# Danderion

# The Cube Collection

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# How to use your growcube

### How to use your GrowCube

There are a lot of ways to use the GrowCube; Here we outline a standard set up and operation of the system.

See this **jargon buster link** for info on different types of vertical farming systems.

### Setting up

- Make sure your GrowCube is set up as described in the Assembly Guidance with one tray per level.
- 2. Plug the lights into a plug socket; check that they are working before you plant anything.
- 3. Review the **Consumables** section and full guidelines before starting any trials to ensure you have all the materials required.

### **Sowing Preparation**

- Choose your crop Plants such as microgreens, leafy greens, and fast growing herbs will grow best in the GrowCube.
- 2. Prepare your growing media Growing media is the material that the plants grow on. Refer to the **Consumables** section (1) for some growing media options.
- 3. Prepare your perforated support for your growing media

Cut or assemble the perforated support to fit. See **Consumables** section (2) for support options.

- 4. Submerge and saturate your growing media in fresh tap water so that it is damp but not excessively wet.
- Take the trays out of your GrowCube and place the growing media into the perforated media support. Use the perforated media support to lift it into the white GrowCube trays (see Consumables section (2) for suggestion).

#### 6. Now it's time to sow the seeds

Depending on what you are growing and the size of the seeds, you will need to either sprinkle the seeds evenly over the growing media or poke a hole in the growing media and place the seed in.

### Germinating

Germination is when the first part of a plant grows out from the seed. Since the plant hasn't grown its leaves yet, it can't get its energy and food from the sun so it uses what it has inside the seed. This part of the plant's life needs different conditions to grow. Normally this is when the plant is still under ground. Here is an outline of how to mimic this environment within the GrowCube.

- 1. To germinate, the seeds need to be kept dark. So cover them with something to keep the light out e.g an opaque tray or black film (as referenced in the **Consumables** section (3)). This can be done in the white trays within the GrowCube, or anywhere dark.
- They also need to be kept moist so lightly spray with water every 1-2 days (see Consumables section (4) for suggestions), more heavily on a Friday before the weekend. The important thing is to not let them dry out.
- 3. Once you can see the shoots out of the seeds they are ready to take out of germination (this can take anywhere from 2 days to a few weeks depending on what you are growing. Check your seed packet or look online for germination times of the plants you are growing. Remove the black film or tray covering and turn the lights on.

### Growing

### **Lighting Schedule**

Key elements of growing in the GrowCube are outlined below.

### Weekday Schedule

A good photoperiod that will work for most crops is 16:8 (16hrs ON, 8hrs OFF), e.g. turning on at 6am and off at 10pm. This is only if the plants are being checked daily to make sure they are not drying out. See Figure 1 below.



### Weekend Schedule

In order to ensure the plants don't dry out over the weekend, adjust your plug settings for your light to: 5 hrs OFF; 3 hrs ON; 1 hr OFF; 3 hrs ON. See Figure 2 below for a recommendation of ON/ OFF times.

This adjusted photoperiod should ensure the system does not dry out. You can either change the photoperiod to this during time periods of over 48 hours (e.g the weekend), or have this photoperiod throughout (i.e. including weekdays as well).



See Consumables section (5) for suggestions for mechanical/digital timer switch plugs.

### Watering & Nutrient Delivery

The crops won't survive if they get too dry or if they are overwatered. The best way to do this is check if the growing media is dry. They will need watering roughly 2-4 times a week once they are out of germination and growing. The plants should be watered with a nutrient solution.

Nutrient Solution (see Consumables section (6) for suppliers)

- 1. Make up your nutrient solution (this process will differ depending on the type you use so follow the manufacturer's instructions). It's best to do this in a large container and use a smaller container or jug to pour into the tray in step 3.
- 2. Pull out the tray and place on an even, accessible surface.
- Slowly pour in the mixed nutrient solution at the side of the white tray (make sure you're not pouring directly onto the plants as it will stress them).
- 4. Fill up the tray with your nutrient solution to half way up your growing media but not above. The growing media should absorb the nutrient solution but should not reach the shoots of the plants. Rock the trays slightly to

ensure even distribution of the solution across the growing media.

(This is a general guide; you can set and adjust measures according to what you are growing and any experiment you are running.)

- Leave for 10-15 minutes so that the plants can soak up the nutrient solution. (Times may vary according to the crops you are growing)
- 6. Extract the plants on the media and perforated support out from the white GrowCube trays and pour out the excess nutrient solution\*, leaving some in the grooves of the white tray.

\*This solution can be reused in a second round of watering if it is kept in an opaque clean, sterile container (i.e. should not be exposed to light).

- 7. Put the perforated support with crops back in the white tray.
- 8. Place the white trays back in the GrowCube and close the doors.

### Harvesting

Congrats! You have successfully grown crops in a GrowCube. Harvest time will differ depending on what you've planted.

When it is time to harvest, take out your white GrowCube trays. Remove the perforated support and harvest.

### Cleaning

Cleaning the system is essential for maintenance of the system and the health of the crops. The GrowCube must be cleaned properly after each harvest.

- 1. Remove all of the trays that you have grown in.
- 2. Using a standard antibacterial detergent cleaning product, thoroughly clean the trays (Consumables section (7)).
- 3. Rinse the trays thoroughly if any cleaning product is left on, it will be harmful to the next plants that are grown in it and will risk the crops not being fit for consumption.
- 4. Once dry, put the trays back in the GrowCube.

### **Consumables**

Item	<b>Useful Links</b> (these links are suggestions, these items, or similar, are available from a number of suppliers)	
(1) Growing media	<ul> <li>For a range of growing media: https://growfelt.com/growing-media/</li> <li>https://www.hydroponics-hydroponics.com/propagation-c37/rooting-media-c41/grodan-sbs-</li> </ul>	
	rockwool-cube-tray-p167/s315? • https://hyjo.co.uk/grodan-rockwool-150-cube-tray.html	
(2) Perforated trays (only for matting style growing media, not pots)	<ul> <li>https://www.amazon.co.uk/Plastic-Garden-Fencing-Netting-Robust/dp/B00JHJEAS/ Cut the black mesh into the size tray you want to fit into the white trays (configurations that work well in the trays are 3 rows or 4 square quarters). Measure the base plus ~3cm for the sides . Fold the sides up and secure the corners with zip ties or similar as pictured below.</li> <li>Image: Configuration of the side of the si</li></ul>	
(3) Black film	<ul> <li>https://www.amazon.co.uk/Triplast-400mm-Pallet-Stretch-Shrink/dp/B01F8TPWIC/ref=asc_df_ B01F8TPWIC/?tag=googshopuk-21&amp;linkCode=df0&amp;hvadid=231947762582&amp;hvpos=&amp;hvnetw=g&amp;h- vrand=16306119100181502281&amp;hvpone=&amp;hvptwo=&amp;hvqmt=&amp;hvdev=c&amp;hvdvcmdl=&amp;hvlocint=&amp;h- vlocphy=9044966&amp;hvtargid=pla-422790036701&amp;psc=1&amp;th=1&amp;psc=1</li> </ul>	
(4) Spray bottle	<ul> <li>https://www.wilko.com/wilko-trigger-sprayer-550ml/p/0310567?gclid=CjwKCAjwxOCRB- hA8EiwA0X8hiy6WbnkhJ0oU1Xi4-qtKXILAAw0JIqTQ8HRC_74uHAmahYtNkXsoAhoCW3EQAvD_ BwE&amp;gclsrc=aw.ds</li> </ul>	
(5) Plug Timer	<ul> <li>a) https://www.screwfix.com/p/masterplug-tes7-digital-plug-in-plug-through-programma- ble-timer/50676</li> <li>b) https://www.screwfix.com/p/masterplug-tcm24-xd-mechanical-plug-in-plug-through- compact-timer/44241?tc=GB9&amp;ds_kid=92700055281954484&amp;ds_rl=1249401&amp;gclid=CjwKCAjwx- OCRBhA8EiwA0X8hi5P8MIgII9Vd2SKhhDYgoR1EdToBqbpuZU0hYnPVN1f4q1tNoA_naRoCWTcQA- vD_BwE&amp;gclsrc=aw.ds</li> <li>c) https://uk.teckinhome.com/products/teckin-sp27-smart-plug?variant=41121300709551</li> </ul>	
(6) Nutrient Solution	<ul> <li>https://www.londongrow.com/products/vitalinkhydromaxgrowabhw?variant=31892653375572</li> </ul>	
(7) Cleaning product	<ul> <li>Any standard antibacterial detergent cleaner will be suitable as long as it effectively rinsed off with fresh tap water.</li> </ul>	

Nutrient solution supplied for 2022 project:

Manufacturer: Terra Aquatica (by GHE General Hydroponics) Manufacturers analysis: The product is made with distilled water and purified mineral salts.

Total nitrogen (N): 3% - 2% Nitrate nitrogen (NO3)

- 1% Ammoniacal nitrogen (NH4) Phosphorus pentovide (P2O5): 1% Potassium oxide (K2O): 6% Magnesium oxide (MgO): 0.8%

Composition (N-P-K): 3-1-6 Usage: Growth accelerator Suitable growing media: All growing media.

### Things to look out for

### Do

- Do clean thoroughly after each time you have grown in the GrowCube.
- Do turn the lights off at night.
- If you see any dead, diseased or mouldy plants do dispose of them and thoroughly clean the tray they were in.
- Do grow multiple crop varieties in the GrowCube at one time if you wish.

### Dont

- Don't place near anywhere that is particularly colder or warmer than room temperature (ideal is 21 degrees celsius but ambient room temperature is fine). Try to avoid placing the GrowCube directly next to a radiator.
- Don't leave the light on overnight.
- Don't let your growing media dry out, but make sure it is not permanently submerged.
- · Don't get the shoots of the plant too wet when watering.
- Don't reuse growing media.
- Don't place the GrowCube in direct sunlight (ambient light is fine!).
- Don't get the electric connections wet.

### **Troubleshooting**

Visit the Liberty Produce **website** (https://www.liberty-produce.com/growcube) for FAQs or **contact us** if you have any issues, just want to know more about the GrowCube or book a visit.

### Why do we need GrowCubes?

The GrowCube is a mini version of a large scale hydroponic growing system. These large-scale systems can also be called Vertical Farms, or Controlled Environment Agriculture.

There are challenges from climate change facing food production in Scotland and around the world. In addition to working to solve climate change, it is a good idea to explore different solutions to the issue of how we provide a range of good food for everyone. Many farmers and growers are doing just that and your experiments with your GrowCube can be part of that exploration too.

There are two experiments designed by SRUC for you to follow. You can also create your own experiments.

#### Thinking about our food

You could find out about the different foods that people eat around the world and why that might be.

- What are the factors that influence what people eat? Are they the same for eveyone?
- What influences your choices about food?
- · Could sustainability be one of those influences?
- What would make food more sustainable?

Here are some suggestions for further reading: Farming for 1.5 degrees – An independent inquiry on farming and climate change in Scotland https://www.farming1point5.org/

Nourish Scotland Food Atlas – 2018 – 2030 Mapping out a sustainable food future http://www.nourishscotland.org/wp-content/uploads/2018/08/Food-Atlas\_FINAL\_online.pdf

Vertical Farming dossier from Wageningen University https://www.wur.nl/en/dossiers/file/vertical-farming.htm

State of Nature Report 2019 – Human impacts, including food production, on the nature in the UK https://nbn.org.uk/stateofnature2019/reports/

Environmental impacts of food production https://ourworldindata.org/environmental-impacts-of-food

## **Experiment 1** Instructions

## **Experiment 1 Instructions**

### Tickling (thigmomorphogenesis)

This experiment is designed to investigate how touch stimulates plant growth. In the wild, plants are exposed to wind, water droplets and animals and insects passing by – all of these have impacts on how the plants grow. In this experiment you will tickle the plants in the cube!

### Hypothesis: Tickling plants improves their growth

#### MATERIALS

- Cube
- Seeds. This experiment is written for 6 different seeds, but you can grow fewer types.
   Remember to adjust the randomization in the layout to match the number of species. 120 x sunflower, 120 x lettuce, 120 x chives, 120 x lemon balm, 120 x kohl rabi, 120 x beet
- Paint brush
- 3 x Growfelt mats or other growing media
- 3 x perforated support for the Growfelt mats. this is to help you lift the Growfelt and seedlings out of the tray. See Consumables on page 5 for suggestions for perforated support.
- Water
- 2 litre jug or clean, empty 2 litre bottle
- Nutrient solution
- Mixing spoon
- Non-toxic permanent marker pen
- Ruler
- Paper cut into 25 pieces
- Hat, bowl, or something similar

### METHOD PART 1 SETTING UP THE EXPERIMENT

N.B. Randomising the design is important to remove any bias. For example, if all the sunflower seeds are sown along one edge, is this fair to the other seeds? No, because they might be exposed to more natural light, and therefore it might impact on the growth. The first thing to do is randomise where each patch of seeds will be.

- 1. Divide each mat of Growfelt into 25 x 11.5cm squares by marking with a non-toxic permanent marker pen and ruler.
- 2. USE THE LAYOUT TEMPLATE TO LABEL EACH PATCH A1, A2, A3 etc. BLOCK out the square where the sensors will be.
- 3. Place your perforated support into the tray. Place the mat into the tray on top of the perforated support.
- DECIDE AND LABEL which shelf will be Control, Treatment 1 or Treatment 2. Label the layout template as well e.g., top shelf = control, middle shelf = treatment 1 etc.
- 5. Cut the paper into 25 pieces. Write sunflower on 4 squares, lettuce on 4 squares, kohl rabi on 4 squares, lemon balm on 4 squares, beetroot on 4 squares, chives on 4 squares Put all the squares into a hat, bowl or similar.
- 6. To randomise the design, draw the names from the hat/bowl and assign each one to a square, starting in the top left and going in rows until all squares are assigned a seed type. Use the marker pen to label each square with the name of the plant. Also use the Layout Template sheet to record which plant species is in each square.
- 7. Carefully open a seed packet and count 40 seeds.
- 8. Sow 10 seeds into each square that is randomly chosen for that species, giving each seed some space and making sure they stay within the square.
- 9. Repeat this process for the remaining 5 species and for all 3 trays.
- 10. Place the trays into the cube. You do not need to exclude the light. If your seeds show no sign of germination by day 7, use squares of black card to cover them.
- 11. Gently fill the trays with water and once the seeds have germinated, you can move onto



the next stage.

Did you know that plants can be grown without soil? In fact, if we provide the right nutrients, light and some form of root support, plants can grow in liquid! Cool, huh? The next part of the methodology is preparing the nutrient solution that will feed the plants. Please make sure you prepare the solution away from any electric devices.

- 12. Once the seeds have germinated, remove the trays from the cube one shelf at a time. Lift out the Growfelt carefully, place on a towel and discard the water in the tray that remains. N.B. You will have to gently lift out the sensors first.
- 13. Place each tray back into the cube in the correct order and replace the sensors into the correct patch.
- 14. To prepare the nutrient solution, add 2 litres of water to the measuring jug (or a 2-litre bottle) and add 30 drops of nutrient solution. Mix well using a spoon/replace cap and shake well.
- **15.** Gently pour the solution into the tray.
- **16.** Repeat this process for all 3 trays. Apply nutrient solution as required, to the same recipe as before.
- Set the timer to turn the lights on or off. All lights to be turned off between 8pm and 4am (8 hours off, 16 hours on).
- 18. For each patch record: the date of germination; date of cotyledon; date of first true leaves.



### PART 2 CARRYING OUT THE TICKLING EXPERIMENT

Once all the seedlings are 2 cm tall, they are ready for tickling. Make sure all patches have got to this height before starting the experiment. Some patches may be taller, but that's OK.

- The control shelf- no tickling
- Treatment 1 shelf- gentle tickling using the paintbrush to brush each plant 5 times
- Treatment 2 shelf- moderate tickling using the paintbrush to brush each plant 10 times
- 19. Carry out tickling 3 times per week Monday, Wednesday, and Friday
- 20. For each patch measure: growth rate in mm (same day each week); vigour score (see notes); leaf colour and mortality rate.
- **21.** Record your results.

### Notes

Vigour score is on a Scale of 0 - 5

- 0 = dead;
- 1 = stems very thin and weak (like thread)
- **2** = stems quite thin and slightly weak
- 3 = some stems moderately thick and getting stronger
- 4 = most stems moderately strong and thick (springy to light touch) (like soft brush)
- **5** = all plants very strong with thick stems (more rigid to light touch) (like brush)

This is a subjective score so different people will score differently. It is important that a consistent person or group generates the score.

Time to germination – record the date Time to cotyledon – record the date Time to 1st true leaves – record the date Growth rate – measured in mm/same days each week Mortality rate – counted with date/ must be translated into a percentage. (10 seeds per patch makes this easy to calculate) Leaf colour – use the colour scale provided

### AT HARVEST – record information about your harvest e.g.

Yield per treatment - calculated by weight in grams or other appropriate unit

Taste of 6 species - provide your own descriptor

Feel of leaves (NOT the stem) of all 6 species - waxy, soft, smooth

Smell of 6 species - provide your own descriptor

How did you feel about eating the microgreens? - Describe and compare your descriptions

# Layout Template

### Layout Template for GrowFelt, seeds and sensors

There is space in the grid for 4 patches of 6 different plant seeds. There is a space reserved for the sensors. Sensors must be placed in E5 on all shelves. You can decide to grow more patches of fewer plant varieties e.g. 8 patches of 3 different plant seeds.

DECIDE and LABEL which shelf will be the Control, Treatment 1 or Treatment 2.

Here are 3 templates for you to use to write down where each patch of your plant species will be. The space for sensors has been indicated for you.

Тор	Top Shelf in the Cube				
	Α	В	С	D	E
1					
2					
3					
4					
5					Place sensors Here

Mi	Middle Shelf in the Cube				
	Α	В	С	D	E
1					
2					
3					
4					
5					Place sensors Here

Bot	Bottom Shelf in the Cube				
	А	В	С	D	E
1					
2					
3					
4					
5					Place sensors Here

Red, Green, Blue 253, 248, 207	Red, Green, Blue 252, 254, 154	Red, Green, Blue 146, 208, 80	Red, Green, Blue 84, 130, 53	Red, Green, Blue 55, 86, 35
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5
1	2	3	4	5

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### **COLOUR CHART FOR CUBE EXPERIMENT MEASUREMENTS**

# What are those crops like to eat?

### **Experiment Questions on sensory responses - Example Descriptors**

When you harvest the microgreens or mature herbs and vegetables grown outside, you can ask what they are like to eat.

Below is a list of descriptive words. These suggested words are to help you describe their taste. You do not have to use words from the list. You can use your own descriptive words.

There's a template you can use on the next page to help you practise tuning into your senses and describing the sensations. Different senses affect how something tastes.

Professional tasters use flavour wheels for different food products like chocolate or coffee. Would you like to taste chocolate for a job? **This is a Consumer chocolate sensory wheel**. **This coffee flavour wheel** might help you understand why you like a particular type of coffee and not another.

### **Example Descriptive words**

Taste	Smell	Emotion
Sour	Sharp	Comfortable
Salt	Fresh	Relaxed
Bitter	Smoky	Cautious
Sweet	Burnt	Self-conscious
Umami	Earthy	Confused
Tangy	Strong	Excited
Bland	Tasty	Nervous
Fruity	Bland	Grumpy
Floral	Rotten	Disappointed
Peppery	Fragrant	Annoyed
Spicy	Fruity	Sceptical
Delicious	Minty	Shocked
Stale	Savoury	Confident
Strong	Meaty	Trusting
Buttery	Chemically	Anxious
Subtle	Scented	Defensive

### Using your senses

How a food looks, smells and feels are part of our experience of taste. This template can help you to practise describing your sensory experience of food. You can practise on any fresh, raw ingredient and even compare crops you have grown with shop bought ones.

1) My food product

#### 2) Describe your food product

Appearance	Aroma/smell	Texture/mouthfeel	Taste

#### 3) Rate your food product from 1 – 5



4) Say what would make you like your food product more? How could it be improved?

# **Experiment 2**Instructions

### Experiment 2 Instructions nutrient concentration

This experiment is designed to investigate how nutrient concentration impacts plant growth. Just like people, plants need food to grow. Plant food in a hydroponic system, is supplied in the form of a liquid. Do plants grow bigger if they are fed more?

### Hypothesis: Higher concentrations of nutrient solution will create larger plants.

#### MATERIALS

- Cube
- Seeds. This experiment is written for 6 different seeds, but you can grow fewer types. Remember to adjust the randomization in the layout to match the number of species. – 120 x sunflower, 120 x lettuce, 120 x chives, 120 x lemon balm, 120 x kohl rabi, 120 x beet
- 3 x Growfelt or other growing media.
- 3 x perforated support for the Growfelt mats. this is to help you lift the Growfelt and seedlings out of the tray. See Consumables on page 5 for suggestions for perforated support
- Water
- 2 litre jug or clean, empty 2 litre bottle
- Nutrient solution
- Mixing spoon
- Non-toxic permanent marker pen
- Ruler
- Paper cut into 25 pieces
- · Hat, bowl, or something similar

### METHOD PART 1 SETTING UP THE EXPERIMENT

N.B. Randomising the design is important to remove any bias. For example, if all the sunflower seeds are sown along one edge, is this fair to the other seeds? No, because they might be exposed to more natural light, and therefore it might impact on the growth. The first thing to do is randomise where each patch of seeds will be. You will need to know which seeds are in which square.

- 1. Divide each mat of Growfelt into 25 x 11.5cm squares by marking with a non-toxic permanent marker pen and ruler.
- 2. USE THE LAYOUT TEMPLATE TO LABEL EACH PATCH A1, A2, A3 etc. BLOCK out the square where the sensors will be.
- Place your perforated support into the tray. Place the mat into the tray on top of the perforated support.
- 4. DECIDE AND LABEL which shelf will be Control, Treatment 1 or Treatment 2. Label the layout template as well e.g., top shelf = control, middle shelf = treatment 1 etc.
- 5. Cut the paper into 25 pieces. Write sunflower on 4 pieces, lettuce on 4 pieces, kohl rabi on 4 pieces, lemon balm on 4 pieces, beetroot on 4 pieces, chives on 4 pieces. Put all the pieces into a hat, bowl or similar.



### 5 x 11.5cm = 57.5cm

- 6. To randomise the design, draw the pieces from the hat/bowl and assign each one to a square on the mat, starting in the top left and going in rows until all squares are assigned a seed type. Use the marker pen to label each square with the name of the plant. Also use the Layout Template sheet to record which plant species is in each square.
- 7. Carefully open a seed packet and count 40 seeds.
- 8. Sow 10 seeds into each square that is randomly chosen for that species, giving each seed some space and making sure they stay within the square.
- 9. Repeat this process for the remaining 5 species and for all 3 trays.
- 10. Place the trays into the cube. You do not need to exclude the light. If your seeds show no sign of germination by day 7, use squares of black card to cover them to stimulate germination.
- **11.** Gently fill the trays with water and once the seeds have germinated, move onto the next stage.

### PART 2 Carrying out the nutrient concentration experiment

Now the experiment begins...

- Control 30 drops nutrient solution (EC 0.4)
- Treatment 1 60 drops nutrient solution (EC 0.5-0.6)
- Treatment 2 90 drops nutrient solution (EC 0.6-0.8)
- 12. Once the seeds have germinated, remove the trays from the cube one shelf at a time and discard the water that remains. N.B. You will have to gently lift out the sensors first.
- 13. Place each tray back into the cube in the correct order and replace the sensors into the correct patch.
- 14. To prepare the nutrient solution, add 2 litres of water to the measuring jug or bottle and 30 drops of nutrient solution. Mix well using a spoon/replace cap and shake well.
- 15. Gently pour the solution into the tray labelled "control"
- 16. Repeat this process, using the amount of nutrient solution given for treatment 1 and treatment 2 (as shown above)
- 17. Apply nutrient solution as required to the correct concentration, to the same recipe as before.
- 18. Set the timer to turn the lights on or off. All lights to be turned off between 8pm and 4am (8 hours off, 16 hours on).
- **19.** For each patch record: the date of germination; date of cotyledon; date of first true leaves; growth in mm; leaf colour; and mortality rate.

### Notes

Time to germination - Record the date

Time to cotyledon - Record the date

Time to 1st true leaves - Record the date

Growth rate - measured in mm/same days each week

**Mortality rate** – counted with date/ must be translated into a percentage. (10 seeds per patch makes this easy to calculate)

Leaf colour - use the colour scale provided

### AT HARVEST – record information about your harvest e.g.

Yield per treatment - calculated by weight in grams or other appropriate unit.

Taste of 6 species - provide your own descriptor

Feel of leaves (NOT the stem) of all 6 species - waxy, soft, smooth

Smell of 6 species - provide your own descriptor

How did you feel about eating the microgreens? - Describe and compare your descriptions.

# **Experiment 3**Design your own

### **Experiment 3 Design your own Experiment**

Here are some ideas to start you off:

- Run the same experiments again but use different plant species.
- Which plant grows best in a Cube?
- Do herbs grow faster than vegetables?
- Do magnetic fields affect plant growth?
- Does water salinity affect plant growth?
- Do household detergents affect plant growth?
- Do different colours of light affect plant growth?
- Do plants respond to music?

#### Write a hypothesis

When you have an idea for your experiment, you need to write a hypothesis. In science, a hypothesis is an idea that can be tested to see if it is true.

A hypothesis is a statement about a relationship between two or more variables e.g. Tickling plants improves their growth. Your hypothesis should say what you expect to happen. Remember that your hypothesis does not need to turn out to be true. It can still be a successful experiment. It is just as valid to disprove something as to prove it. You may even observe something quite unexpected that could be the basis of your next experiment.

#### Test your hypothesis

Think of ways that you can find out if your hypothesis is correct. You can use the 3 shelves in the cube for 3 different treatments. Leave one shelf as the 'control' which is one where the treatment is not applied e.g. no tickling.

# Curriculum for Excellence

### **Experiences and Outcomes**

### Activities in this brochure supports these curricular outcomes.

level	CfE label	explanation
2	SCN 2-03a	I have collaborated in the design of an investigation into the effects of fertilisers on the growth of plants. I can express an informed view of the risks and benefits of their use
2	SOC 2-08a	I can discuss the environmental impact of human activity and suggest ways in which we can live in a more environmentally- responsible way.
2	TCH 2-07a	I can make suggestions as to how individuals and organisations may use technologies to support sustainability and reduce the impact on our environment.
2	MNU 2-20b	I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way.
3	SCN 3-03a	Through investigations and based on experimental evidence, I can explain the use of different types of chemicals in agriculture and their alternatives and can evaluate their potential impact on the world's food production.
3	TCH 3-05a	I understand how scientific and technological developments have contributed to changes in everyday products.
3	TCH 3-07a	I can identify the costs and benefits of using technologies to reduce the impact of our activities on the environment and business.
3	MTH 3-20b	When analysing information or collecting data of my own, I can use my understanding of how bias may arise and how sample size can affect precision, to ensure that the data allows for fair conclusions to be drawn.
4	SCN 4-02a	I have propagated and grown plants using a variety of different methods. I can compare these methods and develop my understanding of their commercial use.
4	SOC 4-08a	I can discuss the sustainability of key natural resources and analyse the possible implications for human activity.
4	SOC 4-09	Having evaluated the role of agriculture in the production of food and raw material, I can draw reasoned conclusions about the environmental impacts and sustainability.
4	TCH 4-05a	I can analyse products taking into consideration sustainability, scientific and technological developments.



# Assemble your growcube



# GrowCube

### Assembly Instructions





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### 2/2- PARTS LIST



### 1-LED LIGHTS ASSEMBLY



WEAR GLOVES

Parts: 1x LED Light Box with: 9x M4 Philips Screws and M4 Washers 3x sets of 3 LED Strips 3x Cable Ties 2x Main Shelves 1x Top Shelf

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<u>Tools:</u> Allen Key 4mm Phillips Screwdriver











### 1- LED LIGHTS ASSEMBLY

- 1. From the LED Light Box, unpack a set of 3x LED Strips. DO NOT touch the LEDs with bare hands (wear nitrile or latex gloves) and DO NOT pull on the cables attached to them as the lights and LED chips are very delicate.
- 2. Turn 1x Main Shelf upside down and overhang it on a table so you can also reach from underneath.
- 3. Lay the set of 3x LED Strips flat onto the shelf, following the holes in the shelf. The LED Strips have rivets on the back that fit into the holes in the shelf (Diagram A).
  - a. Line up the electrical cable on the first LED Strip with the two parallel slits (highlighted) nearer to one corner of the shelf; the cable should run between them.
  - b. Line up the two other LED Strips with the other lines of holes in the shelf.
- 4. Secure each LED Strip using 3x M4 Phillips Screws (each fitted with 1x M4 Washer and 1x M4 Spring Washer - these are included in the LED Light Box) going from underneath through the shelf and into the LED Strip (Diagram B). Do not overtighten. The screws should not protrude through the yellow film on the LEDs.
- 5. Take 1x Cable Tie and thread it through the two parallel slits in the shelf and secure the electrical cable; tighten and cut excess Cable Tie material (Diagram C).
- 6. Safely store to the side standing up.
- 7. Repeat steps 1-6 with the other Main Shelf and the Top Shelf (Diagram D).

The LED strips are now assembled.

### 2-BOTTOM SHELF ASSEMBLY





### 2-BOTTOM SHELF ASSEMBLY

- 1. Loosely fit 12x Sliders each with an M6X10 Button Hex Screw (each fitted with 1x M6 Spring Washer and 1x M6 Washer) (Diagram A).
- 2. Slide 3x Sliders/M6X10 Button Hex Screws into each Extrusion and position 2x Sliders roughly 45mm from either end, and 1x Slider in the center (Diagram B).
- 3. Lay 4x Extrusions down in a square with the Sliders facing inwards. Connect each corner with 1x Corner Connector and 2x M8X20 CS Hex Screws (Diagram C).
- 4. Place the Bottom Shelf on a flat surface with the bent edges facing up.
- 5. Line the Extrusion square around the Bottom Shelf, making sure the rounded edge of the Extrusion is facing up. Slot the M6X10 Button Hex Screws into the Bottom Shelf grooves, with the M6 Washers on the inside of the Bottom Shelf (the metal plate should sit in between the M6 Washers and the Extrusion, Diagram D).
- 6. Tighten each of the M6X10 Button Hex Screws (Diagram E). Do not overtighten.
- Fit the Electrical Connector on the Electrical Bracket with 1x M4X25 Phillips Screw and secure with 1x M4 Hex Nut. Fit 2x M6X10 Button Head Hex Screws (each with 1x M6 Washer and 1x M6 Spring Washer) through the 2 holes on the Electrical Bracket and loosely fit M6 T-nuts on the bottom (Diagrams F-G).
- Flip over the assembled Bottom Shelf and place the Electrical Bracket and Connector onto the 'back' Extrusion (the arrows point to the 'back' Extrusion) and align the T-Nuts into the groves. Position the Electrical Bracket so that it is 190mm from the end of the Extrusion and secure by tightening the M6X10 Button Head Hex Screws. The T-Nuts will turn 90° in the Extrusion, securing the Electrical Bracket (Diagrams H-J).

#### The Bottom Shelf is now assembled.

### 3-TOP SHELF ASSEMBLY





#### Parts: 4x Extrusions 4x Corner Connectors 8x M8X20 CS Hex Screws 12x M6 Washers 12x M6 Spring Washers 12x Sliders 1x Top Shelf

<u>Tools:</u> Allen Key 4mm Allen Key 5mm





### **3- TOP SHELF ASSEMBLY**

- 1. Loosely fit 12x Sliders each with an M6X10 Button Hex Screw (each fitted with 1x M6 Spring Washer and 1x M6 Washer; as in 2.1).
- 2. Slide 3x Sliders/M6X10 Button Hex Screws in each Extrusion and position 2x Sliders roughly 45mm from either end, and 1x Slider in the center. Make sure only the slider sits inside and M6 Washers sit outside Extrusion (Diagram A).
- Lay 4x Extrusions down in a square on a flat face with the Sliders facing inwards. Connect each corner with 1x Corner Connector and 2x M8X20 CS Hex Screws (Diagram B).
- 4. Place the Top Shelf on a flat surface with the LEDs facing up, and cable inside.
- 5. Line the Extrusion square around the Top Shelf, making sure the rounded edge of the Extrusion is facing down. Slot the Sliders/M6x10 Button Hex Screws into the Top Shelf grooves, with the M6 Washers on the inside of the Top Shelf (the metal plate should sit in-between the M6 Washers and the Extrusion as in 2.4; Diagrams C and D).
- 6. Tighten each of the M6X10 Button Hex Screws. Do not overtighten.
- 7. Flip the assembled Top Shelf over.

The Top Shelf is now assembled.

### 4- BACK PANEL





Parts: 1x Assembled Bottom Shelf from Section 2 1x Back Panel 3x Grommets 2x Extrusions 2x Back Brackets (indented) 8x M6X10 Button Hex Screws 8x M6 Washers 8x M6 Spring Washers 8x M6 Spring Washers 8x M6 T-Nuts 2x M8X20 CS Hex Screws Tools: Allen Key 4mm Allen Key 5mm

Ruler/Tape Measure

B











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### 4- BACK PANEL

- Loosely fit each of the 2x Back Brackets with 4x M6X10 Button Hex Screws (each fitted with 1x M6 Spring Washer and 1x M6 Washer). Loosely attach T-Nuts to each M6X10 Button Hex Screw (Diagram A).
- 2. Attach 1x Extrusion to the bottom left corner of the assembled Bottom Shelf, i.e. the corner closest to the Electrical Bracket. Secure the Extrusion with 1x M8x20 CS Hex Screw (Diagram B).
- Take 1x Back Bracket and slot the T-Nuts in the Extrusion groove so that the Back Bracket is facing forward. Position the Back Bracket on the Extrusion so that it is 213mm from top and 218mm from bottom. Tighten the M6X10 Button Hex Screws. The T-Nuts will turn 90° in the Extrusion, securing its position as you tighten (Diagram C).
- 4. Remove blue plastic film from the front and back of the Back Panel.
- 5. Fit the back panel with the 3x Grommets (Diagram D).
- 6. Slide the Back Panel into the groove of the Extrusions. Cuts are shaped to fit around the screws (Diagram E).
- 7. Take 1x Extrusion and fit the Back Bracket loosely following the instructions in Step 3.
- 8. Attach the Extrusion to the bottom right corner of the assembled Bottom Shelf. Secure the Extrusion with 1x M8x20 CS Hex Screw.

The Back Panel is now assembled.

### 5-FRONT FACE







<u>Tools:</u> Allen Key 4mm Allen Key 5mm



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### 5- FRONT FACE

- 1. Loosely fit 8x Sliders each with 1x M6X10 Button Hex Screw (each fitted with 1x M6 Spring Washer and 1x M6 Washer) (Diagram A).
- 2. Fit each of the two Front Brackets with 4x M6X10 Button Hex Screws (each fitted with 1x M6 Spring Washer and 1x M6 Washer). Loosely attach T-Nuts to each M6X10 Button Hex Screw (Diagram B).
- 3. Attach 1x Extrusion over each front corner and secure with 1x M8X20 CS Hex Screw (Diagram C).
- 4. Slide 2x Sliders (with 1x M6X10 Button Hex Screw and Washer each) into each Extrusion ensuring the washer is on the outside of the Extrusion. These will sit below the Front Bracket (Diagram D).
- Take 1x Front Bracket and slide the T-Nuts in the Extrusion groove so the Front Bracket is facing towards the Back Panel. Position the Front Bracket on the Extrusion so that it is 213mm from top and 218mm from bottom and tighten the M6X10 Button Hex Screws. The T-Nuts will turn 90° in the Extrusion, securing its position (Diagram E).
- 6. Slide 2x Sliders (with 1x M6X10 Button Hex Screw and Washer each) into the Extrusion ensuring the washer is on the outside of the Extrusion. These will sit on top of the Front Bracket (Diagram F).
- 7. Repeat steps 5-6 for other Extrusion (Diagram G).

The Front Face is now assembled.

### 6-ADDING SPACERS AND MAGNETS

Parts: 2x Main Shelves 8x Spacers 8x M6X8 Flanged Hex Screws 4x Door Magnets 8x M4X20 Phillips Screws 8x M4 Hex Nuts

<u>Tools:</u> Allen Key 4mm Phillips Screwdriver





### 6- ADDING SPACERS AND MAGNETS

- Fit both Main Shelves with 4x Spacers by placing 1x Spacer on the outside edge of the Main Shelf, aligning with the holes, and securing with 1x M6X8 Flanged Hex Screw from inside/underneath the Main Shelf (Diagrams A-C). Repeat for each Spacer.
- 2. Thread Door Magnets with 2x M4X20 Phillips Screw each.
- 3. Fit both Main Shelves with Door Magnets by attaching 2x Door Magnets to the front of the Main Shelf. Secure each M4X20 Phillips Screw with 1x M4 Hex Nut at the back (Diagrams D-G).

### 7-ADDING SHELVES











Parts: 2x Main Shelves 16x M6X16 Button Hex Screws 16x Washers 16x Spring Washers

<u>Tools:</u> Allen Key 4mm

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### 7- ADDING SHELVES

\* 2 people recommended for this operation

- 1. Fit each of the 16x M6X16 Button Hex Screws with 1x M6 Washer and 1x M6 Spring Washer (Diagram A).
- Take 1x Main Shelf, position the Door Magnets to the front (opposite the Electrical Bracket), and align the bottom of the Main Shelf with the bottom of the Brackets. Align the holes in the Bracket with the holes in the Main Shelf and secure in place with 2x M6X16 Button Hex Screws. Repeat for the other Front Bracket and both Back Brackets (Diagrams B-D).
- 3. Repeat with the second Main Shelf, aligning the top of the Main Shelf with the top of the Brackets (Diagram E).
- 4. Feed the LED Lights Cable through the Grommets.

The Main Shelves are now in place.

### 8-ADDING SIDE PANELS

<u>Parts:</u> 2x Side Panels







### 8-SIDE PANELS

- 1. Remove the blue plastic film from the front and back of the Side Panels.
- 2. Insert the 2x Side Panels into the Extrusion grooves with the arrows pointing up (Diagrams A-B).

The Side Panels are now in place.

### 9-TOP SHELF FIT

#### Parts:

1x Assembled Top Shelf from Section 3 4x M8X20 CS Hex Screws 8x Corner Caps

<u>Tools:</u> Allen Key 5mm







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### 9- TOP SHELF FIT

- 1. Position the assembled Top Shelf (from Section 3) on top of the Cube with the arrow pointing to the back (Diagram A). Make sure to line up the corners on the top of the vertical Extrusions and the Side Panels into the grooves of the Extrusions. Secure the Corner Connectors with 4x M8X20 Countersunk Screws.
- 2. Add 1x Corner Cap to each of the 8 corners. They should click in place (Diagram B).

The Top Shelf is now in place.

### 10-DOORS

Parts: 2x Pre-assembled Doors





### 10- DOORS

The Doors come pre-assembled and marked 'R' for Right Door and 'L' for Left Door, with only the hinges to fit.

- 1. Remove the plastic film from the front and back of both Doors.
- 2. With the Cube facing you, flip it on its right side, and line up the 'R' Door with hinges opened (Diagram A).
- 3. Move the 4x Sliders with Screws (see sections 5.4 and 5.6) into position, aligning them with the hinges. Remove the screws and washers, position the door hinges inside the frame and fit the screws through the hinges and into the sliders. Secure by tightening (Diagrams B-C).
- 4. Repeat on the other side, by flipping the Cube onto its left side and lining up with the 'L' Door.
- 5. Some final adjustment may need to be done for a perfect fit of the doors.

The Doors are now in place.

### **11-ADDING FINAL SCREWS** Parts: 8X M6X8 Flanged Hex Screws 4x M5X12 Flanged Hex Screws <u>Tools:</u> Allen Key 4mm Phillips Screwdriver В А C Q. С . رو D C of Е **BISH BASH BOX!** ģ لطب ف Ē 23 . . . . . . . . . . Danderiol



### 11- ADDING FINAL SCREWS

- 1. Secure the Side Panels with 8x M6X8 Flanged Hex Screws through each Spacer (Diagrams A-B).
- 2. Secure the Back Panel with 4x M5X12 Flanged Hex Screws (Diagram C-D).
- 3. Connect the cables from the LED Strips into the Electrical Connector (Diagram E).
- 4. Connect to the Power Supply and Power Cord.
- 5. Plug in and turn on the Cube.

#### BISH BASH BOX!!

#### CONGRATULATIONS,

You have now finished your Cube, and you are ready to grow  $\Upsilon$ 

If you have any questions, please email us at growcube@liberty-produce.com.

### With thanks to the contributors to this resource:

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