

# Land, water and bees – don't take us for granted:

## Hydroponics and vertical farming

### Teacher notes

#### Wigan University Technical College farm

By 2050 world population is expected to have grown by an extra three billion people. Our current agricultural methods are not producing enough to feed this huge population. Land is an increasingly scarce resource, with many people wanting to use it for different purposes. The idea behind vertical farming is to provide space for plants to grow in layers on top of each other, instead of expanding outwards into more and more land.

Wigan University Technical College (UTC) has a vertical hydroponics farm attached to its historic warehouse buildings. It is the first educational vertical farm and one of only a few vertical farms in the world. The farm has glass-framed rooms full of equipment for growing plants. Students get involved by growing crops that they can then turn into meals in a full-scale production kitchen or sell to local restaurants as fresh food with zero food miles and a minimised carbon footprint.

### Activities

**Video:** Show students the video 'Hydroponics and vertical farming' (available on The Crunch website, [thecrunch.wellcome.ac.uk/schools](http://thecrunch.wellcome.ac.uk/schools)), an interview with the students who run the vertical farm at Wigan UTC. The Student activity sheet has a list of questions about hydroponics that makes a good follow-up.

**Five in five:** Students, as individuals or in a small group, have five minutes to think of and record five points in answer to a question. You can set a timer for the task to add some drama. The class then combines and discusses the ideas. For example:

- five advantages/five disadvantages of vertical farming
- five questions the group would like to ask an expert on hydroponics
- five differences between traditional farming and hydroponic farming.

### Questions

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1. Conditions that plants require for growth: light, warmth, carbon dioxide, water, nutrients.
2. Factors that might cause a crop to fail on a traditional farm: adverse weather, poor soil, lack of nutrients, disease, pests, competition from weed species, lack of care.
3. (a) A high-tech hydroponic farm uses heaters and lights to keep the light levels and temperature at optimum. The water in which the plants grow contains the nutrients that the particular plant needs for optimal growth. Carbon dioxide is present in the atmosphere but more can be added (e.g. with a gas burner).
- (b) Weather events such as heavy rain and flooding, frosts or droughts are not a problem. The water that the plants grow in contains the nutrients that the plant needs and pH can be controlled so no soil additives (e.g. lime) are required. Pests can be excluded from the growing area by hygiene control. Many pests live in soil and this system is soilless. There is no problem with invasive, competitive weeds. A high-tech

hydroponics set-up controls the temperature and light levels to be optimum. Computers can be used to control the machinery and environment so that care is automatic over the whole growing season.

4. A clear poster explaining how the chosen hydroponics system works and its technical and social advantage. Comment on presentation and use of scientific vocabulary as well as content.

## Extension work: aquaponics

Some hydroponic farms put fish in the water that supplies the growing plants. This set-up is known as **aquaponics**. The Wigan UTC vertical farm also uses aquaponics (read about it here:

[wiganutcverticalfarm.blogspot.co.uk/2014/05/peppers-on-vertical-farm.html](http://wiganutcverticalfarm.blogspot.co.uk/2014/05/peppers-on-vertical-farm.html), for example). The fish produce waste containing nitrogen that would be toxic to them if it accumulated, but the plants are able to use this waste as a nutrient that they need to grow well, at the same time removing the toxins from the water. This resembles the nitrogen cycle that occurs in nature (like the carbon cycle and the water cycle). Aquaponics can use edible varieties of fish, giving farmers the ability to produce both fish (a valuable source of protein) and plants for food in a very small space.

### Question

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5. The table could include cost-effectiveness, resource and space efficiency, additional protein production, animal welfare issues, nutrient requirement, the need to monitor the health of the fish.

## Further reading

Feeding the world – hydroponics: [12.000.scripts.mit.edu/mission2014/solutions/hydroponics](http://12.000.scripts.mit.edu/mission2014/solutions/hydroponics)

Underground hydroponics (video from the *Daily Telegraph*):

[www.youtube.com/watch?v=xFL\\_u3qk73U](http://www.youtube.com/watch?v=xFL_u3qk73U)

Growing Underground (hydroponics in old bomb shelter under London): [growing-underground.com/](http://growing-underground.com/)

Wigan UTC vertical farm: [wiganutc.org/vertical-farm.html](http://wiganutc.org/vertical-farm.html)

... and the informative Wigan UTC farm blog: [wiganutcverticalfarm.blogspot.co.uk/](http://wiganutcverticalfarm.blogspot.co.uk/)

Sky Greens vertical farm (soil and hydroponics), Singapore: [www.skygreens.com/](http://www.skygreens.com/)

Small- and large-scale hydroponics in Indonesia: [www.hydroponics.com.au/jakarta-towards-food-security/](http://www.hydroponics.com.au/jakarta-towards-food-security/)

Intermediate technology hydroponics with waste:

[www.agriculturesnetwork.org/magazines/global/farming-at-close-quarters/simple-hydroponics-for-food-security](http://www.agriculturesnetwork.org/magazines/global/farming-at-close-quarters/simple-hydroponics-for-food-security)

Smart floating farms project (hydroponics, aquaculture, photovoltaics): [smartfloatingfarms.com/](http://smartfloatingfarms.com/)