BBC TERRIFIC SCIENTIFIC

SEND Teacher Resource

Grow

Does temperature and light level affect growth rate?

Terrific Scientific Campaign

Investigation Grow

Hello! Welcome to the Grow Investigation from the Terrific Scientific campaign!

At BBC Terrific Scientific we're passionate about helping to develop science learning in Primary Schools across the UK. By taking part in this activity, you will be developing your class's scientific thinking and investigative skills. This resource has been specially adapted for use with children with special needs who are working towards KS2.

At Key Stage 2 (Second Level), **children need to:**

- **Develop** investigative skills.
- **Understand** when it is important to control variables.
- **Predict, observe and record** results.
- **Draw conclusions** (which may generate new questions).
- **Understand** the need to repeat activities.
- **Take** accurate measurements using standard units, using a range of equipment, including thermometers and data loggers.
- **Record** what they see and not what they want to see.

We have incorporated these principles into this exciting activity. We've made it suitable for primary classrooms by using readily available equipment and suggesting opportunities for support and differentiation.

The BBC deems this activity safe if following some basic precautions. It is your responsibility as a school to carry out your own risk assessment and we recommend you consider the risks and mitigations we have described in this activity pack, as well as any risks which may be relevant to your specific class environment.

As well as these key working scientifically principles, we have made sure there are links to the science curriculum for each nation, as well as cross-curricular opportunities for further learning. We think these are just as important, as they help to explain the relevance of science and how it links to the world around us.

On our website you will find a supporting 'How to' film which shows teachers and teaching assistants how to set up and carry out the experiment. You will also find additional resources including a step-by-step lesson presentation, and also an introductory film which sets the investigation into context for your students.

We originally partnered with the University of Warwick for this investigation.

We hope this inspires you and your students to get scientific!

The Terrific Scientific Team.

Related links:

Find out more about Terrific Scientific and our other investigations on – bbc.co.uk/terrificscientific

Supported by: The University of Warwick, The Primary Science Quality Mark and The Royal Society of Biology

Contents

Through these activities children will:

- **Take** accurate measurements of plants.
- **Calculate** the average temperature/plant growth over a period of time.
- **Look for** patterns in their data.
- **Understand** that environmental conditions affect plant growth.

What will the children learn? (Northern Ireland, Wales, Scotland, England)

Northern Ireland

Investigating similarities and differences, patterns and change p85.
Interdependence: Plants and plant growth P90.

Wales

Skills – Developing

Make careful observations and accurate measurements, using digital and ICT equipment at times P13b2.
Make comparisons and identify and describe trends or patterns in data and information P13b4.

Skills – Reflecting

Deciding whether the approach/method was successful P13b2.

Range – Interdependence of organisms

The environmental factors that affect what grows [and lives in those two environments], e.g. sunlight, water availability, temperature P12.

Scotland

Science Experiences and Outcomes

Develop the skills of scientific enquiry and investigation using practical techniques P1.
Develop skills in the accurate use of scientific language, formulae and equations P1.

Planet Earth - Biodiversity and interdependence

I can help to design experiments to find out what plants need in order to grow and develop. I can observe and record my findings and from what I have learned I can grow healthy plants in school. SCN 1-03a.
Through carrying out practical activities and investigations, I can show how plants have benefited society. SCN 2-02b.

England

Working Scientifically:

Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat reading where appropriate P177.
Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs P177.
Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanation of and degree of trust in results P177.

Year 3
Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant.

Notes and guidance (non-statutory)

Year 4
Pupils should use the local environment throughout the year to raise and answer questions that help them to identify and study plants and animals in their habitat.

Year 5
They might try to grow new plants from different parts of the parent plant, for example, seeds, stem and root cuttings, tubers, bulbs.

Health & safety

The preparation for this activity will take place in the classroom. However, the children will grow their spring onions outside. As with all outside activities, teachers should carry out a risk assessment of their school grounds prior to the lessons and follow usual school guidelines when working outdoors with your children. In addition, please consider the following advice below.

- Check whether any children have an allergy to onions. They may still be able to participate in the activity if they are provided with gloves.
- Children should wash their hands after the investigation.
- Children should take care when using scissors.
- Monitor elastic bands and cling film near children who like to put things in their mouths.
- Monitor the floor for spilled water and other slip/trip hazards.

Important!

Check whether any children have an allergy to onions.

Investigating Growth

Introduction

Plants are all around us and they're great! They provide habitats for animals to live in and they produce the oxygen that we need to breathe. Plants also help shape the environment; their roots break up rocks, creating soil and mud. Their roots also trap soil, stopping it from being washed away by water, which is important to stop rivers and sand dunes eroding.

Plants are useful for humans, as we use them in lots of ways. We make materials out of them, like cotton for clothing, wood for building things, or paper for writing on. We can use them as a source of fuel to cook with or to keep warm. We can even use plants to make ourselves feel better - Aloe vera, which makes sunburn sting a little less, comes from the sap of the Aloe plant. Plants are also a really important source of food for everyone on the Earth, from cereals and rice, to fruits and vegetables.

Sometimes it's easy to forget that plants are alive just like us. They need air, light, nutrients and the correct temperature to be healthy – but have you ever wondered **how plants grow and what might affect them? Do they grow at the same rate, day and night? What are the best conditions to grow plants in and do different plants need different conditions?**

The scientists at the University of Warwick are curious about plant growth. They want to know how different environmental conditions affect growth. Normally, when plant scientists (sometimes called botanists) conduct research into plants, they make a model of the environment the plant usually grows in. To do this they use a growth chamber to grow the plants in. In the growth chamber, they can control all of the variables, such as temperature and light. This means they can change the variable they want to investigate and be sure that it is the one influencing growth. However, these growth chambers don't necessarily reflect the conditions that plants experience outside. Temperature can fluctuate a lot throughout the day; if a day is 20°C on average, it might be because it was 20°C all day or because it was very cold in the morning and very hot at night, with an average temperature of 20°C .

Scientists need to collect data from plants growing in lots of different conditions around the UK to see how well it matches their models. This can help them understand how good their models are or if they need improving. It means growing lots of plants outside in all sorts of conditions.

When this investigation originally ran in 2018 classes around the UK were asked by the scientists at the University of Warwick to grow spring onions outside for two weeks, in small growth chambers in their school grounds, and to measure the growth of the spring onion and the temperature outside. They used the data collected to see if they could discover which conditions are best for growing spring onions. The scientists are also combined the data with extra data they collected about the weather conditions and day length in the UK, to see how these affected the growth of spring onions in normal outside conditions. They wanted to know if the variation in conditions across the day was important or whether it was just the average temperature and light conditions that matter, e.g. **do spring onions grow best on a day with a fairly constant temperature, or a warm one with a cold start?** This investigation allowed the scientists to build up a larger picture about plant growth and how plants respond to their environments around the UK.

Scientists could help farmers and plant growers have a deeper understanding of the best conditions for plant growth. This research is important as climate change is making weather patterns more variable. This is having a substantial effect on crop yields, as plants are failing to grow, or ripening too quickly, which affects how much can be harvested and the quality of the crop. The farmers will be able to better predict the best time to sow or harvest crops, which in turn could raise yields, make the farm more efficient, and keep food on our tables. This research could be especially usefully in developing countries which have more extreme weather conditions than the UK.

Teacher preparation

Resources (per pupil)

- 1 clear, plastic tumbler (250-270ml available from supermarkets). Ideally biodegradable, compost-able or recyclable.
- Pupil recording sheet
- String
- Scissors
- Cling film
- Elastic band
- Access to tap water
- Syringe or small measuring cylinder
- Pipette for fine adjustment of water levels
- Spring onions, ideally with roots of at least 1.5cm (make sure you have spares)
- Permanent maker pen
- Ruler
- Tray to work on and/or towels for mopping up spills

Watch the film:

Watch the 'How-to' film on the Terrific Scientific website which will help you and your students conduct this investigation. bbc.co.uk/programmes/p060gqcb

Resources (per class)

- Directional compasses (optional)
- Thermometer or a data logger with a thermometer connection. Or access to a smartphone weather application or a website showing the local temperature
- Trays to carry the cups around on
- Sticky tack to stick the cups to the tray and the onion to the side of the cup if needed

Prior preparation

This experiment runs for two weeks, with children collecting information every school day. There is an option to just collect data each Friday. The initial set-up works best when working in small groups (3-4) with a member of staff. It takes about 20 minutes for each group each day.

1 Purchasing the spring onions

Select packs of spring onions from one supermarket that have the same sell-by date. Ideally, children will be working in groups of 2 to 4, so you will need one spring onion per group, plus one or two spare in case of any errors when preparing. Ensure the spring onions have roots of at least 1.5cm attached. Store the spring onions in a fridge until use, starting the investigation as soon as possible after purchase. Make a note of the supermarket, country of origin of the spring onions and the sell-by date.

2 Selecting a place for the spring onions within the school grounds

Identify a sunny spot against a wall where the tray of spring onions can be left and not disturbed or damaged by children playing nearby.

Note:

Don't forget to download and print the Student Worksheets.

Pre-activity discussion

Ask the children: **have you ever wondered how plants grow? Do they grow continuously at a constant rate or do they have 'growth spurts'? Do they grow faster during the day or the night? Do they grow more quickly if it has just rained? What do you think?**

The growth rate of plants varies from plant to plant. Some plants grow really slowly. The saguaro cactus is a very slow-growing plant. It only grows about 2.5cm each year. A very slow-growing tree is the white cedar tree. One of these trees growing on a cliffside in the Canadian Great Lakes area has grown less than 10.2cm in 155 years. However, some plants grow very fast. The world record for the fastest growing plant belongs to a type of bamboo, which has been found to grow up to 91cm per day. Ask the children to consider: **why don't all plants grow at the same rate?**

Tip:

Encourage the children to make a reasoned prediction.

After everyone has completed this investigation, your class will be able to look at the interactive map on the Terrific Scientific website and find out how the rate of spring onion growth is affected by temperature in other schools across the UK. Encourage the children to make a reasoned prediction. **Do you think your average temperature will be higher or lower than other areas of the UK? Why? How do you think that will affect the growth of your spring onions?**

Main activity

Setting up the growth chamber

Watch the film:

Watch the intro film on the Terrific Scientific website featuring Hacker T. Dog investigating plant growth.
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Watch the film:

Watch the ‘How-to’ film on the Terrific Scientific website which will help you and your students conduct this investigation.
bbc.co.uk/programmes/p060gqcb

Duration: One hour to set up, then approx fifteen minutes per day to measure for two school weeks. One hour to calculate and analyse the data which can be done during a maths lesson.

1. Work in small groups of 3-4 children with a member of staff.

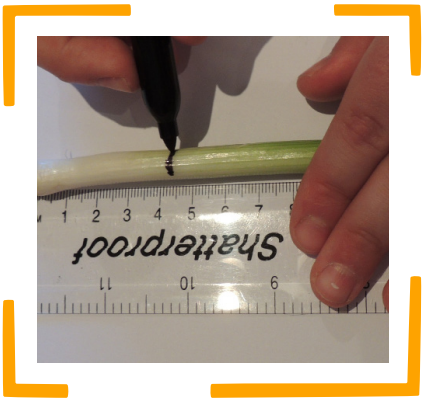
2. Give each group a cup and ask them to name their onion and write it on their cup around the top using a permanent marker pen. Some children may find it difficult to write on a bendy cup, if this happens, stack a few cups inside it to give a firmer surface.

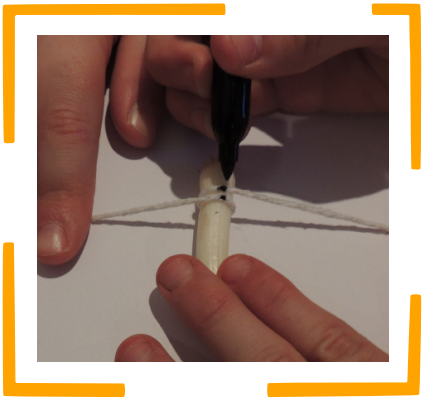
3. Carry out this step in a tray. Show the children how to use a syringe or a measuring cylinder to measure out exactly 30ml of water. They may find a pipette is useful to help them get the exact amount. Encourage them to practice this before adding 30ml of water to their cup. Remind the children that it is important that they are precise with all their measurements.

4. Hold the cup steady on the table and ask the children to mark the level of the water on the outside of the cup, again with the permanent marker pen. Assistance may be needed to get this in the right place, as can be seen in the photograph

5. Move the cups to a safe position until they are needed again.

6. Show the children how to place the spring onion against the ruler with the point where the roots join the stem next to 0cm. Measure 45mm (not including the roots) of the spring onion and mark it with the pen. Cut on this line. Turn the spring onion around and measure and mark 15mm along the roots. Children should then trim the roots so they are no more than 15mm long.





Note:

You may wish to use a visualiser for steps 4 and 5, to make this easier for the children to see.

7. Assist the children to wrap a short piece of string around the widest part of the spring onion bulb, like a belt. Mark the overlap point with a pen. Now unwrap the string and lay it alongside a ruler to measure he circumference (in mm) of the spring onion bulb at its widest point. Help children to record this on the sheet, along with the date.

8. Show the children how to stand the trimmed spring onion in the water roots down, leaning it against the side of the cup as shown in the diagram. Cover the cup with cling film and secure this in place with an elastic band. If the onion keeps falling over, you can secure it to the side of the cup using a piece of sticky tack or tape above the water line. When doing this. Take care not to squash the spring onion. Ask the children what their growth chamber reminds them of. You might need pictures of a greenhouse as a prompt. It is a bit like a mini greenhouse, it will help the plants to grow by trapping some warmth from the sun and protecting them from the wind.

9. Now ask children to wash their hands.

10. Ask the children to secure the pots containing the spring onions to the upturned tray with sticky tack.

11. Take the children outside to where the spring onions will be left in a sunny spot against a wall. Ask the children to stand with their backs to the wall and using the compass to identify, which way they are facing (if a compass is not available most smartphones have a compass function). Ask them to record this on their sheet when they are back in the classroom.

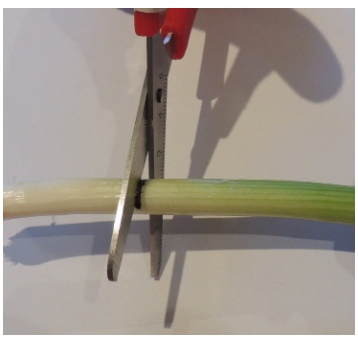
Tip: Using sticky tack to attach the cups to an upturned tray will prevent them from being blown over and also allows them to be brought into the classroom easily for the daily measuring.

Remember:

Don't forget to download and print off the Pupil Recording sheets! Give one to each group.

Tip:

Attaching the cups to an upturned tray using sticky tack will prevent them from being blown over and also allows them to be brought into the classroom easily for the daily measuring.



Taking the daily measurements

This experiment requires the taking of daily measurements. If your pupils find this frustrating, please just take spring onion measurements on each Friday. The weather data should still be collected every day.

It is important to be precise, so all measurements must be taken to the nearest mm.

1. Show the children how to take their daily measurement by carefully removing the spring onion from the cup and laying it down on the table next to a ruler, straightening the spring onion out if it is bent. Some children will need assistance. If it is not possible to straighten the spring onion, a piece of string can be used. Use the string to go along the onion and mark the string to the correct length of the onion, then measure the gap between the dots on the string. **Measure to the longest point of the spring onion, not including the roots**

2. Record this on the sheet along with the time this measurement is taken. If possible, try and measure the spring onions at the same time each day.

3. Ask the children to top the water up so that it is level with the original mark, pipettes are very helpful for this task. Return the spring onion to the cup and secure the cling film back in place.

4. When all the children have completed their measurements, replace the spring onions back outside in the same position.

5. Recording the weather. Ask the children to record the outside temperature using a thermometer. Ideally, this measurement should be taken at the same time each day, preferably at lunchtime. Ask them to record this on their Pupil Recording Sheet (per group) when they are back in the classroom. If you don't have access to a thermometer you can use a smartphone weather application or a weather website to check the local temperature.

Please note the investigation takes place over an eleven (school) day period. For example if you start your investigation on a Monday, the final day will be fifteen days later on a Monday.

Day	Maximum length	Time	Temperature
Day 1	4.5cm		
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			
Day 8			
Day 9			
Day10			
Day 11			

The final day

1. Take the daily measurements as usual.
2. Fill in and complete the above table.
3. You could take a photograph of the spring onions lying flat on a sheet of white paper as evidence of your scientific investigation.
4. Discuss the results as a class.

Ask:

Ask the children to consider how they can present the two sets of data that they collected in order to explore this pattern.

Review

Ask the children to calculate how much their spring onion grew each day.

- Was this consistent over the two-week period?
- Did it grow faster on some days than others?
- Was this the same with other people's spring onions?
- Is there a pattern between the amount of growth and the temperature either on that day or the previous day?

Ask the children to consider how they can present the two sets of data that they collected in order to explore this pattern. They may wish to use a spreadsheet package to try out different styles of graph and identify the most appropriate. A scatter graph is the most appropriate type of presentation. On the scatter graph, children should use the x-axis for the average daily temperature and the y-axis for spring onion size.

Creative conclusions

Related links:

Visit the map page via this link: bbc.co.uk/terrificscientific/map

Visit the map page via the link in the 'Related links' section. See how your data compares to other schools around the UK. Remember to click on the Grow tab.
Gather several results from schools across the UK. Plot them on a scatter graph.

Is there a correlation between temperature and how much spring onions grow? How do they grow best? Why not write a script for an item on *Gardeners World* about growing the best spring onions?

After this investigation is complete, you may want to further investigate other factors that could affect spring onion growth, for example: light/shade, the amount of water used, or whether flat/sparkling water/rain/tap water is used.

Ask:

How is spring onion growth affected by light/shade, the amount of water used, or whether flat/sparkling water/rain/tap water is used?

You could also investigate **the conditions in which spring onion seeds germinate best and whether these are the same conditions a more mature spring onion plant needs to grow.** The children could then use this information to design a seed packet with instructions for gardeners.

Glossary

Plant	A plant is a living thing that uses energy from the sun to make its own food. To do this, plants use a green pigment called chlorophyll to absorb energy from sunlight. Plants are found almost everywhere on Earth. There are around 400,000 known species of plants in the world.
Growth	To grow, plants need the right combination of sunlight, nutrients, warmth and water. Plants begin their lives as a seed, which in turn germinates and grows into a mature plant.
Germinate	Germination is the process where a seed begins to grow into a plant. When the conditions are right, a seed will germinate, sending out its first root and first shoot. Not all seeds require the same conditions for germination. The conditions for germination vary from species to species of plant.
Pollination	This is the process where pollen is transferred from one flower to another. Plants can be pollinated by wind or by insects; some plants can also pollinate themselves. Once a plant has been pollinated, the egg cells (ovules) within the ovary will be fertilised and these will eventually become seeds.
Fertilisation	The process of fertilisation occurs when the pollen reaches the carpel of the new flower. Pollen then travels to the ovary where it fertilises the egg cells (ovules) to make seeds.
Seed dispersal	Seed dispersal is the process where seeds are scattered away from the parent plant. It is important that plants scatter their seeds as widely as possible. If the new plants grow too near to the parent plant, they will be too close and compete for space to grow, light, water and nutrients. Seeds can be spread through various forms of seed dispersal: wind, air, water, exploding seedpods or through animal dispersal.