Easy PEAsy Seed Germination

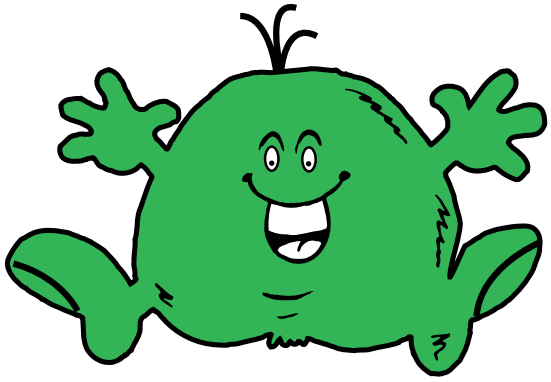
by Dr Paul Dyson
of the University of Wales - Swansea

bbsrc
biotechnology and biological sciences research council

SCIENTISTS IN PRIMARY SCHOOLS

The objective

To determine which conditions are necessary for pea seed germination.



The approach - let's brainstorm!

Ask questions and encourage the children to make predictions.
Record their comments on the white board or in a floor book.

Suggested questions

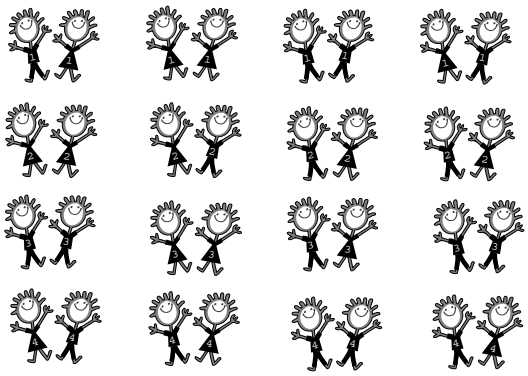
Q: Are seeds alive?
Q: Why do plants produce seeds?
Q: Do they know other ways a plant can survive through the winter?
Q: Do seeds require light to start growing?
Q: Is energy needed for growth?
Q: What is the source of energy for (a) a seed to germinate; (b) a plant to grow; (c) for children to grow? Do they eat peas ... if so why?
Q: Will frozen peas grow?
Q: Do seeds grow faster in the warm or in the cold
Q: Do seeds need moisture to grow?

Let's investigate

Ask the children 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.

Planning the activity

Assuming a class size of 32-40 children, establish four approximately equal groups of 8-10 children. Children within a group should work in pairs.



Each group will test a different set of parameters as outlined below. Each pair within a group will (a) set up their equipment, (b) measure growth and enter their data on the ***Results Sheet*** provided.

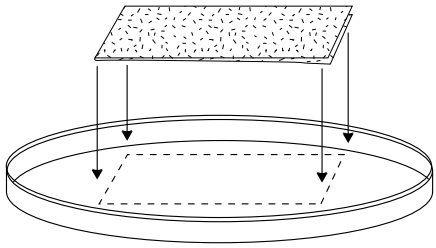
Peas, Petri dishes and preparation

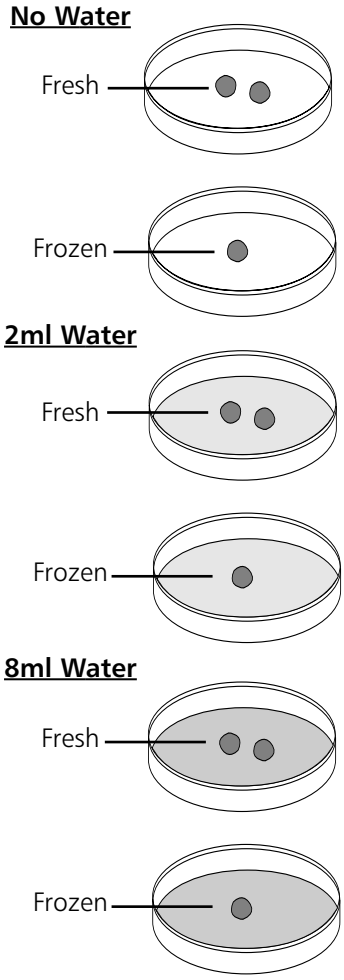
Ask each pair of children to collect:

- six Petri dishes
- some kitchen paper (or circular Petri dish filter papers if available),
- a plastic graduated pipette
- six fresh peas
- three frozen peas
- six sticky labels

Ask each pair to follow the instructions below:

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.





2. Plates 1 a and b. Place two fresh peas on the dry tissue and put the Petri dish lid on.

Write your **group number, your initials and 'plate 1a: fresh'** on a label and stick it to the bottom of the plate taking care not to dislodge or damage the peas.

Repeat this exercise, adding one **frozen** pea to another lined Petri dish and labelling this dish with your **group number, initials and 'plate 1b: frozen'.**

3. Plates 2 a and b. Measure **2ml** of water using the graduated pipette and slowly squeeze this onto the tissue. Add two fresh peas; put the lid on and stick a label on the bottom of the plate with your **group number, initials and 'plate 2: fresh'.** Repeat this exercise, using another Petri dish and one frozen pea and labelling the dish as with your **group number, initials and 'plate 2: frozen.'**

4. Plates 3 a and b. Measure **8ml** water and pipette slowly onto the tissue. Add peas as before; add the Petri dish lid and label with your **group number, initials and 'plate 3 - fresh**. Repeat this exercise, using another Petri dish and one frozen pea and labelling the dish as with your **group number, initials and 'plate 3: frozen.'**

Four different groups; four different tests

Each group of children should expose their Petri dishes to different conditions:

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.

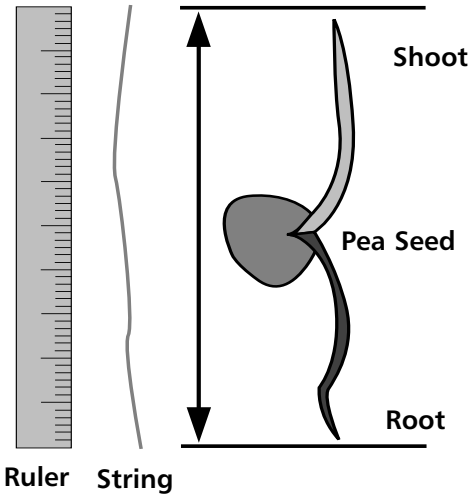
The Petri dishes of groups 1 and 3 should be placed in the **same cool area** while the dishes of groups 2 and 4 should be placed in the **same warm area** to ensure that the test is 'fair'.

Recommendation

The frozen pea seeds will not germinate (see *Expected results*). They may however start to decompose. Seal all the Petri dishes containing frozen pea seeds and allow the children to observe the seeds without re-opening these Petri dishes. Once the experiment is over, dispose of the pea seeds safely following the Association for Science Education's safety guidelines set out in the publication *Be safe!* p21.

Measuring growth

After five to seven days, each pair should measure the length of their pea germlings (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. The data should be entered onto their ***Results Sheet***.



Data Analysis

Just how much analysis of the data the children can cope with will depend on their ages - the class teacher will be the best judge.

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).

Group Number: ..... Dark or Light: ..... Cold or Warm:	Length of germling (millimetres)	Pea seed 1	Pea seed 2	Average for seeds 1 and 2	Frozen pea seed
	Plate 1 (no water)				
	Plate 2 (2ml water)				
	Plate 3 (8ml water)				

Names: .....

Older children 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 'v' moisture just for one set of conditions.

Expected results

Plate 1 - no water
No growth from any of the pea seeds.

Plate 2 - 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** of the two 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.

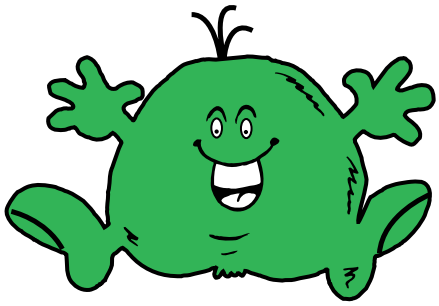
Plate 3 - 8ml water
Group 1 (light and cool) - **some growth** from the fresh pea seeds; **no growth** from the frozen pea seed.
Group 2 (light and warm) - **good growth** of the two fresh pea seeds; **no growth** from the frozen pea seed.
Group 3 (dark and cool) - **some growth** from any of the pea seeds.
Group 4 (dark and warm) - **good growth** from the fresh pea seeds; **no growth** from the frozen pea seed.

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 a vital for seed germination and growth.
The fresh peas: 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 children's results should show that the best set of conditions for pea growth offered through their experiments 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*.
Once their energy stores are depleted however, 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.

Suggestion:
The experiment could be continued after the five to seven day initial observation period to allow the children 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 child writes a report on the experiment: the predictions they tested; the experimental approach they used (including how they ensured a fair test); their results and their conclusions.

Unexpected results:
Fresh peas 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.**