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Easy-PEAsy seed germination

Many land-based plants reproduce using seeds. Seeds are embryonic plants that are formed after sexual reproduction. The embryo is enclosed in a protective outer coating with a food store. Without leaves to carry out photosynthesis, the seed needs another source of energy to germinate. The food store provides the energy required to form a root and a stem, even in the absence of light. The seedlings that start poking their way out of the soil are the result of this germination process. Some seeds have survived thousands of years, lying dormant underground before germinating.

Suitable for Key Stage:

1 **2** 3 4 5

CLEAPSS

Safety checked but not trialled by CLEAPSS

20 YEARS OF PIONEERING GREAT BRITISH BIOSCIENCE
BBSRC 1994 - 2014

Key Information

Teacher

Contents

View online

Scan the QR Code.

Science topics

Green plants, Reproduction, Germination.

Resources

Age

7–11 years old

Duration

30 minutes set up
20 minutes to gather results

- Student worksheets
- Practical Activities
- Crossword
- Wordsearch
- PowerPoint presentation

Key Information

Teacher

Keywords

Germination, reproduction, seed, pea, embryo, growth, seedling, root, shoot, stem, light, water, moisture, temperature, fresh, frozen, soil, leaves.

Learning outcomes

Students will be able to:

- State that the life processes common to plants include growth, nutrition and reproduction
- Identify and describe the functions of roots, stems and leaves
- Describe the process of germination
- Investigate the effects of light, water and temperature on germination and plant growth

Prior learning

Students should recognise that plants need light and water to grow. They should be able to recognise and name the leaf, flower, stem and root of flowering plants, and explain that seeds grow into flowering plants.

What you will need

- Petri dishes (6 per pair of students)
- Fresh peas (6 per pair of students)
- Frozen peas (3 per pair of students)
- Kitchen paper (or circular petri dish filter papers)
- Sticky labels (3 per pair of students)
- Plastic graduated pipettes
- Rulers
- String

Key Information

Teacher

Teacher preparation

Easy-PEAsy seed germination is a practical investigation, suitable for Key Stage 1 or 2 (7–11 year olds). The objective of the lessons is to determine which conditions are necessary for pea seed germination. Choose a suitable place to carry out the experiment where the seeds will not be disturbed and prepare the materials the students will need. The students will label the Petri dishes according to the amount of water and the peas to be added: 1) no water 2) 2ml water 3) 8ml water a) fresh peas b) frozen peas i.e. 1a, 1b, 2a, 2b, 3a and 3b.

The students will take approximately 30 minutes to prepare and set up the experiment and 20 minutes to measure the seedlings, record the results and discuss the findings.

There are practical instructions for the students and worksheets to assess learning which should be printed out before the class. The lesson could be enhanced by having pea plants available for students to identify the parts of the plant.

Health and safety

Instruct the children not to taste or eat the peas and ensure they wash their hands after handling the peas or seedlings.

The frozen pea seeds will not germinate (see **Expected results**) but they may start to decompose. Tape up the Petri dishes containing frozen pea seeds and allow the students to observe the seeds without re-opening these Petri dishes. Once the experiment is over, double-bag the Petri dishes and pea seeds before disposing of them safely in household waste. For further details on safe working with plants in the primary classroom, refer to the Association for Science Education's safety guidelines set out in **Be safe!**

Research Links

Teacher

Plants sense water in soil to grow roots in the right direction
www.bbsrc.ac.uk/news/food-security/2014/140610-pr-plants-sense-water-roots.aspx

Root growth regulation could help boost crop performance
www.bbsrc.ac.uk/news/food-security/2014/140606-pr-root-growth-boost-crop-performance.aspx

Researchers show how plants tell the time [Reference/webpage no longer available – January 2017]

Secret of plant geometry revealed [Reference/webpage no longer available – January 2017]

Plants do sums to get through the night [Reference/webpage no longer available – January 2017]

Cell 'scaffold' is the key to plant growth [Reference/webpage no longer available – January 2017]

Lesson 1 - Introduction and Set Up

Teacher

Start the lesson with a group elicitation to determine the students' knowledge of seeds, plants and their requirements for growth. Ask the students the following questions and encourage them to make predictions. Record their comments on the whiteboard or in a floor book.

Q: Are seeds alive?

Q: Why do plants produce seeds?

Q: Do they know ways in which a plant can survive through the winter?

Q: Do seeds require light to start growing?

Q: Is energy needed for growth?

Q: What is the source of energy for:
(a) a seed to germinate;
(b) a plant to grow;
(c) for children to grow?

Q: Do they eat peas... if so why?

Q: Will frozen peas germinate?

Q: Do seeds grow faster in the warm or in the cold?

Q: Do seeds need moisture to grow?

Let's investigate – planning the activity

Ask the students to think about how they might investigate the effects of **light, temperature** and **moisture** on seed germination. They will need to test each variable separately. Provide the students adequate time to discuss and suggest ideas. Share the procedure with students and ask for their opinion before starting.

Organise the class into four approximately equal groups. Students within a group should work in pairs. Provide each pair of students with an instruction sheet. Each pair within a group will:

1. Collect and set up their equipment
2. Measure growth
3. Enter their data on the **Let's collect the evidence!** sheets

Procedure

Teacher

1. Fold a piece of the kitchen paper in half and then half again and place it into a Petri dish. Repeat this exercise, lining each of your remaining five dishes (Figure 1).

2. Write **1a, your initials** and **'fresh'** on a label and stick it to the underside of a Petri dish. Place **two fresh** peas on the dry kitchen paper and put the Petri dish lid on.

3. Write **1b, your initials** and **'frozen'** on a label and stick it to the underside of a Petri dish. This time add **one frozen** pea to the dish.

4. Collect two more Petri dishes and repeat the same procedure for writing the labels. This time label them **2a** and **2b**. Add **fresh** peas to dish **2a** and a **frozen** pea to dish **2b.**

5. Measure **2ml** of water using the graduated pipette and slowly squeeze this onto the kitchen paper of dish **2a** and put the lid on. Repeat this exercise with dish **2b.**

6. Collect two more Petri dishes and repeat the same procedure for writing the labels. This time label them **3a** and **3b.** Add **fresh** peas to dish **3a** and a **frozen** pea to dish **3b.**

7. Measure **8ml** of water using the graduated pipette and slowly squeeze this onto the kitchen paper of dish **3a** and put the lid on. Repeat this exercise with dish **3b.**

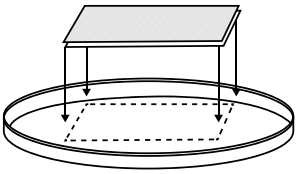


Figure 1.

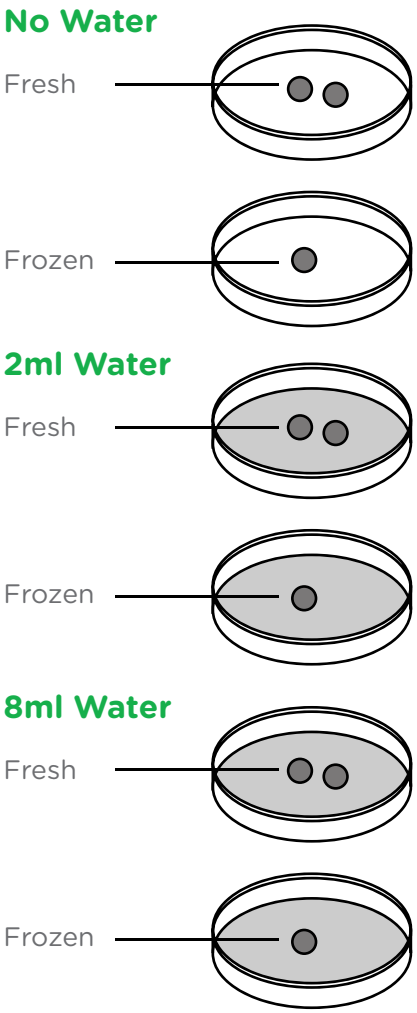


Figure 2.

Four Different Groups - Four Different Tests

Teacher

Each group of students should expose their peas to different conditions as outlined below:

Group 1: clear container allowing light to reach the pea seeds in a **cool** environment (e.g. outside the building or in an unheated room with a window).
Group 2: clear container, in a **warm** environment (e.g. in the classroom).
Group 3: dark container blocking light from the pea seeds (e.g. a storage box), in a **cool** environment.
Group 4: dark container, in a **warm** environment.

The Petri dishes of groups 1 and 3 should be placed in the **same cool area** while the dishes of groups 2 and 4 should be placed in the **same warm area** to ensure that the test is 'fair'.

After setting up the experiment ask the students to make predictions about the outcome.

Lesson 2 - Results and Analysis

Teacher

Measuring growth

After five to seven days, each pair should measure the length of their pea seedlings (distance from shoot tip to the root tip). This can be done by marking the distances on a short length of string, then measuring the string with a ruler (Figure 3). The data should be entered onto their **Let's collect the evidence!** sheet.

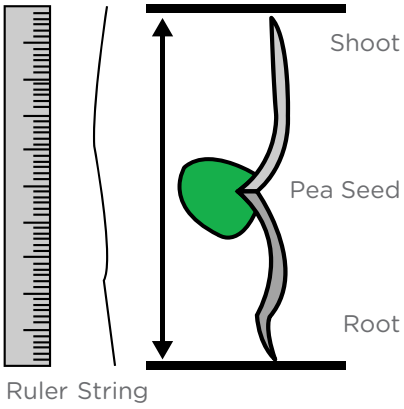


Figure 3.

Data analysis

Just how much analysis of the data the students can cope with will depend on their age. For the youngest, the average (or typical) results of all four groups should be written on the board, so that they can see if their predictions were correct (they may need reminding exactly what they predicted). Older students can perhaps derive their own group averages. They will also need to see the overall results. They might then plot a bar graph of growth versus moisture just for one set of conditions.

Expected results

Dishes 1a and 1b – no water

No growth from any of the pea seeds.

Dishes 2a and 2b – 2ml water

Group 1 (light and cool)	**Little or no growth** from the fresh pea seeds; **no growth** from the frozen pea seed.
Group 2 (light and warm)	**Some growth** from the fresh pea seeds; **no growth** from the frozen pea seed.
Group 3 (dark and cool)	**Little or no growth** from the fresh pea seeds; **no growth** from the frozen pea seed.
Group 4 (dark and warm)	**Some growth** from the fresh pea seeds; **no growth** from the frozen pea seed.

Dishes 3a and 3b – 8ml water

Group 1 (light and cool)	**Some growth** from the fresh pea seeds; **no growth** from the frozen pea seed.
Group 2 (light and warm)	**Good growth** from the fresh pea seeds; **no growth** from the frozen pea seed.
Group 3 (dark and cool)	**Some growth** from any of the pea seeds.
Group 4 (dark and warm)	**Good growth** from the fresh pea seeds; **no growth** from the frozen pea seed.

Lesson 2 - Results and Analysis

Teacher

Explanation

The frozen peas: blanching and freezing processes have destroyed the seed's enzymes. Enzymes are the biological catalysts – they help speed up reactions and are vital for seed germination and growth. **The fresh peas:** these will show the strongest growth when they are placed in 'optimum' growing conditions. Peas, like all seeds, require **warmth** and adequate **moisture** to germinate.

The students' results should show that, according to their experiments, the best set of conditions for pea growth were: **warmth** and **8ml of water.**

Light

Most seeds do not need 'instant' access to light, they can germinate and push up through the soil by drawing from their own energy reserves.*

However, once their energy stores are depleted all green plant seedlings need access to **light** so that they can make their own food (through photosynthesis) and continue to grow.

Therefore fresh peas placed in **light**, warm conditions with adequate water should germinate and continue to grow into healthy young plants. Fresh peas placed in **dark**, warm conditions with adequate water should germinate but, after a short period of time, they will display signs of light deficiency including weak growth and pale, sickly looking shoots and leaves.

Unexpected results

Fresh pea seeds in **light, cool** conditions with adequate water may germinate but growth should be much slower than that of seeds in warm conditions. Generally seeds need to be warmed to a certain temperature before their enzymes start to work effectively and germination begins.

***Note: Some seeds require exposure to either light or to dark conditions to 'trigger' germination. The pea seed however will germinate in either light or dark conditions as long as there is adequate warmth and water.**

Lesson 2 - Results and Analysis

Teacher

Extension activities

The experiment could be continued after the five to seven day initial observation period to allow the students to study the effects of light. The seedlings they have germinated could be placed in compost-filled seed trays, pots or similar and grown on with adequate moisture and warmth, under either light or dark conditions. You may like to suggest that each student writes a report on the experiment including: the predictions they tested; the experimental approach they used (including how they ensured a fair test); their results and their conclusions.

Providing a variety of actual plants and asking students to identify the parts of the plant will greatly enrich the lesson and assess the ability of students to apply their knowledge to real-life examples.

A crossword and wordsearch are provided to aid students' literacy and assess their learning. You can provide the students with the answers to the crossword so they can check their own work.

The learning carried out in this lesson can be followed-up further with practical activities investigating seed and plant growth, and photosynthesis using the **Seeds and plant growth discovery pack, Photosynthesis explored** and an online lesson **The plant detective.**

Students can also test their understanding of plant growth with **Extinct – the plant survival game** in which players must devise plant survival strategies for growing and reproducing as the environment changes.

Plenary

Recap the learning outcomes and the brainstorming exercise. Provide time for the students to ask any questions that may have arisen as they set up their experiment or recorded their results.

You may want to introduce the students to some of the latest discoveries scientists are making in plant research to provide a context for their learning. You can read about the latest plant science research by following the **Research links.**

Curriculum Links

Teacher

Key stage 1-2

Plants

Year 1

Pupils should be taught to:

- Identify and describe the basic structure of a variety of common flowering plants, including trees

Year 2

Pupils should be taught to:

- Observe and describe how seeds and bulbs grow into mature plants
- Find out and describe how plants need water, light and a suitable temperature to grow and stay healthy

Year 3

Pupils should be taught to:

- Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
- 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
- Investigate the way in which water is transported within plants
- Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal

Living things and their habitats

Year 5

Pupils should be taught to:

- Describe the life process of reproduction in some plants and animals

Further reading

Be safe! 4th Edn. 2011. Association for Science Education.

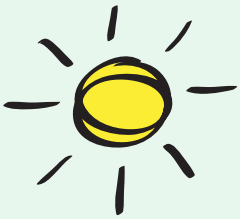
Let's Brainstorm!

Student

1. Are seeds alive?

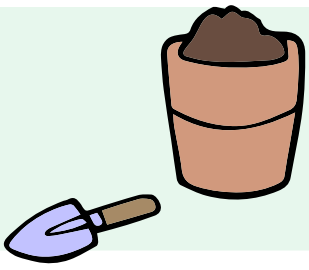
2. Why do plants produce seeds?

3. Do you know ways in which a plant can survive through the winter?



4. Do seeds require light to start growing?

5. Is energy needed for growth?



Let's Brainstorm!

Student

6. What is the source of energy for:

(A) A seed to germinate? _____

(B) A plant to grow? _____

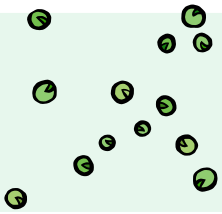
(C) For children to grow? _____

7. Do you eat peas? If so, why?

_____

8. Will frozen peas germinate?

_____

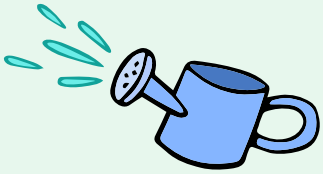


9. Do seeds grow faster in the warm or in the cold?

_____

10. Do seeds need moisture to grow?

_____



Let's Investigate!

Student

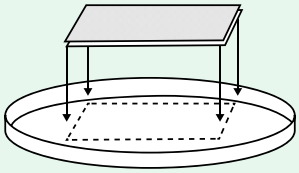
Duration

10 minutes

What you will need

- Six Petri dishes
- Six fresh peas
- Three frozen peas
- Some kitchen paper (or circular Petri dish filter papers)
- Six sticky labels
- A plastic graduated pipette

1. Fold a piece of the kitchen paper in half and then half again. Place it into a Petri dish. Do this again with your five other dishes.



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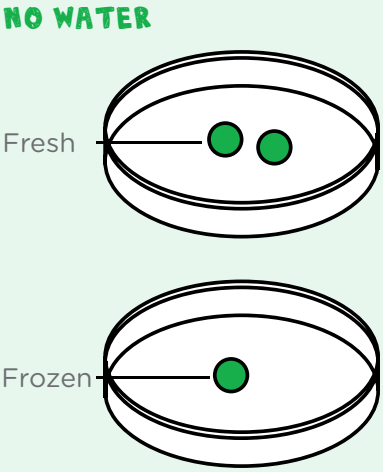

4. Collect two more Petri dishes and repeat the same procedure for writing the labels. This time label them **2a** and **2b.** Add **fresh** peas to dish **2a** and a **frozen** pea to dish **2b.**

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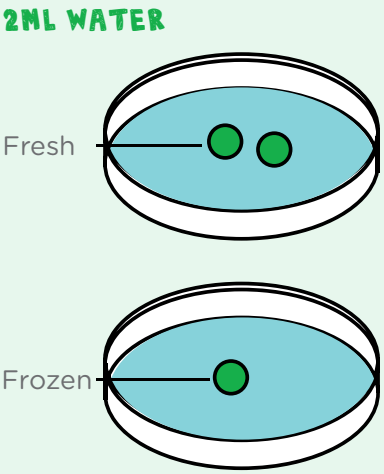

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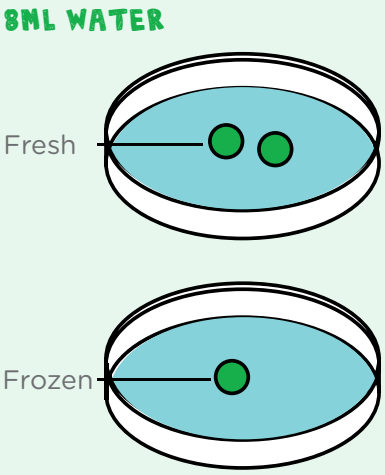


Let's Collect the Evidence!

Student

Names

Group Number

Dark or Light

Cold or Warm

Length of seedling (millimetres)	Pea seed 1	Pea seed 2	Average for seeds 1 and 2	Frozen pea seed
Dishes 1a and 1b (no water)				
Dishes 2a and 2b (2ml water)				
Dishes 3a and 3b (8ml water)				

Wordsearch

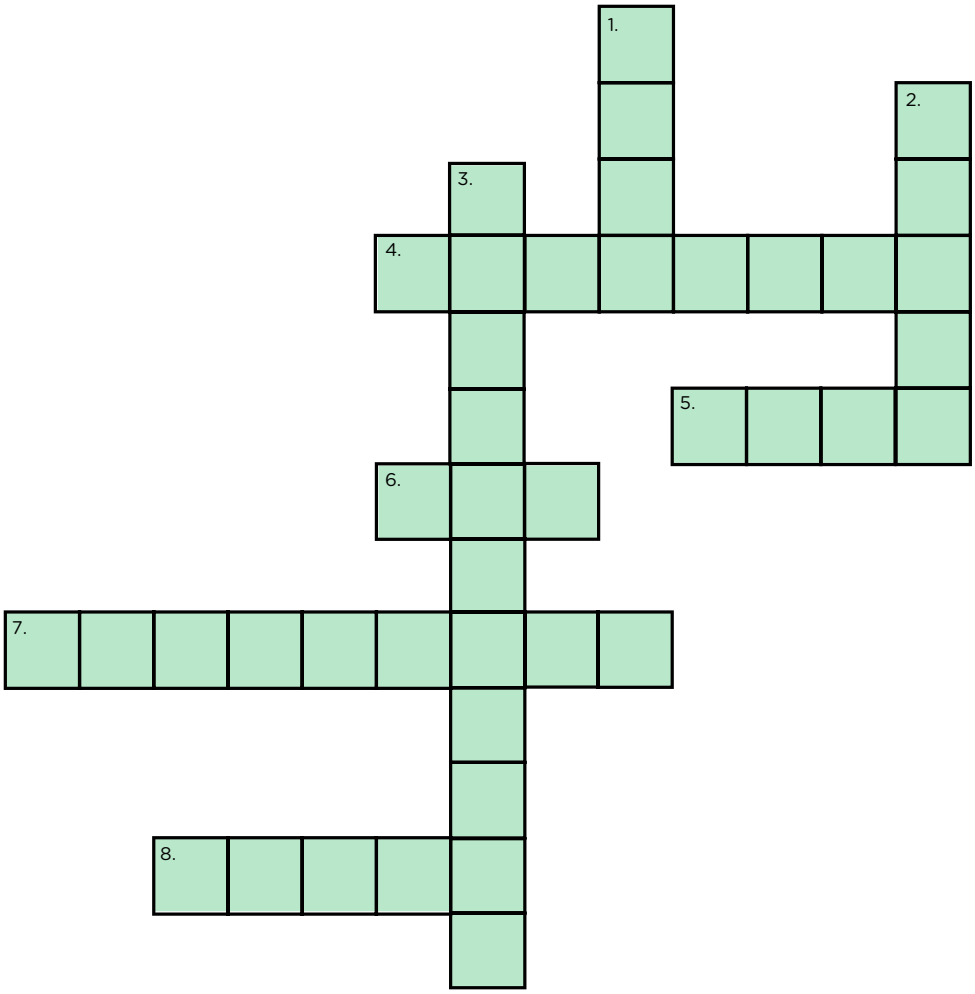
Student

K R Z O T O R O O T Y Q S D
S F C C E M B R Y O E N U P
E H L R D I E E A Q R O X E
E E T A N I M R E G U I U A
D I P G U O A U S M T T M A
L S O I L P L T W N S C I T
I P N O C L M A J Y I U P D
N E L H S Z T R U O O D T F
G M G H N E G E T D M O H A
J E O S R R E P V G T R G E
A O E Z O S X M J E D P I L
T Y K W J T I E M S S E L G
V M T K I E S T Y T L R E L
U H W P A M C B D F X V F S

GERMINATE
GROWTH
LIGHT
REPRODUCTION
SEED
SEEDLING
WATER
SHOOT
PEA
ROOT
MOISTURE
SOIL
EMBRYO
STEM
TEMPERATURE
LEAF

Crossword

Student



DOWN

1. It has a protective outer covering
2. Energy absorbed by leaves
3. In order for a seed to germinate it must be moist and at the right...

ACROSS

4. The name for a recently germinated plant
5. When a seed germinates it produces a shoot and a...
6. A seed that we eat
7. Under the right conditions a seed will do this to grow into a seedling
8. Something a plant takes up from its roots that a seed also needs

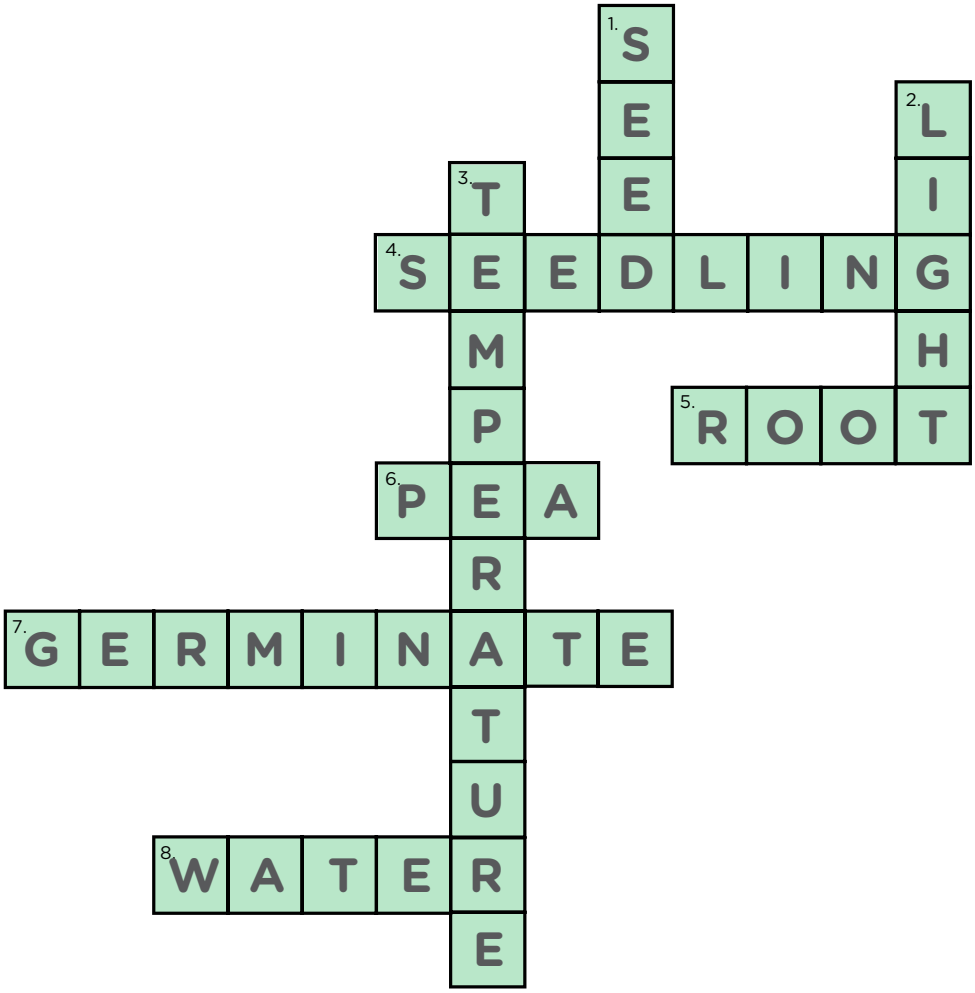
Answers

Teacher

GERMINATE
GROWTH
LIGHT
REPRODUCTION
SEED
SEEDLING
WATER
SHOOT
PEA
ROOT
MOISTURE
SOIL
EMBRYO
STEM
TEMPERATURE
LEAF

Answers

Teacher



Down

1. It has a protective outer covering
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Across

4. The name for a recently germinated plant
5. When a seed germinates it produces a shoot and a...
6. A seed that we eat
7. Under the right conditions a seed will do this to grow into a seedling
8. Something a plant takes up from its roots that a seed also needs

Glossary

Student

Embryo
A young, developing plant, such as the rudimentary plant inside the seed of higher plant forms.

Flower
The sexual reproductive structure of the angiosperms.

Germination
The process by which a dormant seed begins to sprout and grow into a seedling under the right growing conditions.

Leaf
A coloured expansion (usually green) growing from the side of a stem.

Photosynthesis
A process carried out in green plants that uses light energy captured by chlorophyll to convert carbon dioxide and water to carbohydrates and oxygen.

Roots
The water- and mineral-absorbing part of a plant which is usually underground, does not bear leaves, tends to grow downwards and is typically derived from the radicle of the embryo.

Seed
A ripened plant ovule containing an embryo.

Seedling
Any recently sprouted plant.

Shoots
The aerial portions of a plant, including stem, branches, and leaves, and also new immature growth on a plant.

Soil
The top layer of the earth's surface, consisting of rock and mineral particles mixed with organic matter.

Stem
A slender or elongated structure that supports a plant or a plant part or organ above ground level that gives rise to the presence of leaves.

Author: Paul Dyson, Tristan MacLean

Feedback: Please provide us with feedback so we can improve this resource.
Email: external.relations@bbsrc.ac.uk