper A3 thinking pad	- SDG 2 Zero Hunger - SDG 4 Quality Education - SDG 6 Clean Water and Sanitation - SDG 7 Affordable and Clean Energy - SDG 11 Sustainable Cities and Communities -SDG 13 Climate Action -SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

Information

After researching and conducting previous experiments you will now have an awareness of the importance of nutrients for plant growth.

In water- based hydroponic units the most common way to supply nutrients to the growing plants is to buy prepared dried or liquid produce.

Task One

This is dependent on age and supervision required. But always try to ensure children can have access to observing science. Ensure you have risk assessed this activity first.

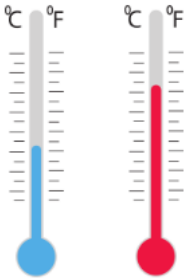
- Using your senses compare dried and liquid forms of nutrients.
- Mix the concentrated produce with water.

Task Two

Study how a thermometer works.

- How do you measure temperature using a thermometer?
- Draw a thermometer in your scientific thinking pad and label it.

Using a thermometer ensure the temperature of the water to be mixed is between 65 - 75 degrees Fahrenheit or 18-24 Celsius/centigrade. This is the best temperature for the growing plants.



Information

There has been discussion about chlorine in water for plant growth.
Chlorine levels in water can impact upon the growth of plant and strength of nutrient solution.

- Research what level of chlorine is recommended or advised.
- Consider, what is the impact of high or low levels of chlorine? Are low levels of chlorine in tap water toxic to the plants as they grow, because it is a required nutrient of plants? But if the chlorine level is too high, could it also be considered as toxic?
- Research the level of chlorine in the tap water in your area.
- Would collected rainwater be a good alternative based on chlorine levels?

If after researching, the tap water has significantly higher levels of chlorine than recommended, you can either use distilled water or leave the tap water out uncovered for a couple of days before using it.

Task Three

Comparing and Contrasting.

Set up and carry out two hydroponic growing experiments. One with nutrient solutions made with distilled or rainwater and one made with tap water.

Compare plant growth, colour, vibrancy of leaves and strength of stem between the plants.

- Reflect upon how this could affect Global farmers who are affected by climate change?
- How do the 17 SDGs relate here?

9. Oxygen

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- Oxygen - Carbon dioxide - Photosynthesis - Absorbent - Wick systems	Hydroponic Smart Garden Pens and paper A3 thinking pad	- SDG 2 Zero Hunger -SDG 4 Quality Education - SDG 6 Clean Water and Sanitation -SDG 7 Affordable and Clean Energy - SDG 11 Sustainable Cities and Communities - SDG 13 Climate Action -SDG 15 Life on Land *Can you make links to the SDGs within the tasks?*

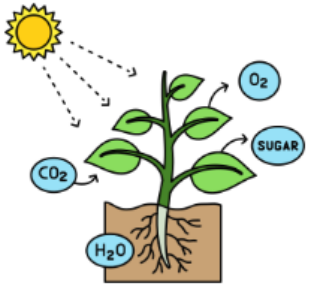
Information

Oxygen is essential for all living things on planet Earth, all animals and plants. It is in the air, water and food we need to live.

Roots of plants, trees etc need to have oxygen even though they are buried deep in the soil.

- **Revisit** the anatomy of a plant.
- **Revisit** your early research on photosynthesis.

Trees and plants capture light energy and transform water, carbon dioxide and minerals in the soil into chemical energy.



Information

Highlight the physics of photosynthesis. Oxygen's atomic number is 8 and its symbol is the letter O. Carbon Dioxide is CO2. Oxygen gas is colourless, odourless and tasteless.

Remember plants need large amounts of oxygen in their roots and if it is limited, it influences the growth of the plant in the hydroponics unit. After light (discuss the difference between sunlight v artificial light), the importance of oxygen to root cells is crucial.

Task

- Research the problems of neglecting oxygen input in a hydroponic unit.
- Consider how the two different systems support the amount of oxygen reaching the root in plants and therefore affect growth.
- Revisit and consider wick systems (absorbent material) that can be included to ensure water and nutrients reach the roots.
- Research absorbency and the best types of material to use.

Ensure all research and scientific experiments are drawn and recorded into your scientific thinking pad.

10. Sustainable Development Goals

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- Climate Action - Sustainable Development Goals	Hydroponic Smart Garden Seeds for growing Nutrients Pens and paper A3 thinking pad (from previous activity)	 *Can you make links to the SDGs within the tasks?*

Information

The Intergovernmental Panel on Climate Change (IPCC) is the United Nations body responsible for assessing the science related to climate change. In August 2021, its report highlighted the urgency of solving the current crisis regarding our world and it strengthened our need as early childhood educators to be part of this solution. In 2015, all United Nations Member States adopted the 2030 Agenda for Sustainable Development. It provided a clear blueprint for peace and prosperity for all people and a recognition of the importance of caring for our planet. Global partnership is key (it is the final SDG 17 Partnerships for the goals) in taking action to end poverty, discrimination, improve health and education for all, reduce inequality, ensure clean water, and encourage economic growth. At its heart are the 17 SDGs to enable countries to devise strategies that can support and empower citizens, whilst also tackling climate change and life on land and below the sea.

Task One

- You now have the skills and knowledge to set up a basic hydroponic unit considering the many different elements.
- Can you explain the processes from your research and consider the benefits that hydroponics systems can bring.
- Consider all positive and negative elements.

Task Two

- Research Climate Action further.
- How would these systems benefit farmers who are struggling? *(consider flooding and drought weather problems)*
- Research about how farmers and gardeners need to be creative and transformative in growing food.

Make strong links to all 17 Sustainable Development Goals (UNESCO,2015) in this process.

11. Design Your Own Hydroponic

Key Vocabulary	Resources	Sustainable Development Goals (SDG) UNESCO, 2015
- Reflect - Extend - Articulate - Analyse	Hydroponic Smart Garden	

Information

UNESCO 2017 highlights the importance of 21st century skills for the changing world. These skills cover creativity, problem solving, whole system thinking, reflective thinking and criticality.
Highlight the need to understand the whole system thinking through links to the Sustainable Development Goals.

Consider how you have used these skills in your learning about Hydroponic Systems.

Task One

- Revisit your research about Media-Based and Water-Based Systems and Passive and Active systems.
- Reflect upon the different types of plant that can be grown, and which are best suited for the two different hydroponic units.
- Reflect upon the different styles of hydroponic units and which are the best for different growing situations.
- Research different units that on the market, analyse their benefits and consider who they would be best used by.

Task Two

As a group, draw and design a hydroponic system of your own. What features will you include and what will be the unique selling points?
Create a marketing poster for your unit and decide how to articulate the benefits to an audience.
Thinking about our changing world and discuss how your newly designed hydroponic unit will help and who and where it would be best used.

SUSTAINABLE DEVELOPMENT GOALS

"Transforming our world: the 2030 Agenda for Sustainable Development". (A/RES/70/1) United Nations (2015).