


Research-Based Curricula



The 365-day British strawberry Key Stage 3 Biology, Chemistry & Geography

2022

access

ed

Building global university
access programmes

Contents

Getting Started

- 03 About this pack
- 04 Meet the author
- 05 Building your skills

Subject Learning

- 07 Vocabulary
- 09 Introduction to Subject
- 10 Resource One: Multiplying strawberries
- 20 Resource Two: Feeding a strawberry plant
- 31 Resource Three: Maximising strawberry yields
- 42 Resource Four: The Christmas day strawberry
- 53 Final Reflection Activity
- 55 Reference List
- 57 More subject resources

Study Skills, Tips and Guidance

- 60 Academic Study Skills
- 71 What's next?
- 76 Insight into the University of Reading

About this Pack

Who is this pack for?



- This pack was created for all students, regardless of whether this is your best or worst subject.
- It's not graded or marked by your teacher. It's a chance to explore the subject and learn in a new way that's different to the classroom.
- Each pack is written by a student at the University of Reading researching this topic and has special knowledge on the subject. When they were your age, they knew nothing about it either!
- By completing their mini-course, you will find out why it's interesting, and you will build the skills that help you improve at school.

So... why complete this pack?



- Learn new cool areas of a subject that you won't cover in the classroom
- Sharpen your academic skills, like short essay writing and interpreting data
- Experience what it's like to explore a subject freely
- Better understand what you enjoy and don't – it will help you make decisions about your future studies and career choices!

What's in this booklet?



Your RBC booklet is a pack of resources containing:

- ✓ More about how and why study this subject
- ✓ Four 'resources' each as a lesson with activities
- ✓ A final assignment to gauge learning
- ✓ Extra guidance throughout about the university skills you are building
- ✓ End notes on extra resources and where to find more information

Meet the Author



Name Sophie Read

Area of Study and Degree PhD in Agriculture

University University of Reading

Where I am from...

I was brought up on a sheep and arable farm near Winchester, which developed my love of the outdoors and the environment. From a young age, I knew I wanted a career in the agricultural sector, whether with plants, animals or both!

I think my subject is awesome because...

It will always have a place in the world since people will always need to eat! Amidst current global and national issues, including global climate change and national food security, finding ways that we as a country can produce more sustainable fresh produce year-round is essential.

At school, I studied...

GCSE: French, Geography, History and PE (+ core subjects)

AS Level: Biology, English Language, Environmental Studies, General Studies, Maths and PE

A Level: Biology, English Language and Environmental Studies

BSc: Biological Sciences

How I chose to study Biology at Uni...

I had always said that I would study Agriculture at university, but when applying, I came across Biological Sciences, a course where I could learn about plants, animals, humans and more. This seemed like the perfect option to me and hopefully shows you that there are many hidden opportunities out there, you just need to be open to finding them! It gave me a lot of flexibility and allowed me to continue learning various topics before specialising in my actual areas of interest later.

One person I admire is...

Amanda Owen, the Yorkshire Shepherdess. I am genuinely inspired by how she has juggled raising nine children, running a farm in the Yorkshire Dales, filming documentaries and writing five books!

Building Your Skills

Research-Based Curricula packs challenge you to build your skills in this subject and be used across any of your schoolwork.



Any time you see a badge, look out for a skill you'll be building!

These skills are the type of skills that teachers and universities look for as you progress, so see how many you know below.

Skills you may see and use in this pack.

Research *your ability to work on your own and find answers online or in other books*

Creativity *your ability to create something original and express your ideas*

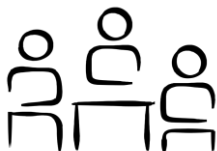
Problem solving *your ability to apply what you know to new problems*

Source analysis *your ability to evaluate sources (e.g. for bias, origin, purpose)*

Data analysis *your ability to discuss the implications of what the numbers show*

Active reading *your ability to engage with what you are reading by highlighting and annotating*

Critical thinking *your ability to think logically to build an argument clearly*

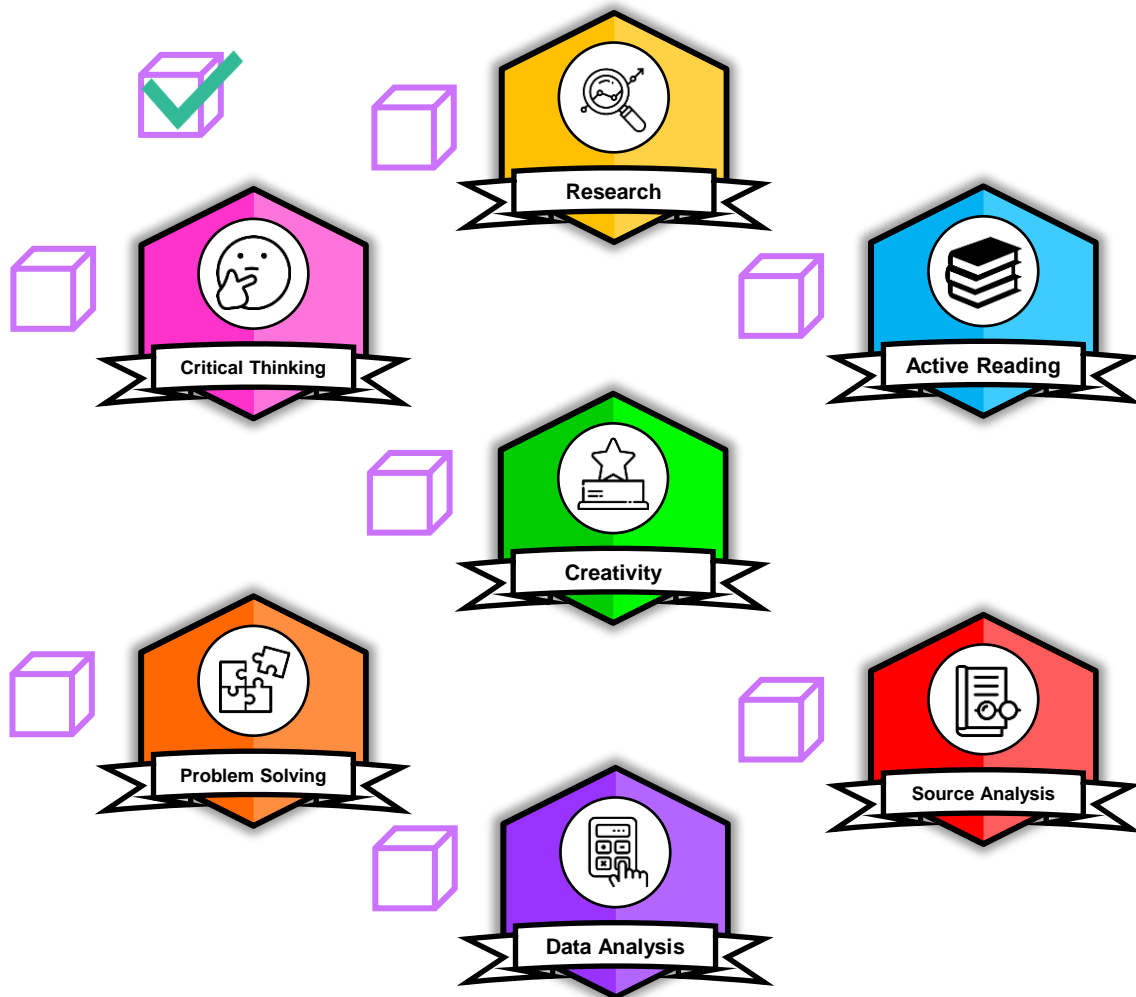


Psst! You can learn more about these skills in the Academic Study Skills section.

Your Skills Badges

As you work through this booklet, you'll have the chance to build the skills you have read on the previous page.

Make sure to revisit this page once you have mastered each skill. Tick off each skills badge below once completed!



Look out for these badges in the Data Source, Activities and Further Reading sections of each Resource. If you complete a skill more than once, write the number of times you completed it next to the badge.

When you've earned all seven skills badges, you can discuss with your teacher how to further build your skills!

Vocabulary

Be sure to use this section as you go through your booklet. If you see an emboldened word, you can find the definition here. If you are still unsure about the meaning or use of the word, we encourage you to use a dictionary or ask a teacher.



Term	Definition
Active transport	The movement of molecules through a cell membrane from an area of lower concentration to an area of higher concentration against a concentration gradient. It requires energy released from respiration.
Clone	An organism produced through asexual reproduction by one parent to which it is genetically identical.
Chlorophyll	The main photosynthetic pigment found in chloroplasts of plants, algae and some bacteria. It absorbs light energy, which is then converted to chemical energy during photosynthesis.
Chloroplast	A cell organelle found in the plant, algal and some bacterial cells that produce energy through photosynthesis.
Crown	The central part of a strawberry plant where the other plant structures emerge.
Dietary fibre	Plant material that cannot be digested by the human body but is an essential component of a balanced diet helping to promote good digestive health.
Enzyme	An enzyme which has had some of its weaker bonds broken. For example, hydrogen bonds causing it to change shape and structure. This can result from factors, such as excess heat, and leads to the loss of the enzyme's original properties.
Fertilisation	The process that takes place after pollination in plant sexual reproduction whereby the (male) pollen fuses with a (female) ovule resulting in an embryo forming in a seed.
Food miles	The distance that food has travelled from the production site, like a farmer's field, to the consumer's plate.

Vocabulary

Term	Definition
Fossil fuels	Are fuels found in the Earth's crust formed from the remains of dead plants and animals. They can be burned to generate energy for activities like transportation and electricity production. Examples include coal, oil and natural gas.
Gametes	Sex cells – in plants, the female gametes are ovules, and the male gametes are pollen grains.
Greenhouse gas (GHG)	A gas that contributes to the greenhouse effect by absorbing infrared radiation, causing heat to be retained in the atmosphere. Examples include CO ₂ , CH ₄ , H ₂ O and NO _x . They are found naturally in the atmosphere but can also be released in higher concentrations by human activities.
Imports	Goods or services that are brought into a country from abroad.
Infrared radiation	Part of the light spectrum that is longer than visible light (700nm – 1mm), so it cannot be seen by the human eye.
Pollination	The process whereby (male) pollen grains produced by the (male) anther of a flower are transferred to the (female) stigma of a flower.
Sustainable farming	Food production that fulfils the long-term needs of the human population for healthy and nutritious food that is produced in an economically and environmentally sound way.
Tip burn	The burning/ browning of the tips and edges of leaves results from water loss due to high temperatures and light levels.
Transpiration	The loss of water through evaporation from plant leaves.
Vegetative	Refers to plant structures/ processes that are not involved in the reproduction of a plant. For example, leaves and roots.
Visible light	The part of the light spectrum that the human eye can see. It includes light wavelengths from 380 (violet light) to 700nm (red light).

When you find words you don't recognise in a resource, look up their definition.

Introduction to Subject

Plant Biology and Food Production

The topics within this pack will include:

How plants reproduce

How plants photosynthesise

What to feed strawberry plants

Factors affecting plant growth

How to increase strawberry yields

The importance of growing year-round British produce

What is this topic about?

Here, we are combining several different subjects, including those that you will study at school, Biology, Chemistry and Geography, as well as ones that you will not have studied yet, Agriculture and Horticulture. This shows how everything in this world interacts and how no subject can be considered a separate entity. We will focus on plants, starting by covering the basics of plant biology: reproduction, photosynthesis, and factors affecting growth. We will then delve deeper into the importance of commercial plant production in the fresh food sector and relate this to the broader topics of human health and global climate change.

Why is this topic important?

Food production is essential to feed the Earth's growing population. We must look at ways to achieve this sustainably to secure healthy food production long into the future with minimal food shortages and health issues. To understand how to achieve sustainable commercial production, it is first essential to learn the basics of plant biology. Throughout this course, we will be using strawberries as a case study, but you should apply the concepts and ideas you learn to the wider fresh fruit and vegetable sector.



Resource One

Overview

Topic Multiplying strawberries

Key Stage 3 Subject Area **Biology:** Structure and function of living organisms; Interactions and interdependencies.

Objectives **By completing this resource, you will be able to:**

- ✓ Label the key reproductive parts of a strawberry flower.
- ✓ Describe the stages of asexual and sexual plant reproduction.
- ✓ Compare and contrast the different pollination methods: insect, wind, and self-pollination.

Instructions

1. Read the data source
2. Complete the activities
3. Explore the further reading
4. Move on to Resource Two



Resource One

Data Source

Section A

What is plant reproduction?

What are the two types of plant reproduction?

Plant reproduction is like animals when new offspring are produced from the parents. However, there are two types of reproduction in plants: 1) one that involves both male and female **gametes** and 2) one that does not require gametes but instead uses different plant structures to reproduce.

Gametes are the sex cells which are pollen grains (male) and ovules (female). Additionally, two parent plants are not essential for plant reproduction.

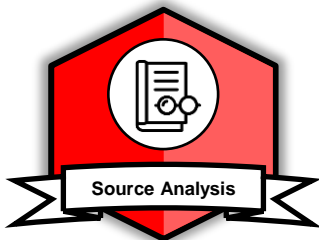
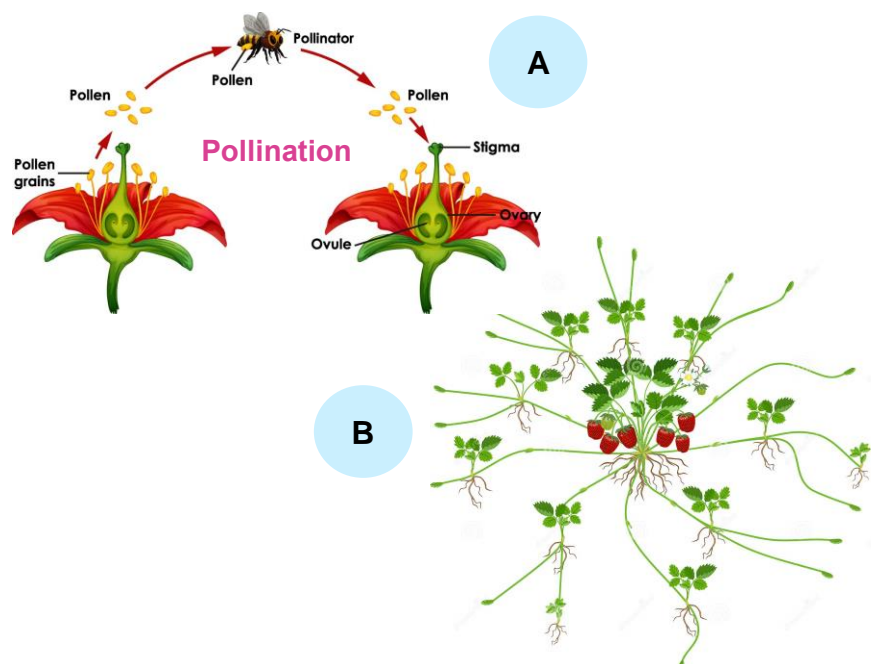
1. Sexual Reproduction

- Fusion of male and female gametes
- Produces genetically different offspring from the parent(s)

2. Asexual Reproduction

- No fusion of male and female gametes
- Produces genetically identical offspring to the parent plant (**clones**)

Figure 1: (A) Sexual reproduction in plants; (B) Asexual reproduction in plants



Resource One

Data Source

Section B

Sexual reproduction in strawberry plants

Figure 2: Life cycle of a strawberry plant

Strawberry plants can reproduce sexually. This involves **pollinating** the flowers to produce seeds that can be planted to grow into new strawberry plants. This is essential to complete the strawberry plant's life cycle.

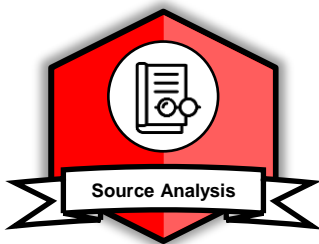
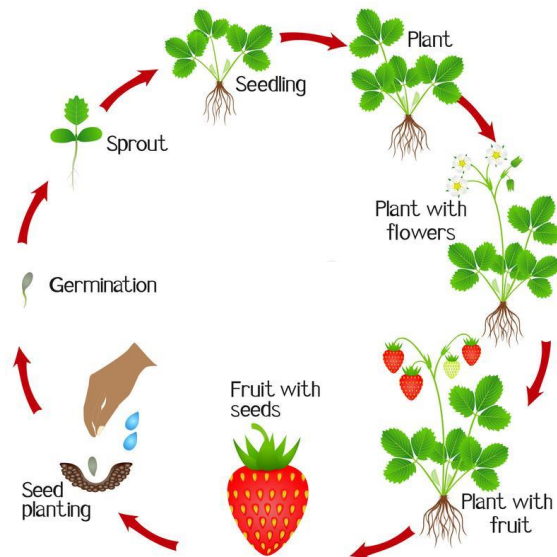
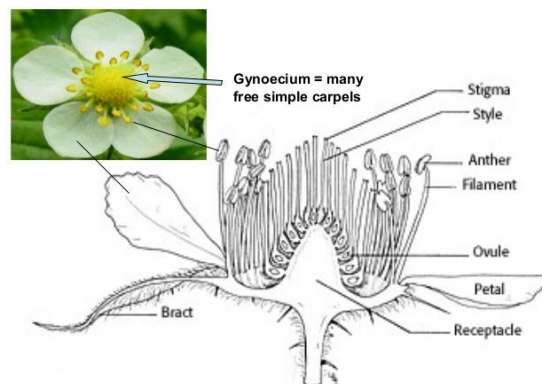


Figure 3: Reproductive structures of a strawberry flower

As in all flowers, the flowers of strawberry plants have different reproductive structures that allow the pollination process to take place. Unlike some other flowers, each strawberry flower contains both male and female reproductive structures with different functions.



29

Resource One

Data Source

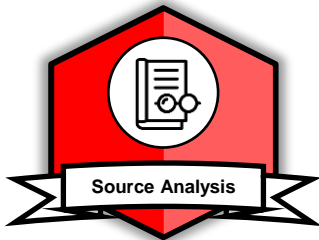
Section B Below is a table that outlines flower structures and their functions.

Use this key to interpret the table:

Pink - Female reproductive structures

Blue - Male reproductive structures

Turquoise - Neutral structures



Structure	Function
Pistil	Female reproductive part of a flower consisting of the stigma, style, ovary and ovule.
Stigma	The top of the female part of the flower that collects pollen grains.
Style	Allows the pollen to travel from the stigma to the ovary for fertilisation .
Ovary	Contains the female sex cells.
Ovule	Female gamete.
Stamen	Male reproductive part of a flower consisting of the anther, filament and pollen grains.
Anther	Produces the male sex cells.
Filament	Holds up the anther.
Pollen grain	Male gamete.
Petal	May be brightly coloured to attract insects.
Sepal	Protects the unopened flower.
Receptacle	The part from which the flower organs develop and become the edible red flesh in strawberries.

Resource One

Data Source

Section B There are two main types of pollination:

Pollination methods

1. **Self-pollination** - The transfer of pollen from the anther to the stigma of the same or a different flower on the same plant.
2. **Cross-pollination** - The transfer of pollen from the anther of one flower to the stigma of another flower on a different plant of the same species.

Figure 4: Self-pollination process

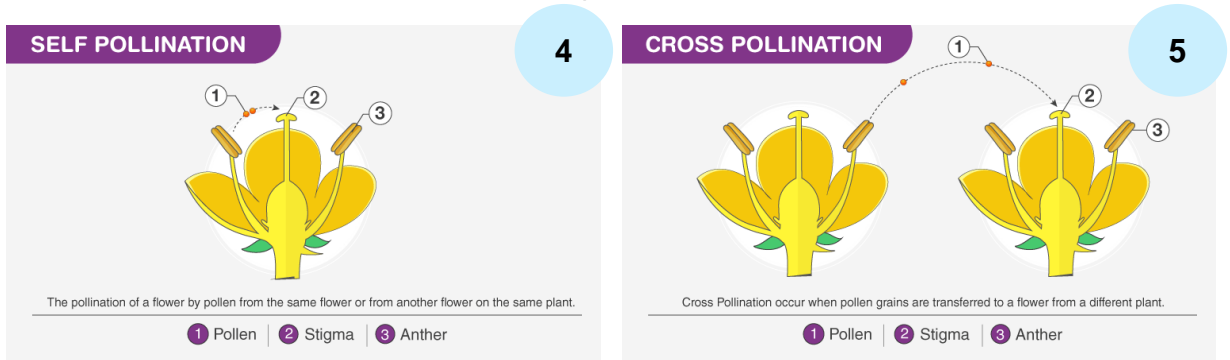


Figure 5: Cross-pollination process

There are also two main types of pollinators:

1. **Wind pollination**
2. **Insect pollination**

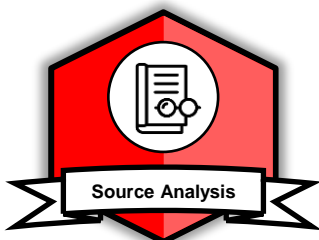
Figure 6: (A) Bee-pollinated strawberry flower; (B) Wind-pollinated strawberry flowers



A



B



Resource One

Data Source

Section B

Advantages of cross-pollination

Insect pollinators increase the chances of cross-pollination occurring. Cross-pollination helps to introduce genetic variation into the plants. This improves the immunity and resistance of plants to diseases and environmental stresses. Generally, cross-pollination results in stronger plants and higher fruit quality.

Section C

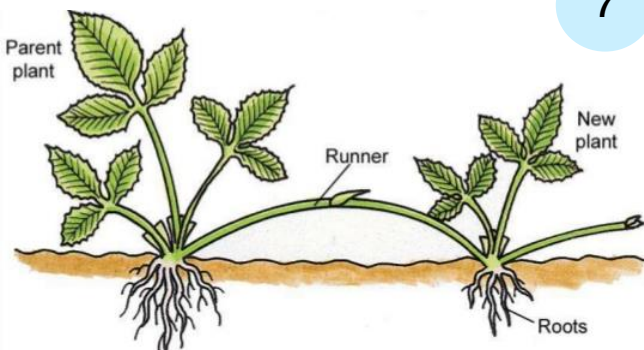
Asexual reproduction in strawberry plants

Strawberry plants can reproduce asexually through the production of runners or **branch crowns**.

- ❑ **Runners** - Runners emerge from the main crown when the plant is exposed to long, warm days. Runners from the parent plant extend horizontally along the ground, producing buds called nodes with the potential of developing into 'daughter' plants in the right environmental conditions.
- ❑ **Branch crowns** - Branch crowns emerge from the main crown typically after the production of runners, when the plant is exposed to cool, short days. Branch crowns can be separated from the main crown in the autumn and re-planted the next spring to generate further strawberry plants. Branch crowns develop their own roots and leaves, similar to the 'parent' plant.

Figure 7: Asexual reproduction with the production of runners in a strawberry plant

Figure 8: Branch crown of a strawberry plant



7

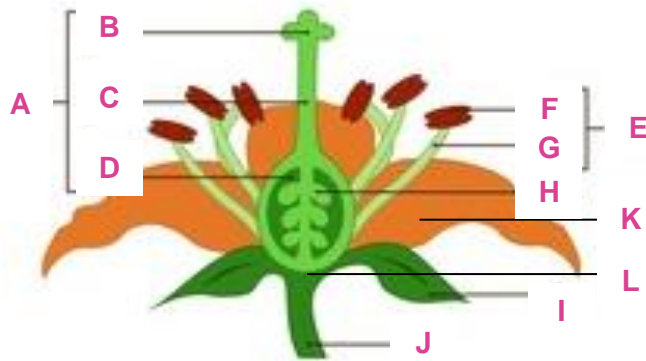
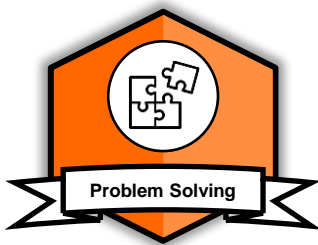


8

Resource One

Activities

Activities 1. Using the words in the table below, label the flower diagram.



Ovule	Anther	Stem	Stamen	Stigma	Receptacle
Style	Petal	Filament	Ovary	Pistil	Sepal

2. Draw arrows between the flower parts and functions in the table below.

Structure	Function
Filament	Protects the unopened flower.
Style	Holds up the anther.
Sepal	May be brightly coloured to attract insects.
Ovule	Female gamete containing the egg cells.
Ovary	Top of the female part of the flower, which collects pollen grains.
Anther	Allows the pollen to travel from the stigma to the ovary for fertilisation.
Petal	Produces the female sex cells.
Stigma	Produces the male sex cells.

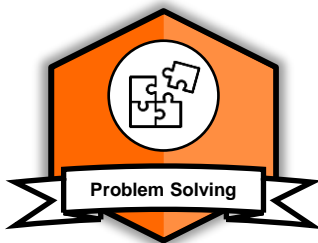
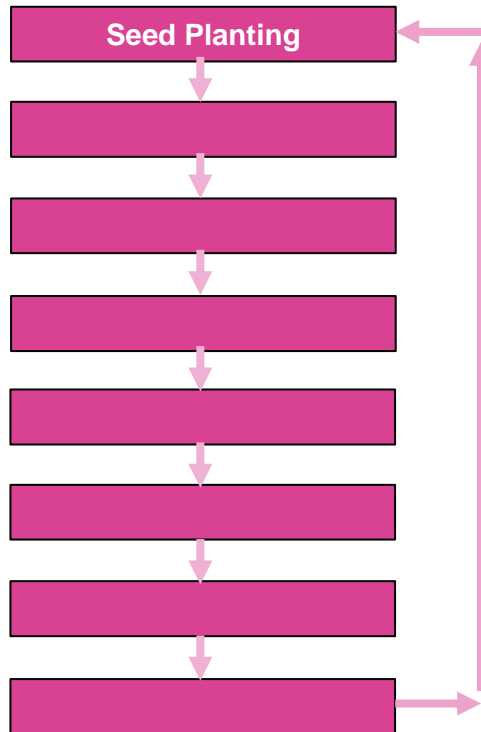
Resource One

Activities

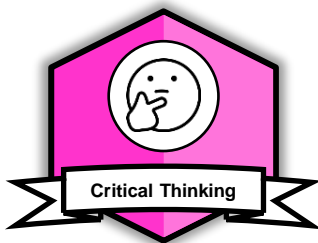
Activities

3. Using the life cycle stages in the table to the left, complete the flow diagram of the life cycle of a strawberry plant.

Plant
Sprout
Seedling
Germination
Fruit with seeds
Plant with flowers
Plant with fruit



4. Define 'asexual reproduction' and name the two structures that can facilitate asexual reproduction in strawberries.
5. What are male and female gametes in plants called?
6. Explain the difference between self-pollination and cross-pollination in the sexual reproduction of plants.
7. Which two pollinators can result in the cross-pollination of strawberry plants?
8. Why might a strawberry grower buy beehives to add to their strawberry crop, despite strawberry plants being able to self-pollinate?



Resource One

Further Reading

- Explore**
- Watch the video ‘How to Propagate Strawberries Using Runner Plants’ to see the asexual reproduction process in action: <https://www.youtube.com/watch?v=bc8nyZFoUCY>
 - Read the article, ‘Misshapen strawberries caused by poor pollination’ in ‘Vegetable Grower News’ to find out the consequences of poor pollination on strawberries: <https://vegetablegrowersnews.com/news/misshapen-strawberries-caused-by-poor-pollination/#:~:text=Strawberries%20have%20both%20male%20and,to%20allow%20for%20complete%20pollination.>
 - Watch the video, ‘How to Pollinate Strawberries: The Chef’s Garden’ to see how you can pollinate strawberry flowers by hand: <https://youtu.be/gTMoV06mtGw> If you can find a strawberry plant, give the process a go and watch a strawberry grow!

- References**
- BBC Bitesize, 2022. Reproduction in Plants. [online] Available at: <https://www.bbc.co.uk/bitesize/guides/z2xg87h/revision/2> > [Accessed 14 November 2022].
 - CYDI, 2022. Reproductive Structures of the Plant. [online] Available at: <https://cydinstitute.com/student-center/science/reproductive-structures-of-the-plant/> > [Accessed 14 November 2022].
 - Johnson, S., 2017. How Do Strawberry Plants Reproduce Asexually? [online]. Available at: <https://www.gardenguides.com/75949-strawberry-plants-reproduce-asexually.html> > [Accessed 14 November 2022].

Resource One

Further Reading

Image Sources

- Resource title page and Figure 7 (A): <https://beeaware.org.au/wp-content/uploads/2014/06/Bee-on-strawberry-flower.jpg>
- Figure 1 (A): <https://labassociates.com/modes-of-reproduction-in-plants>
- Figure 1 (B): <https://thumbs.dreamstime.com/z/strawberry-plant-roots-flowers-fruits-numerous-stolons-daughter-plants-vegetative-reprod-strawberry-plant-roots-147268839.jpg>
- Figure 2: <https://strawberryplants.org/wp-content/uploads/life-cycle-of-strawberry-plant.jpg>
- Figure 3: <https://image.slidesharecdn.com/biomod4unit13lesson3fromflowerstofruitsandseeds-150519162717-lva1-app6891/85/biology-m4-flowers-to-fruits-and-seeds-29-320.jpg?cb=1665707696>
- Figure 4: <https://cdn1.byjus.com/wp-content/uploads/2019/04/Pollination-self-pollination.png>
- Figure 5: <https://cdn1.byjus.com/wp-content/uploads/2019/04/Pollination-cross-pollination.png>
- Figure 6 (B): <https://www.trevenacross.co.uk/wp-content/uploads/2020/06/strawberry-plants-300x212.jpg>
- Figure 7: <https://image.slidesharecdn.com/asexual-reproductionofafloweringplant-110326154023-phpapp02/95/asexual-reproduction-of-a-flowering-plant-8-728.jpg?cb=1301154092>
- Figure 8: <https://th.bing.com/th/id/R.330c54689dc0fb97eafc8cb21d421bda?rik=jNf2KNQRp1xYsg&pid=ImgRaw&r=0>
- Question 1: <https://www.teacherspayteachers.com/Product/Flower-Parts-Clipart-Science-Diagram-Labeled-and-Unlabeled-2101668>

Resource **Two**

Overview

Topic Feeding a strawberry plant

Key Stage 3 Subject Area **Biology:** Structure and function of living organisms; Material cycles and energy.

Objectives **By completing this resource, you will be able to:**

- ✓ Label the key structures of a strawberry plant leaf.
- ✓ Describe the process of photosynthesis.
- ✓ Explain the functions of the six main nutrients required by strawberry plants.

Instructions

1. Read the data source
2. Complete the activities
3. Explore the further reading
4. Move on to Resource Three



Resource Two

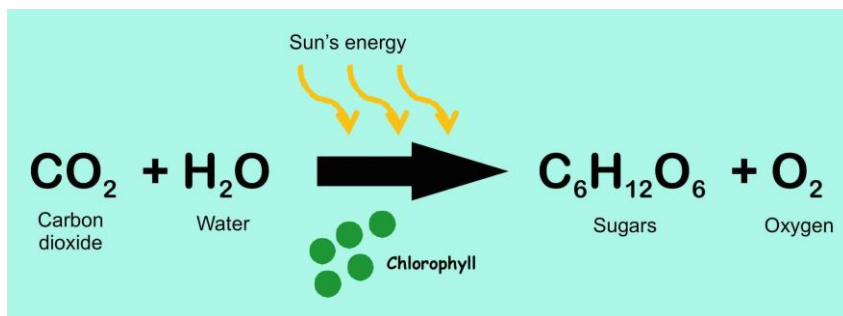
Data Source

Section A

What is photosynthesis?

Figure 9:
Photosynthesis equation

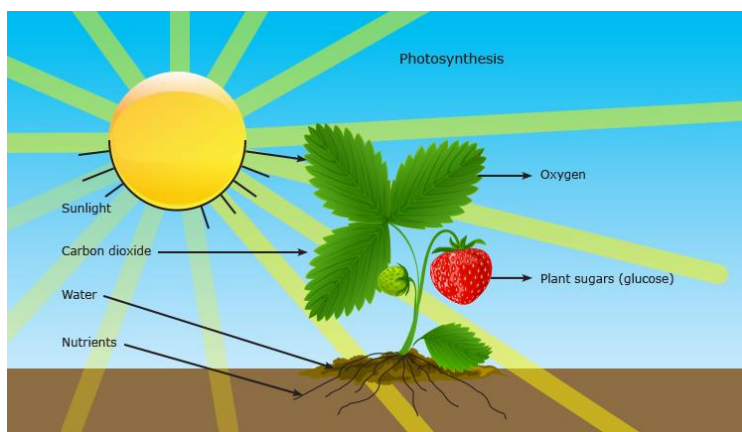
When? Photosynthesis is the process by which plants, algae and some bacteria absorb carbon dioxide (CO₂) from the atmosphere and water (H₂O) from the soil to make sugar (C₆H₁₂O₆) and oxygen (O₂).



Where? Photosynthesis takes place in **chloroplasts** in plant leaves.

How? Photosynthesis occurs through the absorption of light energy by the **chlorophyll** pigment in chloroplasts.

Figure 10:
Photosynthesis in a strawberry plant



Why?

- Produces food for plants, algae and photosynthetic bacteria
- Produces oxygen for all animals to breathe/ respire
- Maintains CO₂ / O₂ balance of the Earth's atmosphere

Resource **Two**

Data Source

Section B

Leaf structure

Leaves of different plants are adapted for photosynthesis in many ways. They vary significantly in size, shape and texture depending on environmental factors like humidity, light and temperature.

Figure 11: Different leaf shapes and sizes



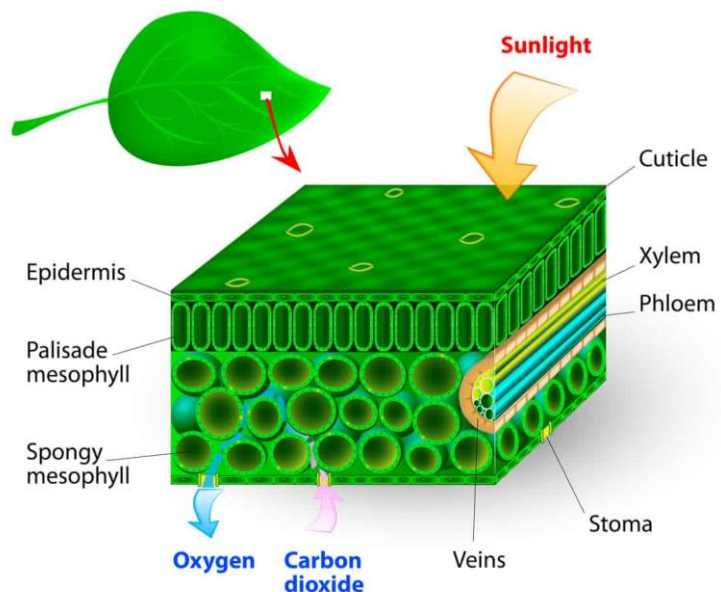
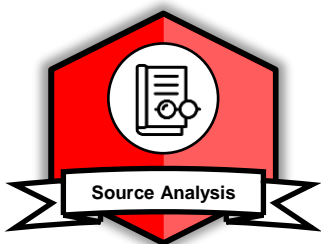
Figure 12: Strawberry leaf



Figure 12 shows the structure of a strawberry leaf, which has adapted to have three smaller leaflets.

Next, we will focus on identifying and explaining the function of structures found in all plant leaves.

Figure 13: Structure of a leaf



Resource **Two**


Data Source

Section B The table below shows leaf parts and their functions.

Structure	Function
Upper epidermis	Protective layer for leaf.
Waxy cuticle	Reduces water loss.
Palisade mesophyll	Densely packed with chloroplasts – the main site of photosynthesis.
Spongy mesophyll	Site of gas exchange transporting gases to and from the xylem and phloem.
Xylem	Transports water to leaves from roots.
Phloem	Transports glucose from leaves to the rest of the plant.
Stomata	Leaf pores controlling the entry/ exit of CO ₂ / O ₂ and water loss through transpiration .

Section C
Feeding strawberries






Strawberry plants need six key nutrients alongside other nutrients required in smaller quantities to allow good **vegetative** and reproductive growth. The amounts of each nutrient required differ at the different stages of the strawberry life cycle. Strawberry growers need to monitor their plants for signs of deficiency. The table below summarises six key nutrients required by strawberry plants:

Mineral Element	Functions	Deficiency Symptoms	Deficiency Example
Nitrogen (N)	<ul style="list-style-type: none"> ❑ Make protein and nucleic acids. 	<ul style="list-style-type: none"> ❑ Small and pale green leaves. ❑ Older leaf tips go red, and the whole leaf turns orange-red. ❑ Reduced fruit size and yield. 	

Resource Two

Data Source

Section C [Cont.] The table below summarises six key nutrients needed by strawberry plants:

Mineral Element	Functions	Deficiency Symptoms	Deficiency Example
Phosphorus (P)	<ul style="list-style-type: none"> <input type="checkbox"/> Energy metabolism. <input type="checkbox"/> Part of the cell membrane. <input type="checkbox"/> Carbohydrate transport. <input type="checkbox"/> Root development. 	<ul style="list-style-type: none"> <input type="checkbox"/> Small dark-green leaves with bluish-purple shading. <input type="checkbox"/> Shading gradually affects the whole leaf. <input type="checkbox"/> Small, soft fruit. 	
Potassium (K)	<ul style="list-style-type: none"> <input type="checkbox"/> Cell water content regulation and maintenance of salt balance. <input type="checkbox"/> Enzyme activity. <input type="checkbox"/> Active transport. 	<ul style="list-style-type: none"> <input type="checkbox"/> Leaf edge turns brown from the tip. <input type="checkbox"/> Brown patches/collapsing stalks. <input type="checkbox"/> Pale fruit. 	
Calcium (Ca)	<ul style="list-style-type: none"> <input type="checkbox"/> Cell wall formation. <input type="checkbox"/> Metabolism and formation of mitochondria and nucleus. 	<ul style="list-style-type: none"> <input type="checkbox"/> Tip burn on young leaves, sepals and runner tips. <input type="checkbox"/> Crinkled older leaves. <input type="checkbox"/> Soft and dull coloured fruit. 	
Magnesium (Mg)	<ul style="list-style-type: none"> <input type="checkbox"/> Part of the chlorophyll. <input type="checkbox"/> Energy metabolism. 	<ul style="list-style-type: none"> <input type="checkbox"/> Dying older leaves. <input type="checkbox"/> Light red and soft fruit. 	
Sulphur (S)	<ul style="list-style-type: none"> <input type="checkbox"/> Part of amino acids. <input type="checkbox"/> Enzyme activity. 	<ul style="list-style-type: none"> <input type="checkbox"/> Similar to N deficiency. <input type="checkbox"/> Older leaf edges turn brownish-black. <input type="checkbox"/> Red/ yellow speckling. 	

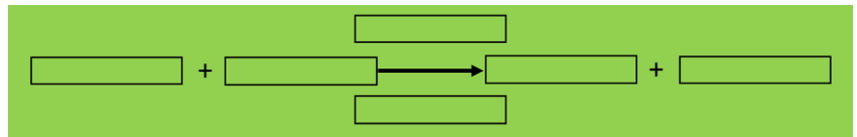
Resource **Two**

Activities

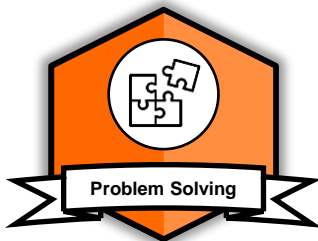
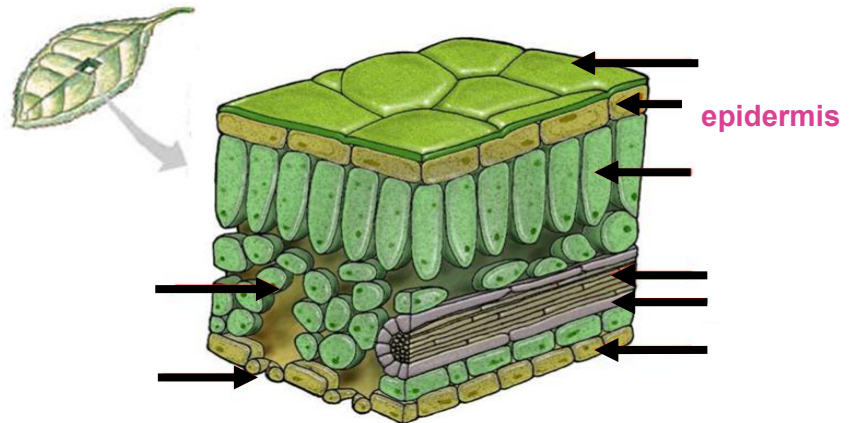
Activities

1. Describe the process of photosynthesis in no more than 100 words.
2. Using the words in the table to the left, complete the flow diagram for photosynthesis below.

Chlorophyll
Glucose
Oxygen
Light
Water
Carbon dioxide



3. Using the words in the table below, label the diagram of a plant leaf. See 'epidermis' as an example.



Lower epidermis	Spongy mesophyll	Xylem	Cuticle
Stomata	Phloem	Palisade mesophyll	Upper epidermis

4. Explain the role of stomata in photosynthesis.

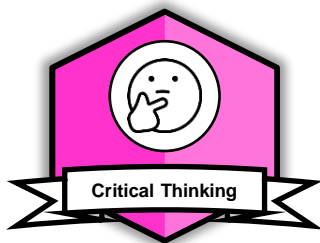
Resource **Two**

Activities

- Activities** 5. Draw arrows between plant nutrients and functions in the table below.

Plant nutrient	Function
Nitrogen (N)	Energy metabolism and makes up part of chlorophyll.
Sulphur (S)	Energy metabolism and carbohydrate transport and forms part of the cell membrane and roots.
Phosphorus (P)	Active transport and enzyme activity and helps to maintain water balance inside plants.
Calcium (Ca)	Contributes to the cell wall, mitochondria and nucleus.
Potassium (K)	Formation of proteins and nucleic acids.
Magnesium (Mg)	Enzyme activity and makes up part of amino acids.

6. Use the following link to help you match the mineral element symbol with the nutrient deficiency shown in each of the strawberry plant photos below (<https://www.yara.co.uk/crop-nutrition/strawberries/nutrient-deficiencies-strawberry/>):

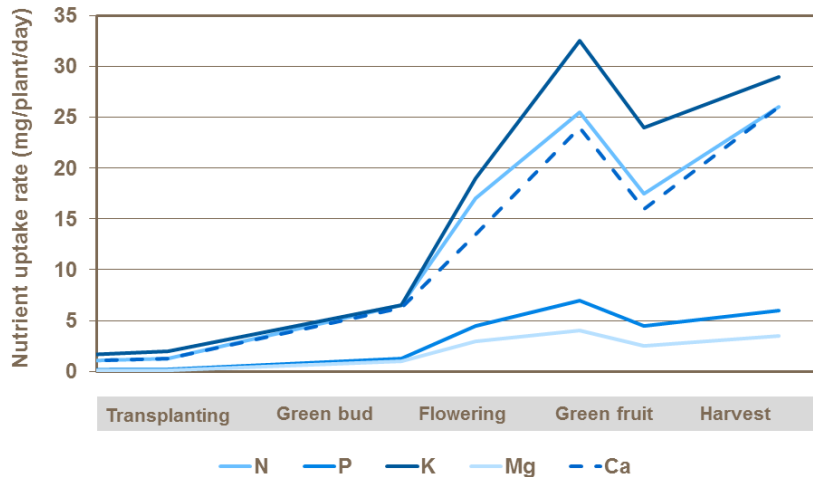
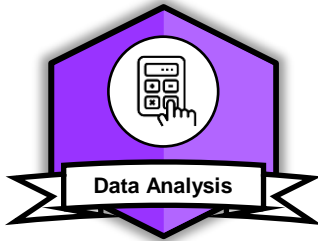


Resource **Two**

Activities

Activities

7. Why is it essential for strawberry growers to recognise signs of mineral deficiencies in their strawberry plants?
8. Use the graph below to answer the following questions:
 - 1 - Which nutrient has shown the lowest uptake in the graph?
 - 2 - In what stage of the strawberry life cycle is the nutrient uptake rate greatest?
 - 3 - Which nutrient shows the highest uptake rate?



REF: Lieten and Misotten – 1993

Macronutrient uptake in strawberries

Resource **Two**

Further Reading

- Explore**
- Watch the video ‘Using nanotech to improve photosynthesis – Glaia’ to discover a new technology being developed to help increase photosynthesis and yields in strawberry plants: https://youtu.be/A4m_TRXrPF0
 - Watch the video, ‘Fertilizing Strawberry Plants Garden Quickie Episode 65’ to discover how to produce good quality strawberries: <https://youtu.be/vZdsdcWCdOw>
 - Have a go at this simple experiment that you can do at home to observe photosynthesis in practice: [DIY Photosynthesis Experiment | Clearway Community Solar](#)

- References**
- BBC Bitesize, 2022. *Photosynthesis*. [online] Available at: <<https://www.bbc.co.uk/bitesize/topics/zvrrd2p/articles/zn4sv9q#zpmcr2p3>> [Accessed 15 November 2022].
 - BBC Bitesize, 2022. *Structure of plants*. [online] Available at: <<https://www.bbc.co.uk/bitesize/guides/z3w4k7h/revision/1>> [Accessed 15 November 2022].
 - Biology Dictionary, 2018. *Leaf Cell*. [online] Available at: <<https://biologydictionary.net/leaf-cell/>> [Accessed 15 November 2022].
 - National Geographic, 2022. *Photosynthesis*. [online] Available at: <<https://education.nationalgeographic.org/resource/photosynthesis>> [Accessed 15 November 2022].

Resource **Two**

Further Reading

Image Sources

- Resource title page: <https://blessmyweeds.com/how-to-irrigate-strawberries/>
- Figure 9: <https://www.environmentbuddy.com/environment/how-do-plants-make-oxygen/attachment/photosynthesis-equation/>
- Figure 10: <https://static.sciencelearn.org.nz/images/images/000/001/073/original/Essential-needs-for-plants20160510-29115-7qtjcb.jpg?1462836697>
- Figure 11: <https://journals.ashs.org/hortsci/view/journals/hortsci/55/4/full-465fig3.jpg>
- Figure 12: <https://www.pinterest.co.uk/pin/447826756668626593/>
- Figure 13: <https://thumbs.dreamstime.com/z/leaf-anatomy-vector-diagram-photosynthesis-chlorophyll-molecule-leaves-uses-energy-sunlight-to-turn-water-34168343.jpg>
- Table – Key nutrients (N): <https://i.pinimg.com/originals/05/4a/30/054a309af860fc30860ed00e4ab9792a.jpg>
- Table – Key nutrients (P): <https://th.bing.com/th/id/R.2606a21d243c5c36a731c73bb2f35e0d?rik=oqZ9xT956n2vLg&riu=http%3a%2f%2fwww.haifa-group.com%2fdutch%2ffiles%2fGuides%2fStrawberry%2ffigure4-6-2.png&ehk=NL8ROoQ3JVo8wXHZuGJZon3KlCm14HOQlxdAiqvU70g%3d&risl=&pid=ImgRaw&r=0>
- Table – Key nutrients (K): <https://content.ces.ncsu.edu/strawberry-potassium-k-deficiency>
- Table – Key nutrients (Ca): <https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=1874>

Resource **Two**

Further Reading

Image Sources [cont.]

- Table – Key nutrients (Mg): <https://content.ces.ncsu.edu/strawberry-magnesium-mg-deficiency>
- Table – Key nutrients (S): <https://content.ces.ncsu.edu/strawberry-sulfur-s-deficiency>
- Question 3: <https://www.pathwayz.org/Node/Image/url/aHR0cHM6Ly9pLmltZ3VyLmNvbS94bUZEUXhNlBuZz8x>
- Question 6: <https://www.haifa-group.com/crop-guide/vegetables/strawberry-fertilizer/crop-guide-strawberry-1>
- Question 8: <https://www.yara.co.uk/crop-nutrition/strawberries/nutritional-summary/>

Resource **Three**

Overview

Topic Maximising strawberry yields

Key Stage 3 Subject Area **Biology:** Structure and function of living organisms; Material cycles and energy; Interactions and interdependencies.
Physics: Energy; Waves.

Objectives **By completing this resource, you will be able to:**

- ✓ Describe the key factors affecting strawberry plant growth.
- ✓ Evaluate the importance of light for strawberries.
- ✓ Suggest ways to increase strawberry yields.

Instructions

1. Read the data source
2. Complete the activities
3. Explore the further reading
4. Move on to Resource Four



Resource Three

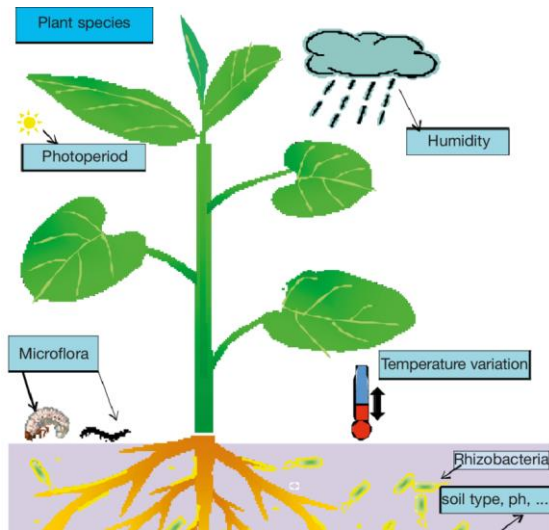
Data Source

Section A

Introduction to environmental factors

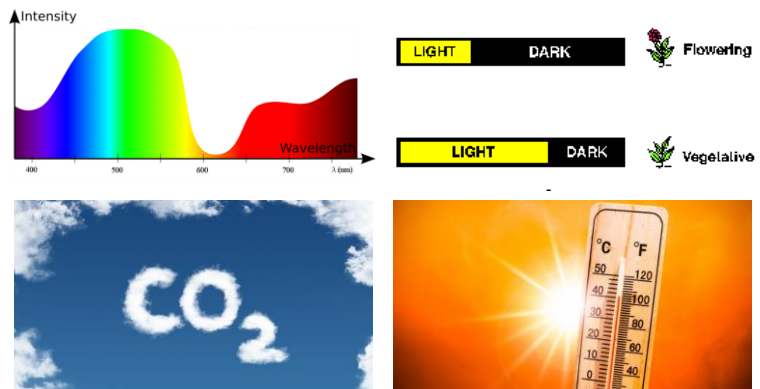
Figure 14: Environmental factors affecting plant growth

Environmental conditions are essential for all growers to consider whether growing cereals, flowers or fruit and vegetable crops. These factors vary between crops, with some affecting certain crops more than others and different crops preferring different conditions. However, some key factors affect all plants, including those which you can see in the diagram below:



It is vital that growers understand how their crops respond to these factors to provide the best conditions to maximise crop growth and production. In this resource, we will focus on the following environmental factors. Can you guess what they are from the pictures?

Figure 15: Four key environmental factors affecting plant growth



Resource Three

Data Source

Section B

Different measures of light affect strawberry growth:

Effect of light on strawberry plant growth



Light duration (photoperiod)



Light quality (distribution)



Light quantity (intensity)

Figure 16: Three dimensions of light

1. Light intensity

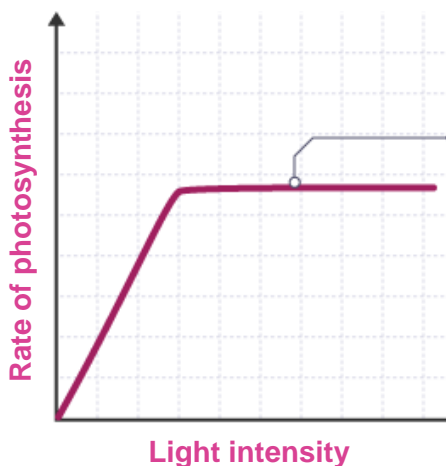
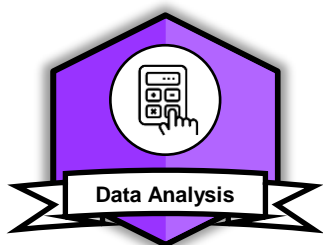
Light requirements change depending on the growth stage of the strawberry plant.

- Low light levels** – Required by crown and runner and for leaf growth and initial flower development.
- High light levels** – Required for flower opening and fruit ripening.

Increasing light levels during the later flowering and fruiting stages typically increase the rate of photosynthesis. A maximum photosynthetic rate is reached when a further increase in light levels no longer increases photosynthesis. This contributes to increased strawberry yields.



Figure 17: Effect of light intensity on the rate of photosynthesis



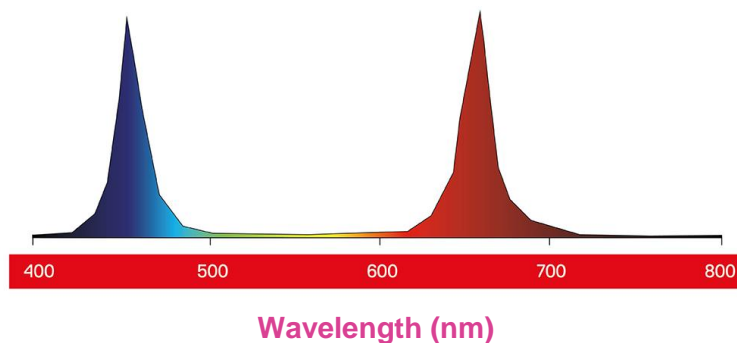
Resource Three

Data Source

Section B 2. Light quality

Strawberry plants require light in the blue and red parts of the **visible light** spectrum. These wavelengths of light are most efficiently absorbed by the photosynthetic pigment – chlorophyll - in leaves.

Figure 18: Visible light spectrum



Section C

Effect of the photoperiod on strawberry plant growth

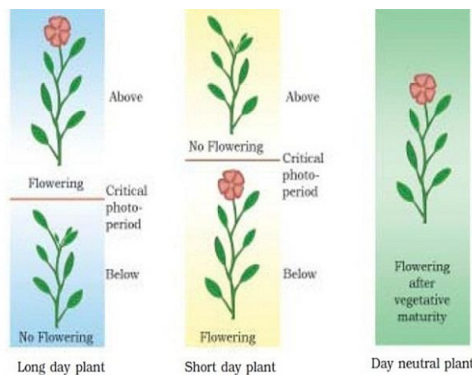


Figure 19: Plant photoperiodic responses

3. Photoperiod

Photoperiod refers to the day length that a plant is exposed to. Strawberry plants can be split into three groups based on their required day length for flowering:

- Short-day plants – *Junebearer***: flowers when the day length is shorter than the critical photoperiod.
- Long-day plants – *Everbearer***: flowers when the day length is longer than the critical photoperiod.
- Day-neutral** – Day length does not affect flowering.



Resource Three

Data Source

Section D

Effect of temperature on strawberry plant growth

Figure 20: Effect of temperature on the rate of photosynthesis

As temperature increases, the rate of photosynthesis increases up until a maximum level. Further temperature increases beyond this level result in photosynthetic enzymes denaturing, and the rate of photosynthesis decreases.

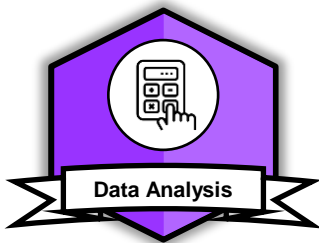
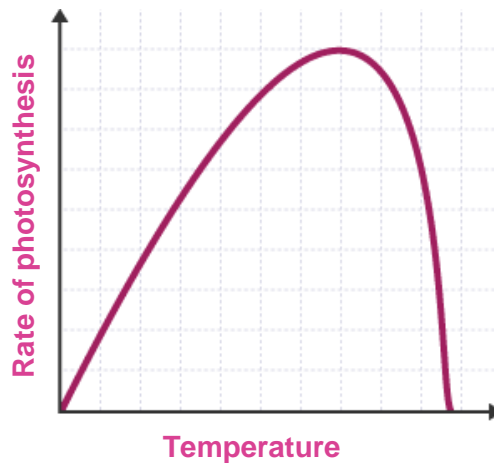
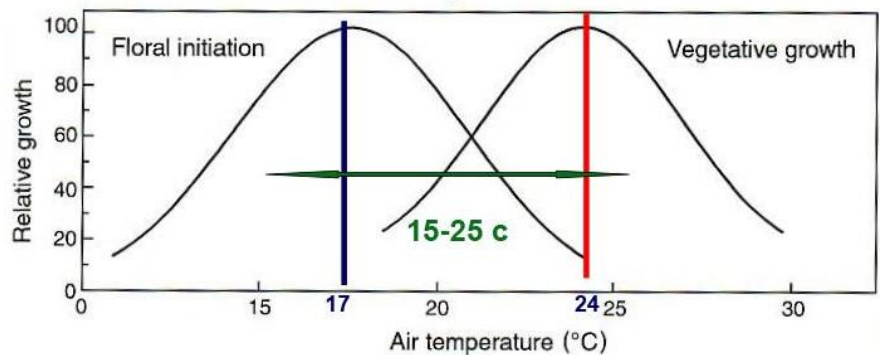


Figure 21: Effect of temperature on strawberry plant growth

Different strawberry cultivars have different optimal temperature ranges depending on their growth stage. In general, cooler temperatures are needed to maximise fruit sets and increase fruit yields and weight, whereas warmer temperatures between 18 and 24 °C trigger flowering and promote vegetative growth. Temperatures above 24 °C can inhibit both vegetative and floral growth, causing damage to the plants and reducing yields.



Resource Three

Data Source

Section E

Effect of CO₂ on strawberry plant growth

Increasing CO₂ increases the rate of photosynthesis up until a point when another factor becomes limiting. As an example, light levels.

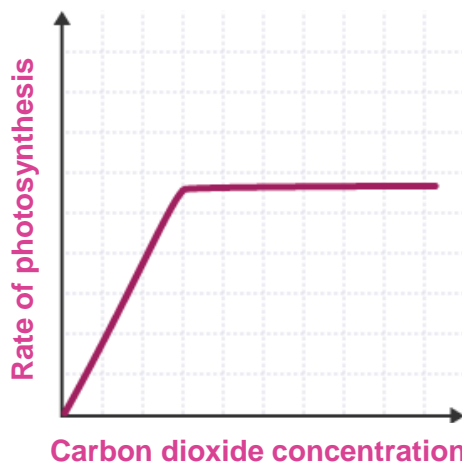
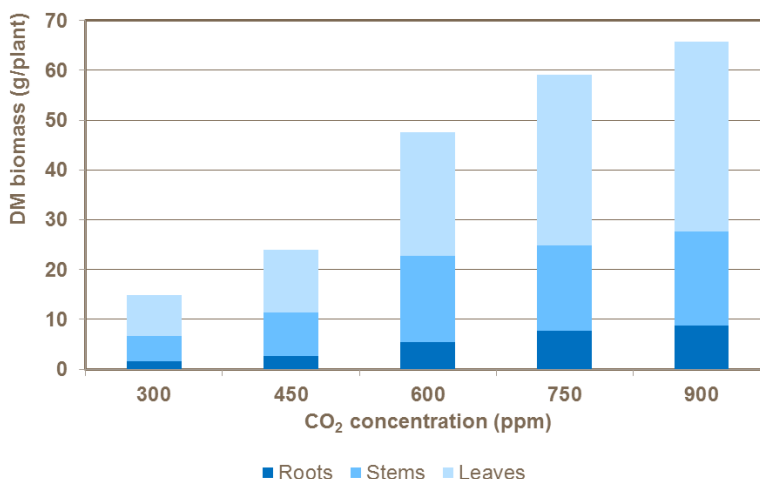


Figure 22: Effect of CO₂ on the rate of photosynthesis



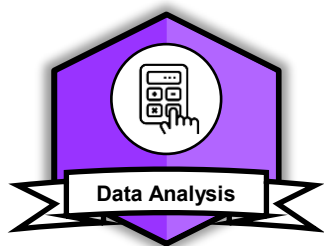
Higher CO₂ levels increase strawberry vegetative growth and can lengthen the duration of crop flowering. This results in higher yields.

Figure 23: Effect of CO₂ on vegetative strawberry plant growth



REF: Chen, Lenz – 1997

Higher CO₂ levels help to increase fruit quality by increasing the sugar content of the strawberries. High atmospheric CO₂ levels increase fruit yields and quality at low temperatures, but high temperatures reduce fruit yield and quality.

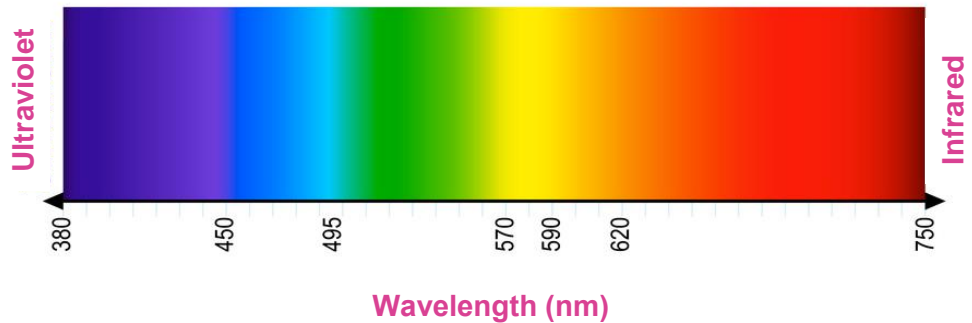


Resource Three

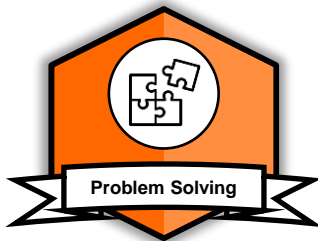
Activities

Activities

1. What are the four main factors discussed in Resource Three affecting plant growth?
2. Read the abstract for the journal article 'The effect of temperature and light intensity on the rate of strawberry fruit ripening'. Explain the importance of commercial strawberry growers understanding the response of strawberry plants to different environmental conditions (https://www.ishs.org/ishs-article/1309_92).
3. Circle the regions on the light spectrum graph which show the wavelengths of visible light needed for strawberry plant growth and development.



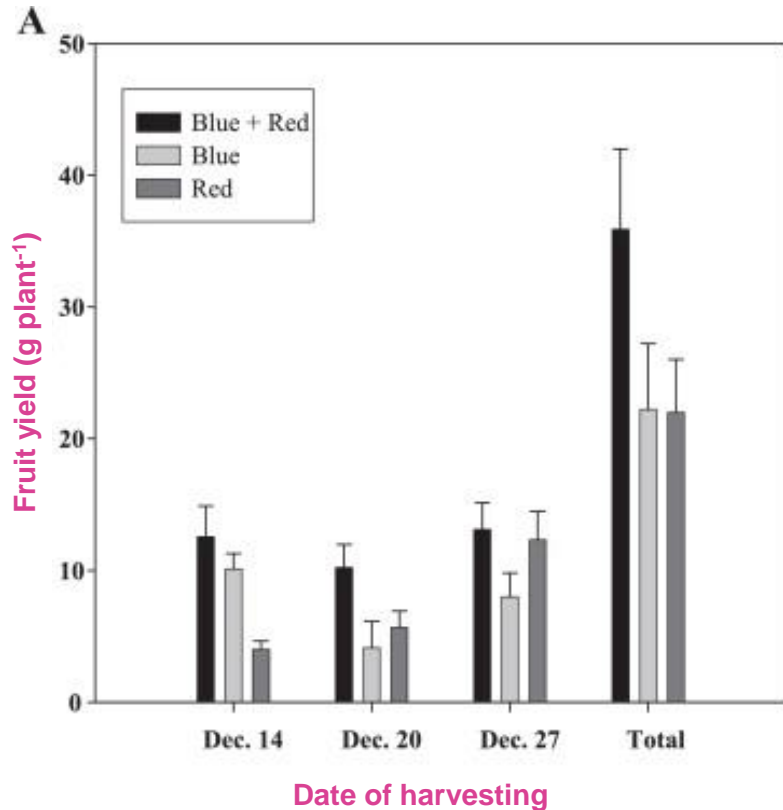
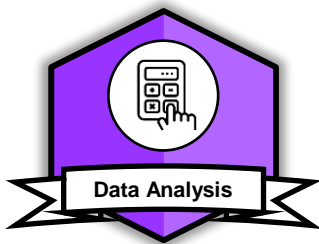
4. Using the graph on the next page, answer the following questions about a lighting experiment conducted on strawberry plants.
 - 1 – What are the dependent and independent variables in this experiment?
 - 2 – Estimate the total yield for each of the three light treatments.



Resource **Three**

Activities

- Activities**
4. [Cont.] See the graph about fruit yield of strawberries grown under three different LED lights in a growth chamber below.



5. Decide whether the following statements relating to photoperiod are true or false:
- 1 – Photoperiodism describes a plant's response to day length.
 - 2 – All strawberry plants require a long day to produce fruit.
 - 3 – Short-day plants will flower when the daylength is less than a critical length.

Resource Three

Activities

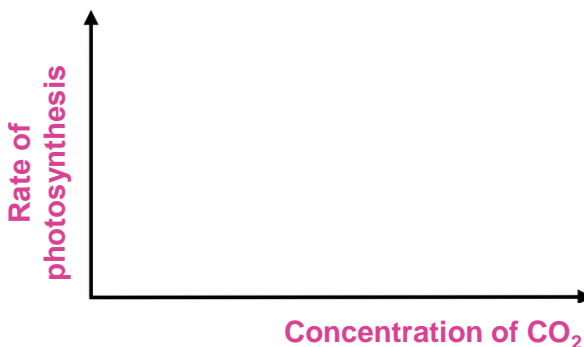
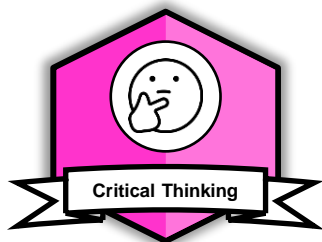
- Activities**
6. Read the following passage about the effect of temperature on strawberry plant growth and delete the incorrect words so that the passage reads correctly:

The optimum temperature for strawberry plant growth **stays the same/ changes** depending on the plant growth stage. Generally, **warmer/ cooler** temperatures increase leaf growth, whereas **warmer/ cooler** temperatures are needed for fruit production. Strawberry plants exposed to higher temperatures during fruiting tend to produce **more/ less** uniformly shaped and **smaller/ larger** fruit.

7. Read the following passage and then sketch a line on the graph below to show the effect of increasing CO₂ concentration on the rate of photosynthesis and hence plant growth.

Carbon dioxide and the rate of photosynthesis

An increase in the carbon dioxide concentration increases the rate at which carbon is incorporated into carbohydrate in the light-independent reaction, and so the rate of photosynthesis generally increases until limited by another factor. As it is normally present in the atmosphere at very low concentrations (about 0.04%), increasing carbon dioxide concentration causes a rapid rise in the rate of photosynthesis which eventually plateaus when the maximum rate of fixation is reached.



8. Applying what you have learnt about the effect of different factors on strawberry plant growth, suggest two methods that a strawberry grower could use to increase their yields?

Resource Three

Further Reading

- Explore**
- Watch Dyson's 'Strawberry production' video to find out how they are using technology to optimise the growing conditions to maximise strawberry yields on a commercial scale:
<https://dysonfarming.com/strawberries/>
 - Watch the video 'Factors affecting the rate of Photosynthesis - GCSE Biology (9-1)' to familiarise yourself with the graphs for how each of the key factors discussed in Resource Three affects plant growth: <https://youtu.be/UU5gA-95wgA>
 - Have a go at using the virtual lab to see how temperature and light intensity affect the rate of photosynthesis and plant growth. Design a simple experiment to test these factors and record your results. Consider light intensity and temperature intervals and the time for which you will record the number of bubbles produced:
<https://leosiiman.neocities.org/lab-rate-of-photosynthesis/photolab-individual.html>

- References**
- Babu, N. M., 2018. Environmental Factors that affecting Plant Growth.pdf. [pdf] Available at: <https://www.academia.edu/es/38142288/Environmental_Factors_that_affecting_Plant_Growth_pdf> [Accessed 16 November 2022].
 - Khammayom, N., Maruyama, N., Chaichana, C. and Hirota, M., 2022. Impact of environmental factors on energy balance of greenhouse for strawberry cultivation. Case Studies in Thermal Engineering, 33.
 - Oregon State University, 2008. Environmental factors affecting plant growth. [online] Available at: <<https://extension.oregonstate.edu/gardening/techniques/environmental-factors-affecting-plant-growth>> [Accessed 16 November 2022].
 - Tang, Y., Ma, X., Li, M. and Wang, Y., 2020. The effect of temperature and light on strawberry production in a solar greenhouse. Solar Energy. 195, pp.318-328.

Resource **Three**

Further Reading

Image Sources

- Resource title page: <https://www.oreon-led.com/cache/led-grow-lights-for-strawberries.2554/led-grow-lights-for-strawberries-s800x800.jpg>
- Figure 14: https://www.researchgate.net/publication/297824614/figure/download/fig1/AS:393309605384195@1470783725104/Ecological-factors-influencing-the-root-exudation-process-and-thereby-rhizosphere.png?_sg=eeohle4EX7qYtCJEgg7oxu28Jri34mT_B_ITMJZhAygkNDZ5GzYL921UkCRsl2JwW21KpJLZxQo
- Figure 15: <https://i1.wp.com/tech-ish.com/wp-content/uploads/2016/04/Light-Wavelength-Distribution.png>
- Figure 15: https://hoopermuseum.earthsci.carleton.ca/vegetation/9a_photoperiodism.htm
- Figure 15: <https://autokunz.ch/app/uploads/2019/08/import-co2-boerse-1366x911.jpeg>
- Figure 16: <https://image.slidesharecdn.com/dharmesh-light-161203131234/95/light-12-638.jpg?cb=1480770780>
- Figures 17, 20 and 21: <https://www.bbc.co.uk/bitesize/guides/zx8vw6f/revision/2>
- Figure 18: <https://growwithdaylight.co.uk/blog/important-considerations-when-comparing-led-lighting/>
- Figure 19: <https://th.bing.com/th/id/R.073c26db389c70d220b253818b1a1667?rik=0DxCMq3Q33hWcg&riu=http%3a%2f%2fexxamm.com%2fblog%2fImages%2fArticleImages%2farticle-14961%2fImage2.png&ehk=CyLpYVZSmTQxG0PCKf9yH42o6dGSfG0X63b0c%2bR9wCQ%3d&risl=&pid=ImgRaw&r=0>
- Figure 23: <https://www.yara.co.uk/crop-nutrition/strawberries/production-systems/>

Resource **Four**

Overview

Topic The Christmas day strawberry

**Key Stage 3
Subject Area**

Biology: Nutrition and digestion.

Chemistry: Earth and atmosphere.

Geography: Human and physical geography.

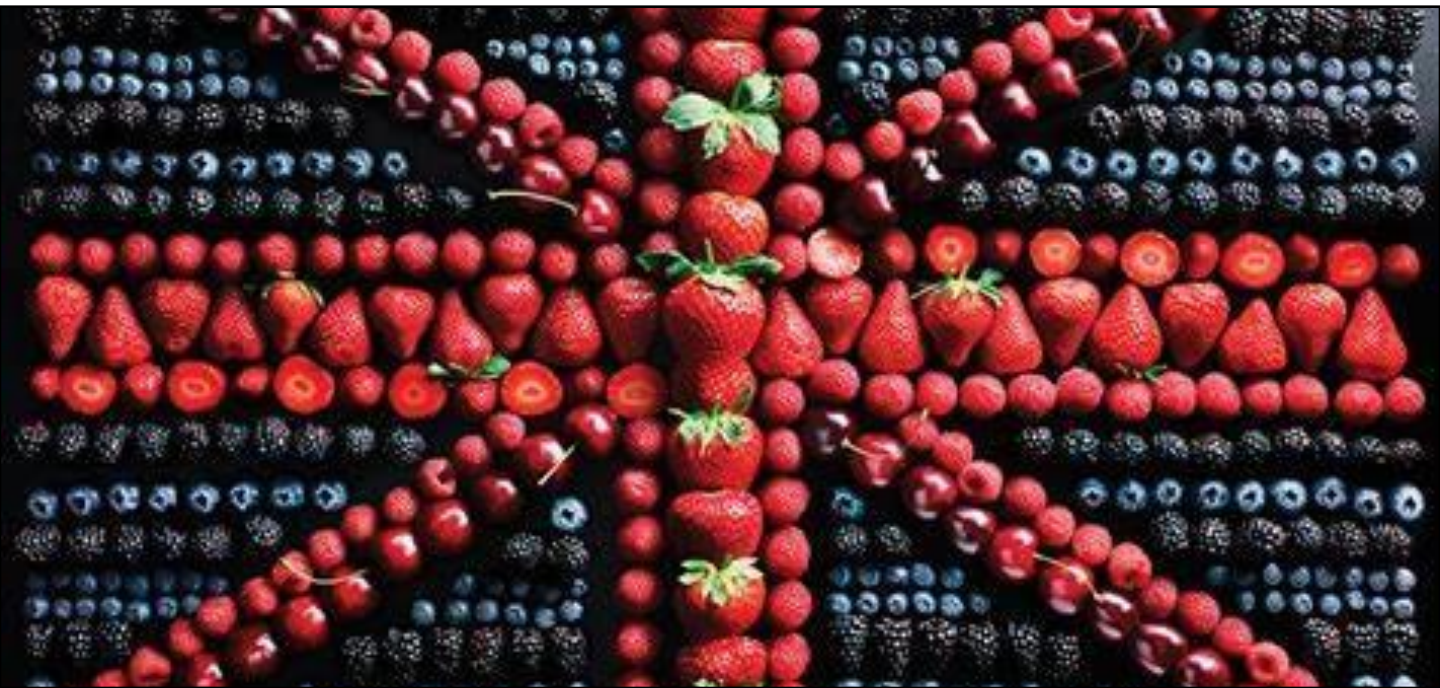
Objectives

By completing this resource, you will be able to:

- ✓ Describe global climate change.
- ✓ Discuss how food production contributes to global climate change.
- ✓ Explain the benefits of producing year-round, fresh British produce.

Instructions

1. Read the data source
2. Complete the activities
3. Explore the further reading
4. Move on to the final reflection activity



Resource Four

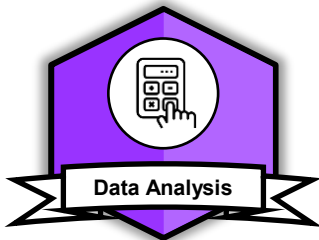
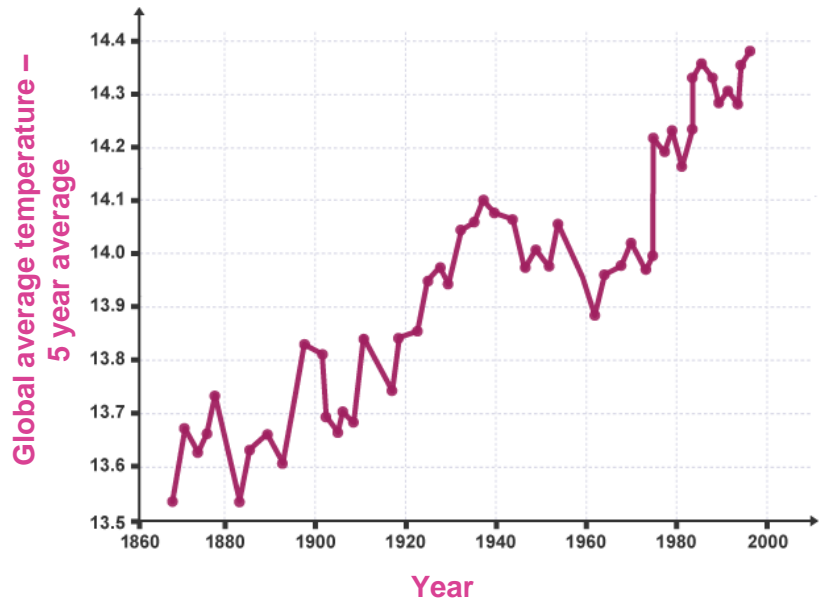
Data Source

Section A

Global climate change

Figure 24:
Change in the
average global
temperature 1860-
2000

Global climate change refers to a change in the average conditions on the planet over a long period. For example, temperature and rainfall.



There is particular concern about the consequences of the current Global Warming trend. This describes the rapid increase in the Earth's average surface temperature over the last century due to the increased release of **greenhouse gases** (GHGs), largely thought to be the result of human activity increasing the burning of **fossil fuels**.

Figure 25: Changing habitats due to global warming



Resource Four

Data Source

Section B

The greenhouse effect

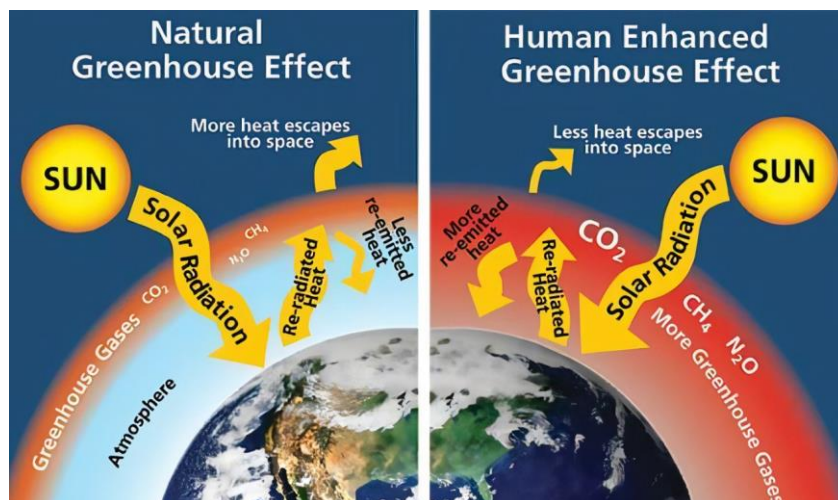


The greenhouse effect is a process that works like a greenhouse works to retain heat absorbed during the day at night. See below:

1. Sun shines through the atmosphere during the day.
2. Earth's surface absorbs most of the radiation and heats up.
3. However, some radiation is released back into the atmosphere as **infrared radiation** (heat energy).
4. Some infrared passes straight through into space
5. Some infrared radiation is trapped by **GHGs** present naturally in the Earth's atmosphere: carbon dioxide (CO₂), methane (CH₄), water vapour (H₂O) and nitrous oxide (NO_x).
6. Lower atmosphere warms up.

Over the last century, human activity has increased the release of GHGs into the Earth's atmosphere, largely through burning fossil fuels. This has contributed to more heat being trapped in the Earth's atmosphere, known as the enhanced greenhouse effect.

Figure 26: Enhanced greenhouse effect



Resource Four

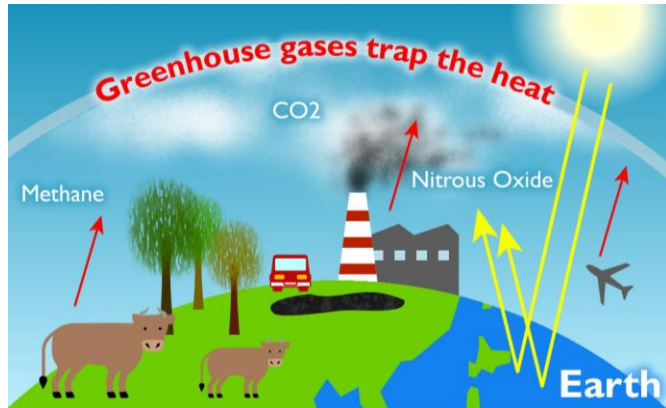
Data Source

Section C

Human activities and the enhanced greenhouse effect

Figure 27: Human activities contributing to the greenhouse effect

Many different human activities are contributing to increased GHG emissions. See below:

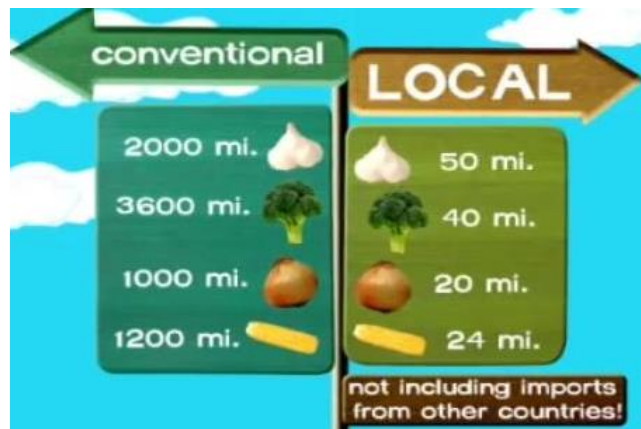


One activity is food production. This creates a potential problem as food production is a key global activity for the world's population survival. Therefore, it is essential to find ways to produce enough food to feed the planet's population whilst reducing the release of GHGs.



One way this can be achieved is through developing methods to allow local, fresh produce production to reduce **food miles** since transport is a major cause of burning fossil fuels. This means finding ways to extend the growing season of fresh produce so that local supply can meet local demand with a reduced need for **imports**.

Figure 28: Food miles of imports vs locally produced food



Resource **Four**

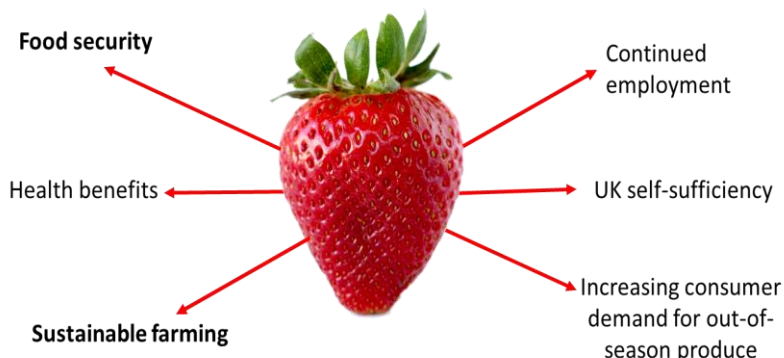
Data Source

Section D

Importance of local food production

Figure 29: Reasons why local food production and consumption are important

As well as local production helping to reduce food miles, there are many other potential benefits of increasing local food production which are listed in the picture below:



Having learnt about the growth and development of strawberries throughout this course, we will now use the strawberry as a case study to look at some of these benefits and see how we might achieve season extension.

1. Health benefits

Strawberries are a low-calorie, soft fruit consisting mainly of water. They contain a small proportion of carbohydrates in the form of simple sugars (glucose, fructose and sucrose) and are a source of **dietary fibre**. Strawberries are high in vitamins and minerals, including vitamin C, vitamin B9/ folate, manganese and potassium.

The nutritional make up of strawberries has been shown to contribute to several health benefits associated with strawberry consumption. Health benefits include reducing the risk of diabetes, cancer, cardiovascular disease, metabolic syndrome, and obesity. In addition, it's an antioxidant that has neuroprotective properties.



Resource **Four**

Data Source

Section D 2. Increased consumer demand

The demand for strawberries has increased over time due to several factors, including improved health awareness promoted through governmental campaigns encouraging fruit and vegetable consumption.

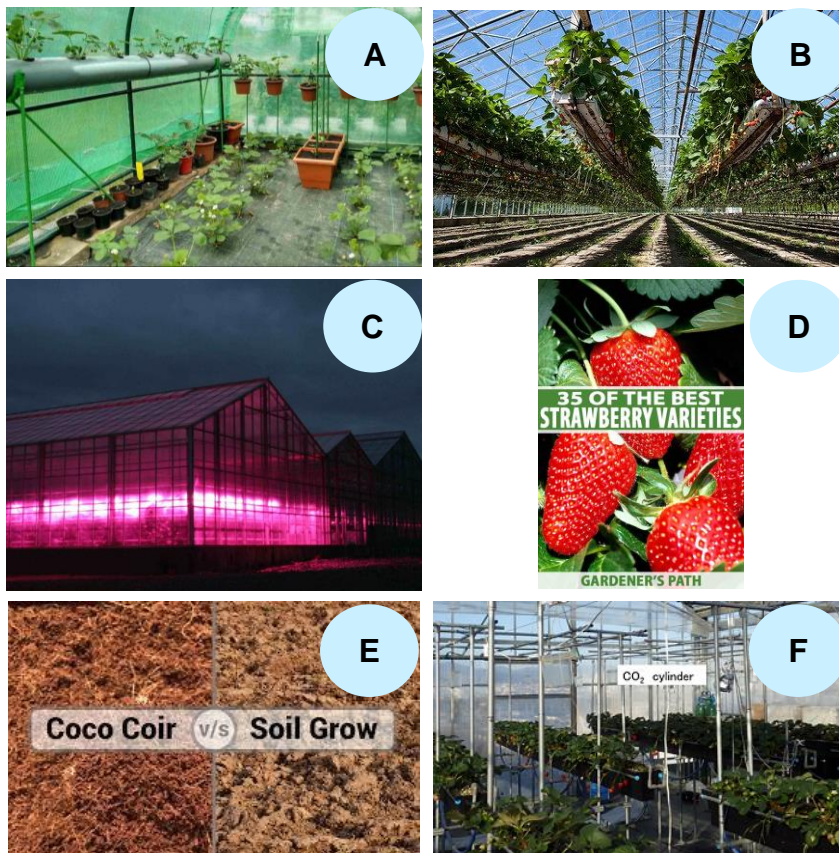
Section E

Strawberry season extension

Technological and scientific developments have increased the UK strawberry growing season from 6 weeks in the 1980s (June-July) to 9 months (March-November), with research ongoing to extend the growing season even further.

Examples of Technological and scientific developments include polytunnels, glasshouses, LED-lit glasshouses, new strawberry varieties, a shift from soil to substrates, and CO₂ enrichment.

Figure 30: (A) Poly tunnel; (B) Glasshouse; (C) LED-lit glasshouse; (D) New strawberry varieties; (E) Shift from soil to substrate; (F) CO₂ enrichment



Resource **Four**

Activities

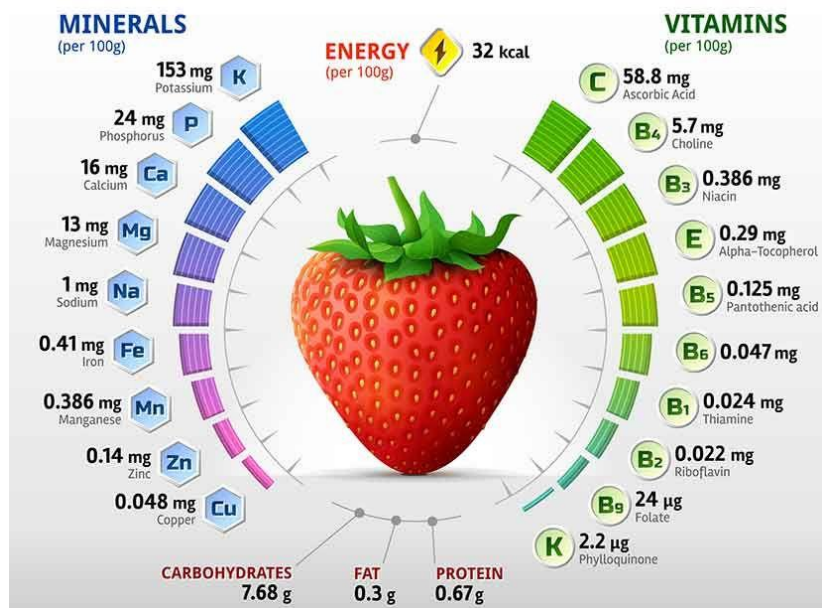
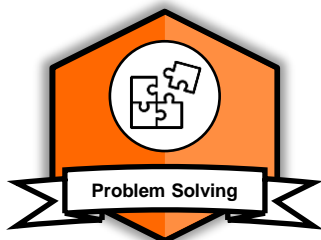
Activities

Sustainably
Nutritious
Healthy
Available
Accessible
Population

- Using as many of the words in the table on the left, write your own definition of food security.
- Explain how the glasshouses' development has extended the strawberry growing season.
- Make a table to outline the advantages and disadvantages of a UK strawberry grower growing strawberries in a glasshouse compared to the open field.
- Using what you have learnt about the effects of CO₂ on plant growth and the role of CO₂ as a GHG, decide whether you think a commercial strawberry grower should add additional CO₂ into their strawberry glasshouse. Give justified reasons for your choice using the link below for ideas (<http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Docu ment-10655/HLA-6723web.pdf>).

Minerals
Immune
Glucose
Sugar
Tissue
Calorie

- Use the image below and the table on the left to complete the passage on the next page about the nutritional value of strawberries.



Resource **Four**

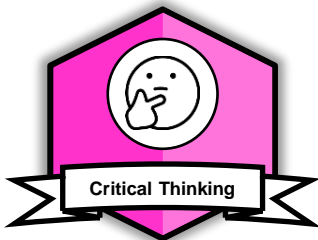
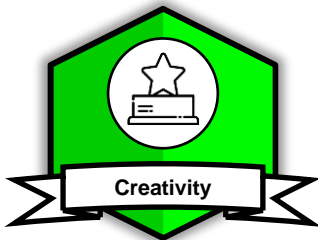
Activities

- Activities** 5. [Cont.] Complete the following passage about the nutritional value of strawberries.

Nutritional value of strawberries

Strawberries are a low _____, healthy food containing mainly water and carbohydrates in the form of simple sugars. For example, _____, fructose and sucrose and fibre. Fibre is important for helping to maintain stable blood _____ levels. Strawberries are rich in vitamins, including vitamins C and B9 and _____, such as potassium and manganese. Vitamin C promotes healthy _____ function and skin health whilst vitamin B9 is essential for normal _____ growth and cell function.

6. What are three suggested health benefits of strawberries that might have contributed to increased consumption in the UK over the last 20 years?
7. Imagine you are a campaigner for the 'Back British Farming' Campaign trying to promote the importance of British farming to the nation. Your task is to write a short paragraph (about 100 words) to persuade consumers to buy fresh, local British produce.
8. In Resource Four, we have focussed on the relationship between food production and global climate change. Can you think of other human activities that could contribute to global climate change? Use the link below for further ideas (<https://science.howstuffworks.com/environmental/green-science/human-activities-increase-carbon-dioxide.htm>).



Resource **Four**

Further Reading

- Explore**
- Download the seasonal guide to find out what fruit and vegetables are in season when in the UK so you can do your bit to support local British produce:
<https://www.countrysideonline.co.uk/tools/downloadseasonalitychart>
 - Watch the video, read the information about 'Food miles' and 'Food and the environment' and then test your knowledge by completing the 'Sustainable food' quiz:
<https://www.bbc.co.uk/bitesize/topics/zfmpb9q/articles/zs9gsk7>
 - Discover how your food choices impact the environment using this 'Climate change food calculator':
<https://www.bbc.co.uk/news/science-environment-46459714>

- References**
- Afrin, A., Gasparinni, M., Forbes-Hernandez, T. Y., Roberedo-Rodriguez, P., Mezzetti, B., Varela-López, A., Giampieri, F. and Battino, M., 2016. Food Chem., 64, pp.4435-4449.
 - BBC Bitesize, 2022. Food miles and the environment. [online] Available at: <<https://www.bbc.co.uk/bitesize/topics/zjr8mp3/articles/zjnxwnb>> [Accessed 17 November 2022].
 - BBC Bitesize, 2022. The greenhouse effect and the enhanced greenhouse effect. [online] Available at: <<https://www.bbc.co.uk/bitesize/topics/zpgd8hv/articles/zn9t6g8>> [Accessed 17 November 2022].

Resource **Four**

Further Reading

References [cont.]

- Honeycutt, E., 2017. Why Buy Local Food? It's Healthier for You and Better for the Environment. [online] Available at: <<https://foodrevolution.org/blog/why-buy-local-food/>> [Accessed 12 November 2022].
- NASA, 2022. What Is Climate Change? [online] Available at: <<https://climatekids.nasa.gov/climate-change-meaning/>> [Accessed 20 November 2022].
- Raffle, S., Irving, R. and Moore, G., n.d. Extending the UK strawberry season using a range of plant types and growing systems. [pdf] Available at: <<https://projectbluearchive.blob.core.windows.net/media/Default/Horticulture/Publications/Extending%20the%20UK%20strawberry%20season%20using%20a%20range%20of%20plant%20types%20and%20growing%20systems.pdf>> [Accessed 12 November 2022].
- The World Bank, 2022. What is Food Security? [online] Available at: <<https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security>> [Accessed 12 November 2022].

Image Sources

- Resource title page: https://th.bing.com/th/id/OIP.QUIXpNL94aKM2atjD5Uc_AHaFk?pid=ImgDet&rs=1
- Figure 24: <https://www.bbc.co.uk/bitesize/guides/zx234j6/revision/1>
- Figure 25: <https://sites.google.com/site/globalclimatechangejfr/the-problem-with-global-climate-change/the-causes-of-global-climate-change/the-future-effects-of-global-climate-change>

Resource **Four**

Further Reading

Image Sources [cont.]

- Figure 26: <https://enhancedgreenhousegasemissions.weebly.com/enhanced-greenhouse-gas-effect.html>
- Figure 27: https://www.worldvision.org.hk/en/images/data/07_Learn/01_Issue/05_Climate_Change/2019-03-06_update/greenhouse_gases_en.jpg
- Figure 28: <https://sites.google.com/site/foodmiles/whytheymatter/>
- Figure 30 (A): <https://gardeningtips.in/growing-strawberries-in-greenhouse-polyhouse>
- Figure 30 (B): <https://www.hortweek.com/s-a-produce-takes-south-wales-glasshouses-strawberry-production/fresh-produce/article/1171400>
- Figure 30 (C): <http://blog.louielighting.com/led-lighting-horticulture/>
- Figure 30 (D): <https://gardenerspath.com/plants/fruit/best-strawberries/>
- Figure 30 (E): <https://hydroxchange.com/coco-coir-v-s-soil-grow/>
- Figure 30 (F): https://www.agr.shizuoka.ac.jp/bs/vegetable/index_en.html
- Question 5: <https://ar.pinterest.com/pin/691232242795221054/>

Final Reflection Activity

Further Guidance

Individual activity

Now that you have learnt all about strawberry plants and the possible ways that we can achieve year-round strawberry production in the UK, your task is to choose a different seasonal fresh food product that you would like to see produced year-round in the UK. This could be any fresh food product, such as pears or brussel sprouts. You should design a one-page A4 poster informing British supermarket consumers about your chosen produce using the subheadings below as a checklist for the type of information to include:

Plant Classification

- Family, Genus and Species
- For example, strawberries belong to the Family: Rosaceae and their scientific name is *Fragaria ananassa* (Genus, species)

Origin

- Native country
- Where it might already be grown in the UK and in what season
- Any countries where it can be grown year-round

Statistics

- Include tables/ graphs to show how factors, such as production/ consumption, supply/ demand or imports/ exports, have changed over time in the UK
- Use <https://www.gov.uk/government/statistics/latest-horticulture-statistics> to help you

Methods of Plant Reproduction

- Simple diagram of the plant's reproductive structures

Benefits of Year-Round Production

What makes a Good Poster?

1. Subheadings
2. Structured layout – short paragraphs
3. Images/ graphs
4. Colour
5. Bullet points

Final Reflection Activity

Further Guidance

Group activity

In small groups, discuss your ideas to answer the following questions. Be ready to feedback to the class.

1. What methods can produce fresh produce year-round in the UK?
2. What is the importance of producing fresh produce year-round in the UK?
 - Consider different user groups, such as growers, supermarkets, and consumers.
3. What might some of the drawbacks to producing fresh produce year-round be?
 - Consider different user groups, such as growers, supermarkets, and consumers.

Tip: *Be creative in your answers and think outside the box!*

Reference List

Journal Articles

- Khammayom, N., Maruyama, N., Chaichana, C. and Hirota, M., 2022. Impact of environmental factors on energy balance of greenhouse for strawberry cultivation. *Case Studies in Thermal Engineering*, 33.
- Tang, Y., Ma, X., Li, M. and Wang, Y., 2020. The effect of temperature and light on strawberry production in a solar greenhouse. *Solar Energy*. 195, pp.318-328.
- Afrin, A., Gasparinni, M., Forbes-Hernandez, T. Y., Roberedo-Rodriguez, P., Mezzetti, B., Varela-López, A., Giampieri, F. and Battino, M., 2016. *Food Chem.*, 64, pp.4435-4449.

Websites and PDFs

- <https://www.youtube.com/watch?v=bc8nyZFoUCY>
- <https://vegetablegrowersnews.com/news/misshapen-strawberries-caused-by-poor-pollination/#:~:text=Strawberries%20have%20both%20male%20and,to%20allow%20for%20complete%20pollination>
- <https://youtu.be/gTMoV06mtGw>
- <https://www.bbc.co.uk/bitesize/guides/z2xg87h/revision/2>
- <https://cydinstitute.com/student-center/science/reproductive-structures-of-the-plant/>
- <https://www.gardenguides.com/75949-strawberry-plants-reproduce-asexually.html>
- https://youtu.be/A4m_TRXrPF0
- <https://youtu.be/vZdsdcWCdOw>
- [DIY Photosynthesis Experiment | Clearway Community Solar](#)
- <https://www.bbc.co.uk/bitesize/topics/zvrrd2p/articles/zn4sv9q#zpmcr2p3>
- <https://www.bbc.co.uk/bitesize/guides/z3w4k7h/revision/1>



Reference List

Websites and PDFs [cont.]

- <https://biologydictionary.net/leaf-cell/>
- <https://education.nationalgeographic.org/resource/photosynthesis>
- <https://dysonfarming.com/strawberries/>
- <https://youtu.be/UU5gA-95wgA>
- <https://leosiiman.neocities.org/lab-rate-of-photosynthesis/photolab-individual.html>
- https://www.academia.edu/es/38142288/Environmental_Factors_that_affecting_Plant_Growth_pdf
- <https://extension.oregonstate.edu/gardening/techniques/environmental-factors-affecting-plant-growth>
- <https://www.countrysideonline.co.uk/tools/downloadseasonalitychart>
- <https://www.bbc.co.uk/bitesize/topics/zfmpb9q/articles/zs9gsk7>
- <https://www.bbc.co.uk/news/science-environment-46459714>
- <https://www.bbc.co.uk/bitesize/topics/zjr8mp3/articles/zjnxwnb>
- <https://www.bbc.co.uk/bitesize/topics/zpgd8hv/articles/zn9t6g8>
- <https://foodrevolution.org/blog/why-buy-local-food/>
- <https://climatekids.nasa.gov/climate-change-meaning/>
- <https://projectbluearchive.blob.core.windows.net/media/Default/Horticulture/Publications/Extending%20the%20UK%20strawberry%20season%20using%20a%20range%20of%20plant%20types%20and%20growing%20systems.pdf>
- <https://www.worldbank.org/en/topic/agriculture/brief/food-security-update/what-is-food-security>
- <https://www.gov.uk/government/statistics/latest-horticulture-statistics>



More Subject Resources

A Deeper Look into Plant Biology and Food Production



Read

- Read the NFU 'Back British Farming Campaign' brochure to find out more about **sustainable farming** and food security in the UK and hear directly from farmers themselves with their views on food production and climate change:
<https://www.nfuonline.com/archive?treeid=152296>
- Look at the UN's website section on 'Climate Action' to find out more about the science behind climate change, including the causes and effects, solutions and the Sustainable Development Goals:
<https://www.un.org/en/climatechange/what-is-climate-change>
- Look at the UN's website section on 'Peace, dignity and equality on a healthy planet' to find out more about global food issues: <https://www.un.org/en/global-issues/food>

Watch

- Watch the video to find out how the food system might look in 2050:
<https://www.youtube.com/watch?v=4IKoJFx1jSI&t=238s>
- Watch the video to discover some of the research happening in the research glasshouses at NIAB HQ, Cambridge:
<https://www.youtube.com/watch?v=JmpzCcroJi4&t=103s>
- Watch the BBC One documentary 'Our Family Cucumber Farm' to see some of the challenges that British glasshouse growers face in today's changing food industry:
<https://www.bbc.co.uk/iplayer/episode/m001d85j/we-are-england-farming-england-our-family-cucumber-farm>

More Subject Resources

A Deeper Look into Plant Biology and Food Production



- Do**
- Find out how to grow your own strawberries and have a go at home! <https://www.youtube.com/watch?v=xhR7I0jpbSM>
 - Have a go at this quiz to find out more about where different foods are grown throughout the world:
<https://www.booktrust.org.uk/books-and-reading/have-some-fun/quizzes/food-quiz-test-your-knowledge-on-ingredients-from-around-the-world/>
 - Join this Future Learn course 'Future Food: Sustainable Food Systems for the 21st Century' to develop your understanding of sustainable food systems:
<https://www.futurelearn.com/courses/future-food>

Study Skills, tips & Guidance

This section includes helpful tips to help you complete this pack and improve your study skills for school.

It also includes a few fantastic, easy-to-use resources to know what to do next and where else you can look for more information on the subject.



Helpful information you will find in this section:

1. Cornell Notes
2. Academic Terminology (keywords)
3. Academic Writing Style
4. Referencing
5. How to Evaluate Your Sources
6. Subject Guidance
7. University Guidance

Psst! Learning these tips to improve your school skills could help you do better in exams and make assignments easier!

You can use the tips and web links in this section throughout your pack!



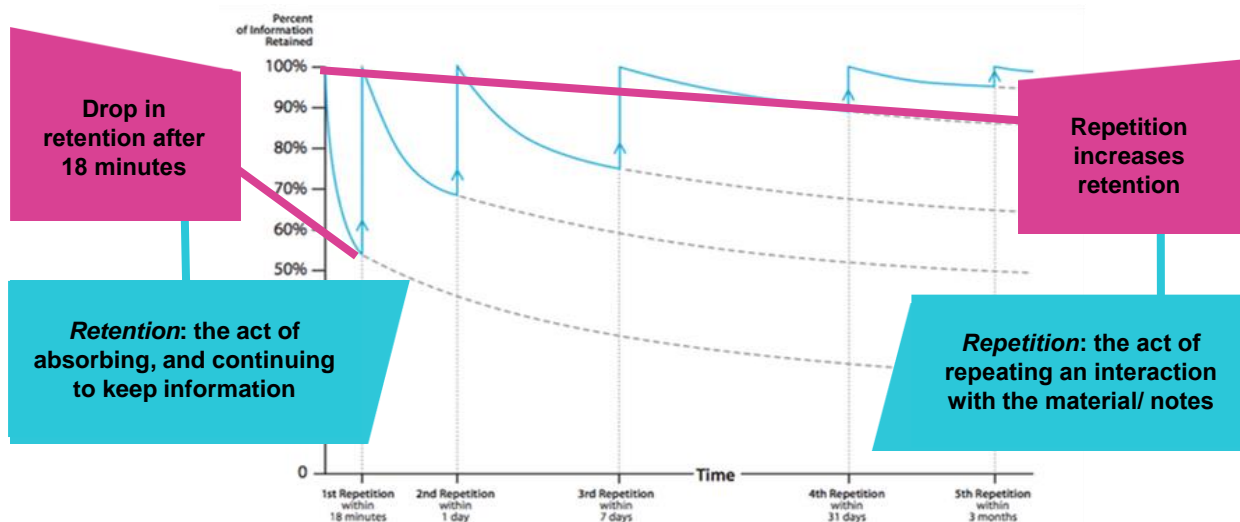
Academic Study Skills

Cornell Notes

Why is good note-taking important?

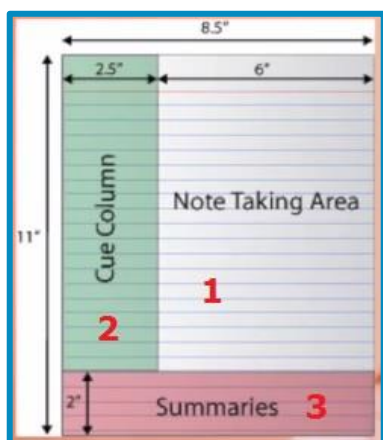
If you forget new information almost as quickly as you hear it, even if you write it down, you tend to lose nearly 40% of new information within 24 hours of first reading or hearing it.

However, if we take notes effectively, we can retain and retrieve almost 100% of the information we receive. Consider this graph on the rate of forgetting with study/ repetition:



Learning a new system

The Cornell Note System was developed in the 1950s at the University of Cornell in the USA. The system includes interacting with your notes and is suitable for all subjects. There are three steps to the Cornell Note System.



Step 1: Note-Taking

- 1. Create Format:** Notes are set up in the Cornell Way. This means creating three boxes like the ones on the left. You should put your name, date, and topic at the top of the page.
- 2. Write and Organise:** You then take your notes in the 'note taking' area on the right side of the page. It would be best if you organised these notes by keeping a line or a space between 'chunks'/ main ideas of information. You can also use bullet points for lists of information to help organise your notes.

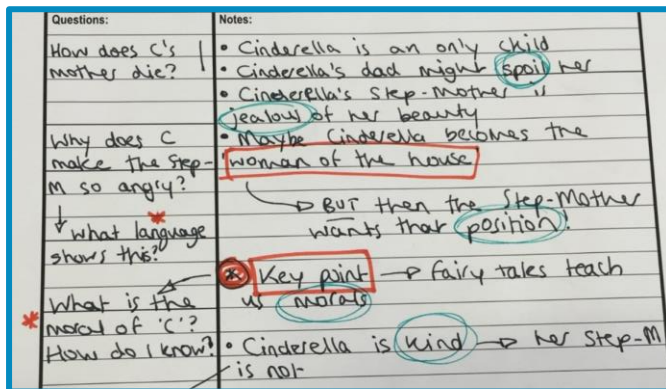
Academic Study Skills

Cornell Notes

Step 2: Note-Making

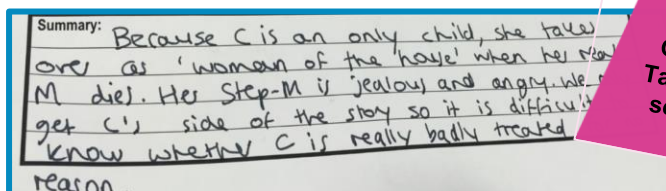
- 1. Revise and Edit Notes:** Go back to box 1, the note-taking area and spend some time revising and editing. You can do this by highlighting 'chunks' of information with a number or a colour; circling all keywords in a different colour; highlighting main ideas; adding new information in another colour.
- 2. Note Key Idea:** Go to box two on the left-hand side of the page and develop some questions about the main ideas in your notes. The questions should be 'high level'. This means they should encourage you to think deeper about the ideas. Example 'high level' questions would be:
 - Which is the most important/ significant reason for...
 - To what extent...
 - How does the (data/ text/ ideas) support the viewpoint?
 - How do we know that...

Here is an example of steps 1 and 2 for notes on the story of Cinderella



Step 3: Note-Interacting

- 1. Summary:** Go to box three at the bottom of the page, summarise the main ideas in box one, and answer the essential questions in box 2.



Give the Cornell Note-Taking System a try and see if it works for you!

Academic Study Skills

Key Words

Below is a series of key terms you will come across from teachers and tutors as you go through school, especially as you enter upper secondary.

Knowing these will help you understand what you are being asked to do!

- **Analyse:** When you analyse something, consider it carefully and in detail to understand and explain it. To analyse, identify the main parts or ideas of a subject and examine or interpret the connections between them.
- **Comment on:** When you comment on a subject or the ideas in a subject, you say something that gives your opinion or an explanation.
- **Compare:** To compare things means to point out their differences or similarities. A comparison essay would involve examining the qualities/ characteristics of a subject and emphasising the similarities and differences.
- **Contrast:** When you contrast two subjects, you show how they differ when compared with each other. A contrast essay should emphasise striking differences between two elements.
- **Compare and contrast:** To write a compare and contrast essay, you would examine the similarities and differences between two subjects.
- **Criticise:** When you criticise, you make judgments about a subject after thinking about it carefully and deeply. Express your judgement concerning the correctness or merit of the factors under consideration. Give the results of your analysis and discuss the limitations and contributions of the factors in question. Support your judgement with evidence.
- **Define:** When you define something, you show, describe, or state clearly what it is and what it is like; you can also say its limits. Do not include details but do include what distinguishes it from the other related things, sometimes by giving examples.
- **Describe:** To describe in an essay requires you to give a detailed account of a subject's characteristics, properties or qualities.
- **Discuss:** To discuss in an essay, consider your subject from different points of view. Examine, analyse and present considerations for and against the problem or statement.

Academic Study Skills

Key Words

- **Evaluate:** When you evaluate in an essay, decide on your subject's significance, value, or quality after carefully studying its good and bad features. Similar to assess. Use authoritative (e.g. from established authors or theorists in the field) and, to some extent, personal appraisal of both contributions and limitations of the subject.
- **Illustrate:** If asked to illustrate in an essay, explain the points that you are making clearly by using examples, diagrams, statistics, etc.
- **Interpret:** In an essay that requires you to interpret, you should translate, solve, give examples, or comment upon the subject and evaluate it in terms of your judgement or reaction. Explain what your subject means. Similar to explain.
- **Justify:** When asked to justify a statement in an essay, you should provide the reasons and grounds for the conclusions you draw from the statement. Present your evidence in a form that will convince your reader.
- **Outline:** Outlining requires that you explain ideas, plans, or theories in a general way, without giving all the details. Organise and systematically describe the main points or general principles. Use essential supplementary material, but omit minor details.
- **Prove:** When proving a statement, experiment or theory in an essay, you must confirm or verify it. You must evaluate the material and present experimental evidence and/ or logical argument.
- **Relate:** To relate two things, you should state or claim the connection or link between them. Show the relationship by emphasising these connections and associations.
- **Review:** When you review, critically examine, analyse and comment on the major points of a subject in an organised manner.

Write any other keywords you come across below. Ask your teacher to explain their meaning or use a dictionary to find out.

Academic Study Skills

Academic Writing Style

What is academic writing?

'Academic writing' is a specific way of writing when communicating research or discussing a point of view. You will most often do this in essays and reports.

Academic writing has a logical structure and uses formal language. Unlike creative or narrative writing, academic writing uses different sources of information to support what is being said (see next page about various sources).

Top Academic Writing Tips

Do's

- Do use words you know the meaning of and are confident using.
- Remember, words don't have to be complicated to be clear!
- Do write words out fully, e.g., do not, cannot, does not, it would.
- Use the third person point of view
- Minimise the use of informal adjectives, such as cool, amazing and wonderful.

Don'ts

- Do not use contractions, e.g., don't, can't, doesn't, it'd.
- Do not use public speaking phrases like "We can all agree that..." and "As I previously mentioned...".
- Do not use conversational phrases, such as 'literally' or 'basically' too often.
- Do not use slang or jargon, for example, 'awks', 'lit', 'woke'.
- Do not use words that express value judgements, e.g., crazy, ridiculous, terrible. Suitable synonyms are surprising, unjustified or distressing.



Academic Study Skills

Academic Writing Style

Expressing your opinion in academic writing

In academic writing, it is best practice to express an opinion without writing in the first person.

Rather than saying, 'In my opinion, this proves that you can express your opinion by saying:

- 'Based on (insert fact/ theory/ finding) it shows that....';
- 'The graph here indicates that...';
- 'The aforementioned problems in Smith's argument reveal that...';
- 'Such weaknesses ultimately mean that...'; and so on.

Signposting

Signposting guides your reader through different sections of your writing. It lets those who read your writing know what is being discussed and why and when your piece is shifting from one part to another. This is crucial for clear communication with your audience.

Signposting stems for a paragraph which expands upon a previous idea	Signposting stems for a paragraph which offers a contrasting view
Building on from the idea that ... (mention the previous idea), this section illustrates that ... (introduce your new idea).	However, another angle on this debate suggests that ... (introduce your contrasting idea)
To further understand the role of ...(your topic or your previous idea), this section explores the idea that ... (introduce your new idea)	In contrast to evidence which presents the view that ... (mention your previous idea), an alternative perspective illustrates that ...
Another line of thought on ... (your topic or your previous idea) demonstrates that ...	However, not all research shows that ... (mention your previous idea). Some evidence agrees that ...

Academic Study Skills

Referencing

What is a reference or referencing?

A reference is just a note in your assignment that tells your reader where particular ideas, information or opinions that you have used from another source have come from. It can be done through 'citations' or a 'bibliography'.

You must include references in your writing assignments when you get to university. As well as being academic good practice, referencing is very important because it will help you to avoid plagiarism.

Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. You must be careful to reference your sources correctly.

Why should I reference?

Referencing is essential in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps prevent you from losing marks or failing due to plagiarism.

When should I use a reference?

- You should use a reference when you:
- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.



Academic Study Skills

Referencing

How do I reference?

There are several different ways of referencing, but most universities use the Harvard Referencing Style. Please speak with your teacher about which style they want you to use because the most important thing is that you remain consistent!

The two main aspects of referencing you need to be aware of are:

1. In-text citations

These are used when directly quoting a source. They are in the body of the work after you have referred to your source in your writing. They contain the surname of the source's author and the year it was published in brackets.

- E.g. *Daisy describes her hopes for her infant daughter, stating, "I hope she'll be a fool—that's the best thing a girl can be in this world, a beautiful little fool."* (Fitzgerald, 2004).

2. Bibliography

This is a list of all the sources you have referenced in your assignment. In the bibliography, you list your references by the numbers you have used and include as much information as possible about the reference. The list below gives what should be included for different sources.

- **Websites:** Author (if possible), *title of the web page*, 'Available at:' website address, [Accessed: date you accessed it].
 - E.g. 'How did so many soldiers survive the trenches?', Available at: <http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr> [Accessed: 11 July 2019].
- **Books:** Author surname, author first initial, (year published), *title of book*, publisher
 - E.g. Dubner S. and Levitt, S., (2007) *Freakonomics: A Rogue Economist Explores the Hidden Side of Everything*, Penguin Books
- **Articles:** Author, '*title of the article*', where the article comes from (newspaper, journal, etc.), date of the article.
 - E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', The Guardian Newspaper, 10 July 2014.

Academic Study Skills

Referencing

Is it a source worth citing? Use these tips to question your sources before referencing them.

- **Currency – the timelines of the information:** When was it published or posted? Has it been revised or updated? Does your topic require current information, or will older sources also work?
- **Relevancy – the importance of the information for your needs:** Does the information relate to your topic or answer your question? Have you looked at a variety of sources? Who is the intended audience?
- **Authority - the source of the information:** Who is the author/ publisher/ source/ sponsor? What are the author's credentials? Is the author qualified to write on the topic?
- **Accuracy – the reliability and correctness of the source:** Does evidence support the information? Has the information been reviewed or refereed? Can you verify whether it is a personal or professional source? Are there errors?
- **Purpose – the reason the information exists:** Does the author clarify the intentions/ purpose? Is the information fact opinion or propaganda? Are there biases? Does the viewpoint appear objective?



Academic Study Skills

Evaluating Your Sources

What is a source?

When you learn new things, you might get information from different places. These places are called sources. Some sources are more reliable than others. For example, information in a textbook written by an expert is more reliable than the information in a non-expert's social media post.

How do you decide which source to use? From newspaper articles to books to tweets, this provides a brief description of each source type and breaks down the factors to consider when selecting a source.

Twitter



A platform for millions of concise messages on a variety of topics.

Blog



Blogs (e.g. WordPress) are an avenue for sharing both developed and unpublished ideas and interests with a niche community.

Youtube



A collection of millions of educational, inspirational, eye-opening and entertaining videos.

Newspaper



A reporting and recording of cultural and political happenings that keeps the general public informed. Opinions and public commentaries can also be included.

Journal



A collection of analytics reports that outline the objectives, background, methods, results and limitations of new research written for and by scholars in a niche field.

Academic book



The information presented is supported by clearly identified sources. Sometimes each chapter has a different author.

Encyclopaedia



Books or online – giving information on many different subjects. Some are intended as an entry point into research; some provide detailed information and onwards references.

Popular magazine



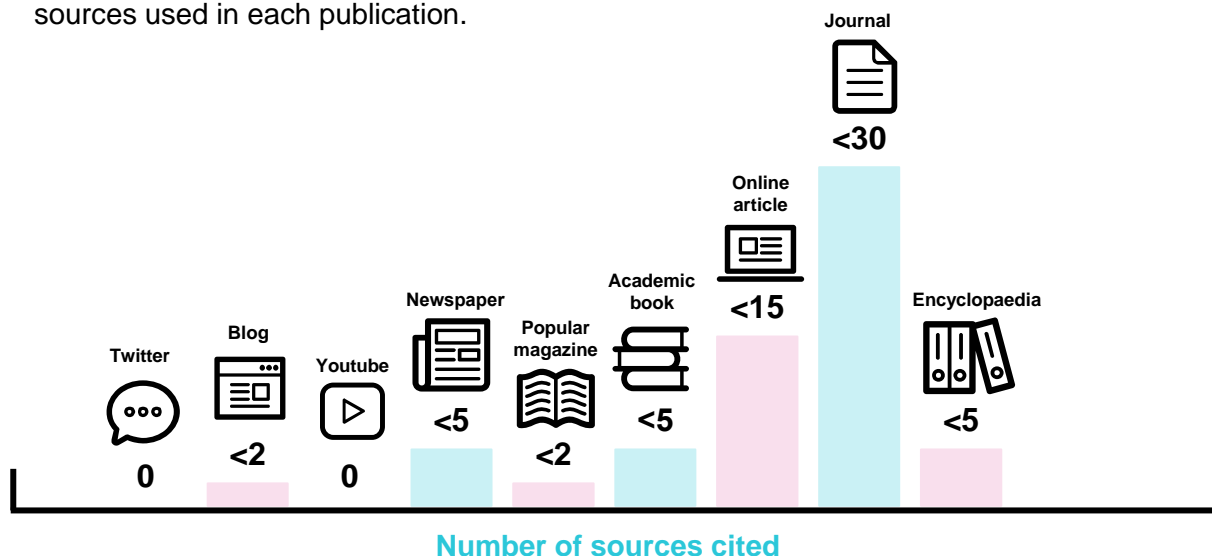
A glossy compilation of stories with unique themes intended for specific interests.

Academic Study Skills

Evaluating Your Sources

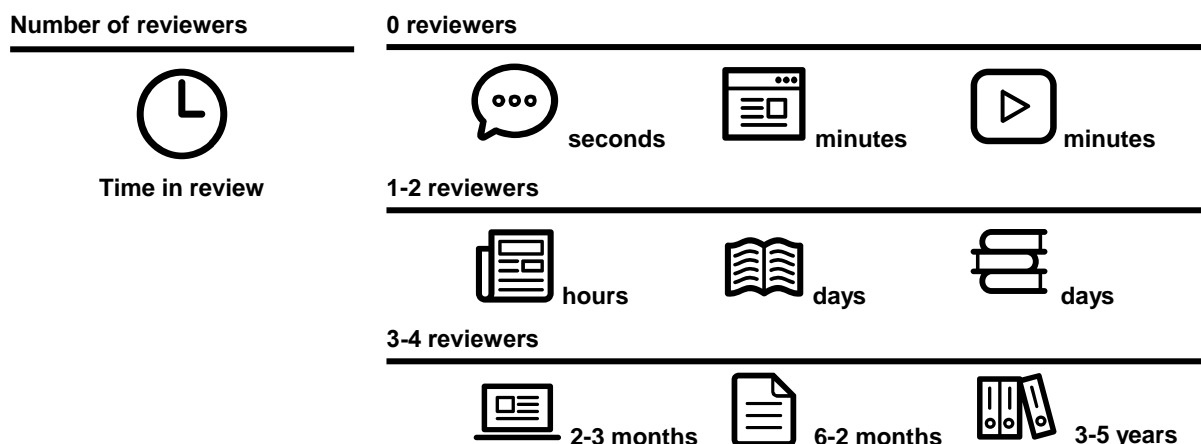
Number of outside sources

When an author used many outside sources in their writing, they demonstrate familiarity with ideas beyond their own. As more unique viewpoints are pulled into a source, it becomes more comprehensive and reliable. This shows the typical number of outside sources used in each publication.



Degree of review before a source is published

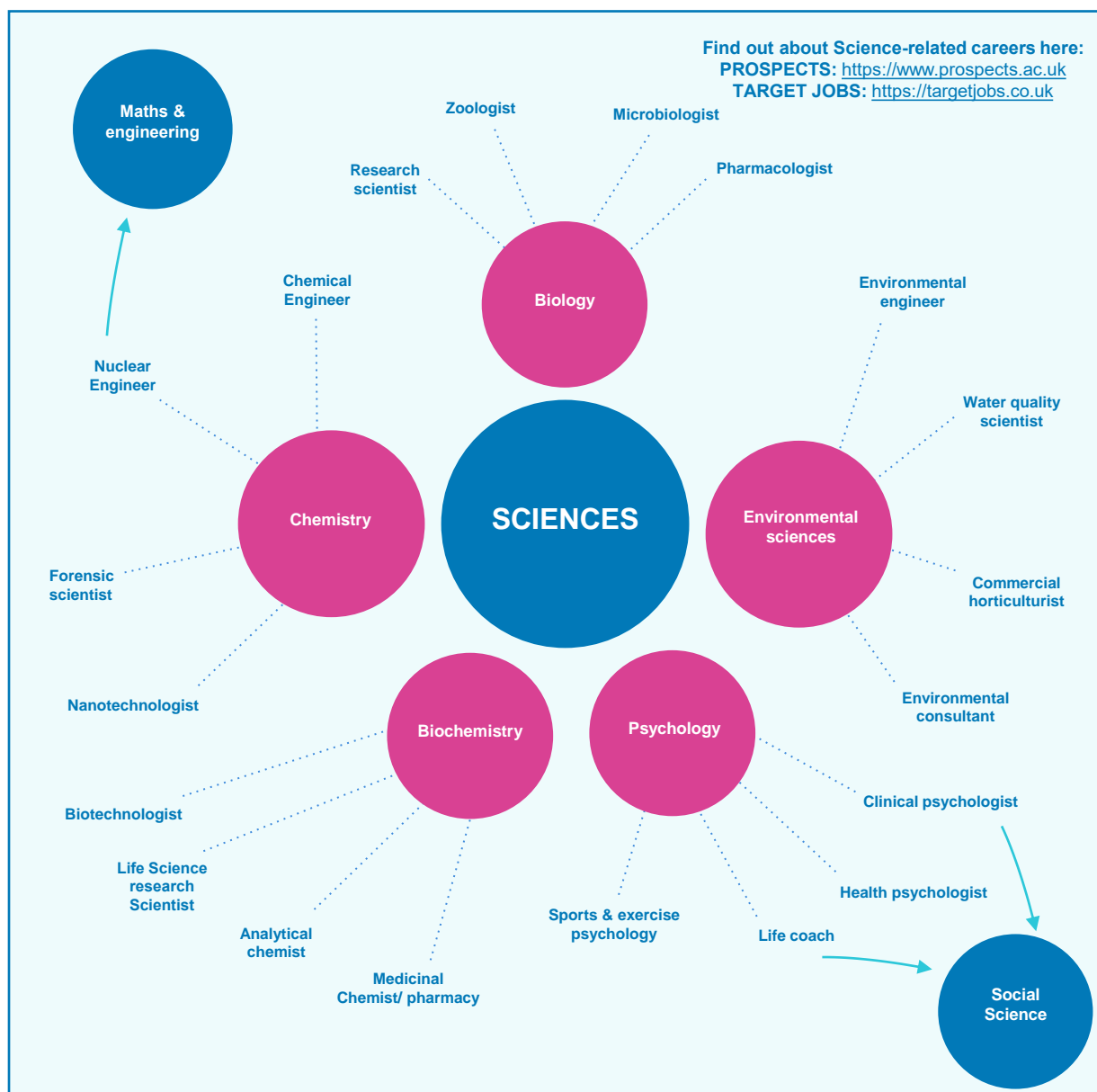
Two factors contribute to the amount of inspection a source receives before it might be published: the number of reviewers fact-checking the written ideas and the total time spent by reviewers as they fact-check. The more people involved in the review process and the longer the review process takes, the more credible the source is likely to be.



What's next?

Sciences subject maps & jobs

A degree in Sciences gives Students access to many career choices. Students who study sciences go on to pursue their Master's degree in Science. However, a significant portion of them also start looking for jobs in the fields of Cancer Research, Stem Cell technology and other positions in this space.



What's next?

University Guidance

Different people go to university for different reasons. You might have a particular job in mind or want to study a subject you are passionate about.

Whatever your motivations, going to university can help improve your career prospects and develop your confidence, independence and academic skills.

Choosing a course and university

Choosing the right course to study is important, so research the options available to you. Here are some top tips:

- You don't have to choose a course you have already studied; many courses don't require prior knowledge of the subject. You can apply skills gained from school studies to a new field.
- The same subject can be taught differently depending on your chosen course and university. Search university websites to learn more about the course content, teaching styles and assessment types.
- When choosing a university, think about what other factors are important to you. Do you want to study at a campus university or be based in a city center? What accommodation options are there? Does the university have facilities for any extracurricular activities you're involved in?
- To research your options, look at university prospectuses and websites and see if there are opportunities to speak to current students who can give you a real insight into what life is like there.



What's next?

University Guidance

Exploring careers and subject options

- Find job descriptions, salaries and hours, routes into different careers, and more at <https://www.startprofile.com/>
- Research career and study choices, and see videos of those who have pursued various routes at <http://www.careerpilot.org.uk/>
- See videos about what it's like to work in different jobs and for different organisations at <https://www.careersbox.co.uk/>
- Find out what different degrees could lead to, how to choose the right course for you, and how to apply for courses and student finance at <https://www.prospects.ac.uk/>
- Explore job descriptions and career options, and contact careers advisers at <https://nationalcareersservice.direct.gov.uk/>
- Discover which subjects and qualifications (not just A levels) lead to different degrees and what careers these degrees can lead to at <http://www.russellgroup.ac.uk/media/5457/informed-choices-2016.pdf>

Other useful resources

- <https://www.ucas.com/>
- <https://www.whatuni.com/>
- <https://www.opendays.com/>
- <https://www.thecompleteuniversityguide.co.uk/>



You may or may not have thought about studying at university.

Don't worry – you have plenty of time to think about this and explore your options if you would like to go!

What's next?

University Guidance

UCAS and the university application process

All applications for UK degree programmes are made through **UCAS**. There is lots of information on the UCAS website to guide you through the process and what you need to do at each stage.

Apply

- Applications **open in September** the year before you plan to start university.
- You can apply for up to **five courses**.
- The deadline for most courses is **25 January**.
- The University of Reading's UCAS code is **R12**. It does not have a UCAS campus code.

Decisions

- Some courses may require an interview, portfolio or admissions test in addition to a UCAS application. Check individual university website details.
- Check UCAS Track which will be updated with decisions from the universities you have applied for, and to see your deadline for replying to any offers.
- You should choose a firm (or first) choice university and an insurance choice. If you already have your exam results or a university thinks your application is particularly strong, you might receive an **unconditional offer**.

Results

- If you're holding a conditional offer, then you will need to wait until you receive your exam results to have your place confirmed.
- Clearing & Adjustment allows you to apply to courses which still have vacancies if you didn't meet the conditions of your offer, have changed your mind about what or where you want to study, or have met and exceeded the conditions of your offer and would like to look at alternate options.

Personal statements

An important part of your application is the personal statement. The personal statement allows you to tell universities why they should offer you a place.

Here are a few top tips for making your personal statement stand out:

- You can only submit one personal statement, so it's important that you are consistent in your course choices. Make sure you have done your research to show your understanding of the subject area and your passion for it.

What's next?

University Guidance

Personal Statement (cont.)

- Start by brainstorming all your skills, experience and attributes. Once you have everything written down, you can begin to be selective – you only have 47 lines so won't be able to include everything.
- The ABC method: action, benefit and course can be a useful way to help demonstrate your relevant experience and how it applies to the course you're applying for.

Personal Statement do's and don'ts

Read the tips below from real life professors and admissions staff in university Science departments, on the 'do's' and 'don'ts' of what to include in your personal statement.

Science

- Tell us why you want to study Science.
- What area of Science fascinates you?
- Demonstrate your interest by telling us what you have recently read, watched or listened to and how they helped your understanding of Science.
- Describe how your school or individual work has equipped you with the necessary knowledge and ability to be a successful Science student.

Other useful resources

- An easy template to start practising your personal statement:
<https://www.ucas.com/sites/default/files/ucas-personal-statement-worksheet.pdf>
- Untangle UCAS terminology at <https://www.ucas.com/corporate/about-us/who-we-are/ucas-terms-explained>
- Discover more about the application process including when to apply and how to fill in your application on the [UCAS website](#).
- Read more useful advice about what to include in your personal statement on [UCAS, the Complete University Guide](#) and [The UniGuide](#).
- Attend one of the University of Reading's [virtual sessions](#) to find out more about applying and personal statements.

Insight into the University of Reading

University of Reading



University of
Reading

The author of this coursebook attends the University of Reading.

The University of Reading offers a variety of programmes for Key Stage 3 pupils.
For more information about the below programmes [click here](#).

Widening Participation for Under 16s

Find Your Future: Our Find Your Future days are on campus events that feature a diverse range of university subject activities focused around a particular theme or topic for the day.

Schools Conferences: Support your pupils through significant transitions in their school life and give them the skills to unlock their future with our multi-school conferences for years 8, 9 and 11.

Assemblies: We are available to come into your school and give University information talks to entire year groups or more. Our talks are about 20 minutes long and are perfect for assemblies.

Subject Taster Sessions: We offer various subject tasters focused on engaging and introducing your pupils to university subjects and learning styles.

Ignite: Our Ignite programme provided sustained, focused support for a cohort of students from widening participation backgrounds, from year 7 through their school career.

Activities for Looked After Children: We offer on-campus events and bespoke campus visits for Virtual Schools during half terms and term time.



www.access-ed.ngo/coursebooks-partner/university-of-readings



www.access-ed.ngo



[@_AccessEd](https://twitter.com/_AccessEd)



hello@access-ed.ngo



**Kemp House, 160 City Road
London, EC1V 2NX**



**AccessEd is a charity registered in
England and Wales (#1186355)**