Jane Goodall's Roots & Shoots UAE

Fertilizers & food waste

Just like humans, plants need food to grow. Most plants get their food or nutrients from the soil they grow in. When we harvest crops relatively few nutrients are naturally recycled, so those nutrients need to be replaced using a fertilizer.

In this resource we will learn about what fertilizer is, how it is used and what problems and benefits different types have on our environment. We'll then learn about different ways of making the organic fertilizer compost and make our own.

Foerster, CC0, via Wikimedia Commons

برنامج إكسبو للمدارس
EXPO SCHOOL PROGRAMME
من مدينة إكسبو دبي
BY EXPO CITY DUBAI

Roots & Shoots UAE and the Expo School Programme

This resource was put together by Roots & Shoots UAE in partnership with the Expo School Programme by Expo City Dubai. The Expo School Programme's mission is to inspire the next generation of thinkers and change makers by offering students the knowledge, tools, and platforms needed to foster creativity, innovation, and meaningful collaborations for a sustainable future for all.

Find out more about the Expo School Programme and arrange your visit today at schools.expocitydubai.com

Get the links

Find all the links used in this resource on our website – scan the QR code or typing this link into your web browser: https://janegoodall.ae/fertilizer-and-food-waste

What is fertilizer?

A fertilizer is a chemical or natural substance added to soil to increase its fertility – meaning that the soil will then contain more of the nutrients needed for plants to grow well.

Fertilizer Spreading On Arable #2 by James T M Towill, CC BY-SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0>, via Wikimedia Commons

Plants need 16 elements to grow well. The most important are: carbon, hydrogen, oxygen, nitrogen, phosphorus and potassium. Plants obtain carbon and oxygen from carbon dioxide (CO_2) in the atmosphere through photosynthesis and hydrogen and more oxygen from water (H_2O); everything else is taken up from the soil.

So, as a plant grows the nutrients are taken from the soil into the structure of the plant itself. In an unfarmed environment these nutrients will return to the soil when the plant naturally dies and rots. However, when we farm for crops we take the plants away from the soil in which they grow and the nutrients are lost from that soil. So, if you want to grow more crops in the same place, you'll need to put the nutrients back in. This is where fertilizers come in.

Chemical fertilizers

Chemical fertilizers are man-made and most contain one or more of the key elements plants need: nitrogen, phosphorus and potassium.

Nitrogen – most nitrogen based fertilizers are made from ammonia. Ammonia is made by combining nitrogen and hydrogen at a high temperature and pressure. The ammonia is then processed to create essential fertilizer ingredients like urea, ammonium nitrate, and nitric acid.

Phosphorus – phosphorus fertilizers like calcium phosphate can be sourced from phosphate rock (which is mined from deposits in the ground) or from animal bones.

Potassium – potassium fertilizers like potassium chloride and potassium sulfate are mainly extracted from potash salts found in ancient seabed deposits.

When farmers use chemical fertilizers they first need to assess what needs to be added to the soil. When they know which nutrients the soil is lacking, they can buy a specially made mix of chemical fertilizer to use when they sow the crop seeds.

Are chemical fertilizers good or bad?

Chemical fertilizers can be specially formulated to increase crop yields and adjusted to suit the current needs of a crop anywhere in the world. This will mean farmers can grow crops that are bigger and stronger and more adaptable to changes in their environment.

Overuse of chemical fertilizers can cause big problems. If too much of a chemical fertilizer is used it can degrade the soil and stop it absorbing other nutrients the plants need. If there is excess fertilizer on a field, when it rains it will run off into local rivers and from there out into the sea.

Further reading:

- Britannica article: https://tinyurl.com/ynk86ccj
- Fertilizer producer blog post: https://tinyurl.com/y6vmb8ad

Organic fertilizer

Organic fertilizers are made of manure (e.g. cow or horse poo!) or compost. This kind of fertilizer is as old as agriculture itself.

Manure – otherwise known as animal faeces, is the waste from farmyards and stables. Along with faeces it will also include animal bedding like straw and hay. Manure's main value comes in maintaining and improving soil quality because of the plant nutrients, humus, and organic substances contained in it. Mixing manure with the top soil improves the structure of the soil and helps it absorb nutrients. Manure must be carefully stored to minimize loss of nutrients, particularly nitrogen. It must be applied to the right kind of crop at the proper time.

Compost – is made from rotting vegetables and green waste. It provides a slow release of nutrients into the soil over the whole growing season. It is lower in nutrients than chemical fertilizers, so lots of it needs to be used.

SuSanA Secretariat, CC BY 2.0 <https://creativecommons.org/licenses/by/2.0>, via Wikimedia Commons

Are organic fertilizers good or bad?

Organic fertilizers are 100% natural and biodegradable and can be a great way to reduce waste, return nutrients to the soil and avoid excessive mining and processing. However, they still need to be handled with care. As with chemical fertilizers, overuse can cause problems with run off into waterways leading to problems such as eutrophication (see box). It is also lower in nutrients when compared with chemical fertilizers so more of it needs to be used creating extra work for farmers who have little time to spare.

Further reading:

- Britannica article: https://tinyurl.com/mt77abz8
- Wikipedia: https://tinyurl.com/3usxa4pc

Eutrophication

This is where nutrients accumulate in a body of water, resulting in increased growth of organisms (like algae or bacteria) that use up the oxygen in the water that other creatures need to live. This can happen when too much fertilizer is used on a crop and it runs off into the water system.

Chemical fertilizers have much higher levels of nutrients than organic versions, so are more likely to cause eutrophication in local water systems.

You can read more about eutrophication on wikipedia: https://tinyurl.com/3w87sfhh

You decide!

Ask your group to read the information above (using the further reading links if needed) and then discuss the following questions:

- Why would farmers use chemical fertilizers?
- Why would farmers use organic fertilizers?
- What problems come with using either option?
- If you were growing vegetables, what would you use?

From food waste to fertilizer

An average person in the UAE generates around 2.7kg of organic waste a day.

In the UAE about 38% of food made is uneaten. The majority of this ends up in landfills and decomposes, releasing methane and carbon dioxide into the atmosphere (read more about where your food waste ends up here: https://tinyurl.com/3emyjw32).

To help improve these figures, the UAE has launched ne'ma (https://www.nema.ae/en) – the National Food Loss and Waste Initiative. Ne'ma highlights that food waste can be reduced in a few different ways, from production all the way to your table.

In their sustainability report, Expo City Dubai describe how they are making efforts to reduce food waste by doing things like rescuing surplus edible food from shops within the city and redistributing to local communities in need. Since starting, they have rescued over 10 tonnes of food! You can read more about this on pages 56-58 of their report: https://tinyurl.com/ECD-paper

One way households can help is to only buy and cook food that is needed and then to find ways to use up leftovers (here are some suggestions: https://tinyurl.com/5m2nwntz). Another way is to learn how to compost food waste and use it to help grow more food!

How is compost made?

There are a few different ways to make compost and each method can handle different types of food waste and may work better in different climates.

Aerobic or hot composting

Aerobic composting is the decomposition of organic materials using microorganisms that require oxygen. The only by-products of aerobic composting are heat, water, and a small amount of carbon dioxide (which is easily reabsorbed by surrounding vegetation).

Aerobic composting is good for uncooked food waste like vegetable peeling, but also garden waste like grass cutting and leaves. These can be classed as green or brown waste:

- **Green** – this is usually soft, leafy material, including grass clippings, sappy green plants (such as annual weeds), crop waste, old fruit and vegetables and kitchen peelings. These materials are rich in nitrogen
- **Brown** – mainly dry woody waste, such as prunings and hedge-trimmings (shredded, chipped or chopped up), and other dried materials such as dead stems and straw, as well as torn-up or shredded paper and cardboard. These are rich in carbon.

To make this kind of compost, you need a space in your garden for a wood frame or a compost bin. You add green and brown waste and allow it to decompose over time, turning with a garden fork every few months to ensure it is well mixed. It can take 6 months to 2 years before it is ready for use in your garden.

More information about aerobic composting:
https://tinyurl.com/y5c4m2vv

Anaerobic composting (fermentation/bokashi)

Anaerobic composting takes place without oxygen. The organic matter is broken down through fermentation. Anaerobic composting is smelly, so needs to be in a sealed container. If doing this at home the Korean and Japanese system of bokashi composting is a good option.

Bokashi composting uses 'bran' – a medium such as rice, wheat or sawdust, inoculated with bacteria which ferments food waste. This 'pickles' the waste, creating the by-product 'bokashi tea', which can be diluted and used as a plant food. After around two weeks the food waste will be at a pre-compost stage. It will look like pickled food rather than compost and it can either be added to a compost bin – where it will break down very quickly – or buried directly into the ground and left for two weeks before planting.

Check out these examples of bokashi composting in action:

- **Bokashi projects on Roots & Shoots UAE.** Read the latest updates from schools experimenting with coffee ground composting: https://tinyurl.com/3hynhf3r
- **Expo City Dubai's coffee grounds to mushrooms project.** They are collecting coffee grounds and turning it into a substrate for mushroom cultivation – essentially bokashi composting. (see p55 of their report) https://tinyurl.com/ECD-paper)

More information about bokashi composting:
https://tinyurl.com/3yn65mtt

Vermicomposting

Photo by Kyle Spradley | © 2014 - Curators of the University of Missouri

Vermicomposting uses worms to break down the organic matter. A wormery can produce nutrient rich compost and also a concentrated liquid fertilizer.

Generally, composting worms prefer uncooked vegetable scraps, but small amounts of garden waste could also be added.

Guide to vermicomposting: https://tinyurl.com/58sppvum

Optional activity: Visit an eco farm

If you would like to see how composting might work on a farm scale, then think about taking a trip to Emirates Bio Farm. They run school activities to learn about sustainable farming: https://emiratesbiofarm.com/. Your groups could visit and ask them about how they use fertilizers and if they make their own compost.

Vermicomposting at Expo City Dubai

Expo City Dubai is exploring vermicomposting, a process that transforms organic waste into nutrient-rich compost. Terra currently has two varieties of composting worms under its care in custom-made vermi-towers: African Night Crawlers and Red Wigglers.

African Night Crawlers, known for their larger size and voracious appetite, excel in breaking down organic matter efficiently. Red Wigglers, on the other hand, thrive in a wider range of environmental conditions and reproduce rapidly, ensuring a steady population for composting activities.

These composting worms play multifaceted roles in ecosystem maintenance. By consuming organic waste materials such as food scraps, paper, and yard waste, they accelerate decomposition and nutrient cycling processes. In doing so, they create a nutrient-rich compost known as “worm castings,” which serve as a natural fertilizer for plants, enhancing soil structure and promoting healthy growth.

Moreover, African Night Crawlers and Red Wigglers contribute to soil aeration and drainage through their burrowing activities, improving soil texture and reducing compaction. Their secretions, rich in beneficial microorganisms and enzymes, further enhance soil fertility and microbial activity, fostering a balanced and resilient ecosystem.

Composting worms excel in waste conversion and soil enrichment. Their role extends beyond mere waste processing, encompassing soil revitalization and ecosystem sustainability. Incorporating African Night Crawlers and Red Wigglers into composting practices offers a cost-effective and environmentally friendly solution for soil health improvement and waste management- supporting Expo City Dubai’s commitment to sustainability.

Make your own compost

It's time to get your hands dirty and have a go at making your own compost!

Photo by Dawafenjo Gurung: https://www.pexels.com/photo/close-up-shot-of-seedlings-4118322/

Discuss

Having learnt all about fertilizers and composting methods have a think about what composting method would work best for your group and the environment:

- How much space do you have? Will you try it at school together or at home with your families?
  - **If at home:** each group member would plan where and what they will compost as part of the group, then take photos and update their group on how it's going.
  - **If at school or community garden:** Set up some composting at your school or community garden and add to it together either using school waste or bringing compostable material to school in sealed tubs.
- What food or garden waste is available for composting and where will it come from?
- Do any of the methods need equipment that you would need to buy?

Create a plan to follow

Use the RHS composting guides to help you create a plan to follow:

- Overview of composting: https://tinyurl.com/yjysmzad
- Aerobic composting: https://tinyurl.com/y5c4m2vv
- Anaerobic or bokashi composting: https://tinyurl.com/3yn65mtt
- Vermicomposting: https://tinyurl.com/58sppvum

Get scientific!

To extend this activity, when your compost is ready your groups can run a science experiment by using their homemade compost to grow plants alongside plants in normal soil to see the difference in how the plants grow – if edible plants, they can also see if there are any taste differences.

Tell us how you got on

We'd love to here about your composting project! Your group leader can upload a story with images to the Roots & Shoots UAE website (find us at janegoodall.ae). If your school or youth group does not already have an account then just fill in the web form on **janegoodall.ae/join-roots-shoots-uae** and we can set you up.

Keep up to date with Roots & Shoots UAE and the Expo School Programme

You don't have to have an account to keep up to date with what our groups are up to. Head on over to janegoodall.ae to sign up for our email newsletter packed with all the latest information on what our members in the UAE have been doing.

If social is more your thing then you can also find Roots & Shoots UAE on Facebook at fb.com/RootsnShoots.ae, on Instagram as @JaneGoodallUAE, and on LinkedIn as "Jane Goodall's Roots & Shoots UAE" (direct link: chk.me/bkGPm7M). Give the Expo School Programme a follow on Instagram (@exposchoolprogramme), Facebook (fb.com/ExpoSchoolProgramme) and YouTube (short link: chk.me/tpuWe7U).