# Doing Darwin's experiments

Survivor seeds
Activity 2b: Digesting seeds
Subject: Science
50 minutes for reading letters and treating seeds
15 minutes for planting seeds and writing labels
+ follow-up monitoring time

## Suggested preparation

Presentation:
Doing Darwin's experiments

## What do I need?

Letter 1681 Charles Darwin to Joseph Hooker
Letter 1762 Edward Blyth to Charles Darwin
Darwin's experiment notebook extract
Letter questions: Digesting seeds
Who's who?
Packet of quickly germinating seeds (eg, spinach, lettuce, pea, capsicum)
4 small pots filled with compost with labels
4 Petri dishes
1 small hammer/ object to crush seeds
Small amount of simulated gastric juices (e.g. white vinegar, lemon juice or, for more accuracy, muriatic acid – NB: highly diluted and handled with care)
Source of heat (e.g. a heat lamp or an incubator)
Digesting seeds recording table

Darwin wanted to find out what conditions seeds could endure and yet still germinate. He wanted to test their 'vitality' (viability). Read about his experiments in his notebook then recreate the different conditions (heat, crushing and digestive juices) that he put seeds through.

## What do I do?

1. Read through the letters and experiment notes and answer the questions.

2. Label each Petri dish with your seed type (e.g. lettuce) and one of each of the four treatments (i.e. control, gastric juices, crushed and heated).

3. Separate the seeds into 4 piles and treat them as follows:

   - Control: place several seeds in the control Petri dish

   – Gastric juices: mix several seeds with gastric juices and place in the' gastric juices' Petri dish

   – Crushed: crush several seeds with the hammer and place in the 'crushed' Petri dish

   – Heated: place several seeds in the 'heated' Petri dish and place under a source of heat

4. Leave the Petri dishes for an agreed amount of time (1-3 days).

5. Remove the seeds from the Petri dishes and plant in moist compost.

6. Label the pots with seed type and treatment.

7. Monitor every day for 1-2 weeks.

8. Record your results and share with the class: which type of seeds germinated best in which conditions?

# Letter 1681, Charles Darwin to J. D. Hooker, 15 May 1855?

15th Down

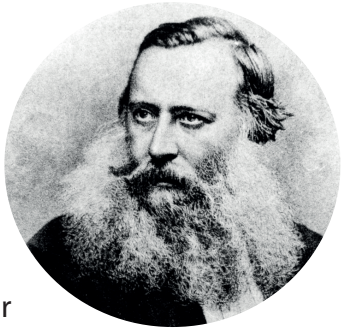
My dear Hooker

… Everything has been going wrong with me lately; the fish at the Zoolog. Soc. ate up lots of soaked seeds, & in imagination they had in my mind been swallowed, fish & all, by a heron, had been carried a hundred miles, been voided on the banks of some other lake & germinated splendidly,—when lo & behold, the fish ejected vehemently, & with disgust equal to my own, all the seeds from their mouths.—

But I am not going to give up the floating yet: in first place I must try fresh seeds, though of course it seems far more probable that they will sink; & secondly as a last resource I must believe in the pod or even whole plant or branch being washed into sea: with floods & slips & earthquakes; this must continually be happening, & if kept wet, I fancy the pods &c &c wd. not open & shed their seeds.—...

Goodbye my dear Hooker
Ever yours
C. Darwin

# Letter 1762: Edward Blyth to Charles Darwin, 1-8 Oct, 1855

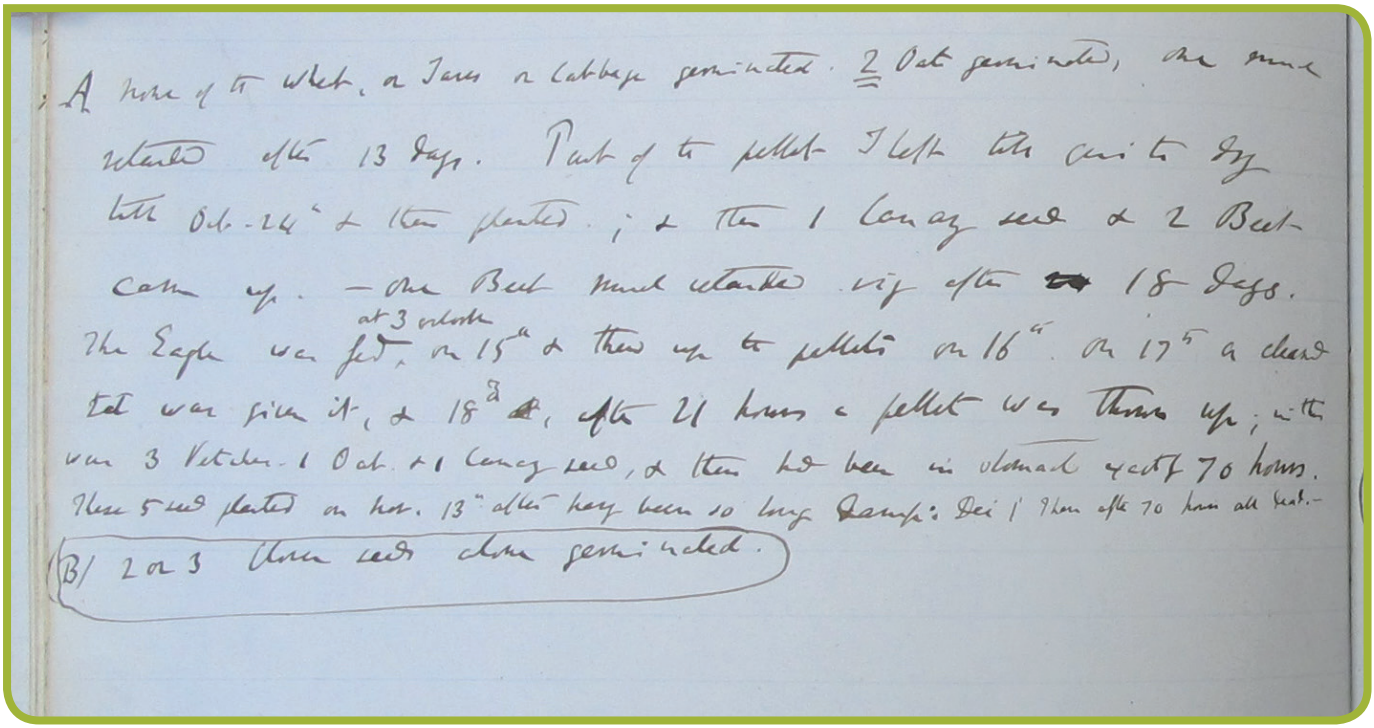


(Notes addressing Darwin's questions about the dispersal and viability of seeds, which were enclosed with a letter.)

…Thrushes eject the seeds of the haw by the mouth, not "in their excrement"; but the farmers in Surrey have another way to accelerate the germination of the haw-seeds, viz. by allowing a mass of berries to ferment, & the heat so generated quickens the vitality of the seed, equally with the heat of the bird's body. I would try the experiment of feeding a Turkey with haws. Here again bear in mind Henslow's experiments, & the results of steeping seeds in hot water.—…

# Extract from Darwin's experiment notebook

Between 1855 and 1868 Darwin kept a notebook of the experiments that he carried out. In these pages Darwin explores how seeds may be dispersed including through the gut of animals inside other animals. (The notebook was amended by Darwin regularly, as shown by the information in brackets.)



Darwin's Experiment Book, CUL DAR 157A

...The Eagle was fed (at 3 oclock) on 15th & threw up the pellets on 16th.

On 17th a cleaned rat was given it, & 18th, after 21 hours a pellet was thrown up; in this was 3 Vetches— 1 Oat & 1 Canary seed, & these had been in stomach exactly 70 hours. These 5 seed planted on Nov. 13th. after having been so long damp: Decr 1st Then after 70 hours all dead.—...

...Oct. 29th I have now seen plenty of Thorn, Yew, (Bryony I am almost sure) Laurel, & 3 other kinds (Raspberry) planted in Birds dung.— some of the seeds were in insectivorous Birds dung.— (I may add Hollies am certain were one).
Nov. 7th. I have now seen 7th, Kind, I think of wild Rose . All during Octr. & Novr.—

## Letter questions:

1. What does Darwin hope and imagine will happen to the seeds swallowed by fish in letter 1681. What is he trying to find out through this process?

2. Describe the stages of natural dispersal and germination when hawthorn berries are eaten by thrushes, as referred to in the notes from Edward Blyth, letter 1762. What other factors can contribute to the dispersal and germination of seeds?

3. What does the extract from Darwin's experiment book show about Darwin's scientific method and ways of working?

# Digesting seeds recording table

| **WEEK 1** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** |
|---|---|---|---|---|---|---|---|---|---|
| Control | | | | | | | | | |
| Gastric juices | | | | | | | | | |
| Crushed | | | | | | | | | |
| Heated | | | | | | | | | |
| **WEEK 2** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** | **dd/mm** |
| Control | | | | | | | | | |
| Gastric juices | | | | | | | | | |
| Crushed | | | | | | | | | |
| Heated | | | | | | | | | |

# Doing Darwin's experiments

## Who's who?

### Edward Blyth

Edward Blyth (1810–73) was a zoologist. He wrote and edited under the pseudonym 'Zoophilus'. He was curator of the museum of the Asiatic Society of Bengal, Calcutta, India (1841–62). Blyth provided Darwin with information on the plants and animals of India.

### Charles Darwin

Charles Darwin (1809-1882) was a naturalist who established natural selection as the mechanism for the process of evolution. He joined the voyage of HMS *Beagle* when he was 22, a journey he described as the 'most fortunate circumstance in my life'. He wrote to around 2000 correspondents all over the world as a means to inform his research. Most famously he published *On the Origin of Species* in 1859, but he researched and wrote extensively on natural history throughout his life.

### Joseph Hooker

Joseph Dalton Hooker (1817–1911) was a botanist who worked chiefly on taxonomy and plant geography. Hooker accompanied James Clark Ross on his Antarctic expedition (1839–43) and later publishing the botanical results of the voyage. He was appointed palaeobotanist to the Geological Survey of Great Britain in 1846. He travelled in the Himalayas (1847–50) and introduced many plants to Britain for the first time. He became Assistant director of the Royal Botanic Gardens, Kew from 1855 to 65 and was made director in 1865. He held the post for 20 years and was knighted in 1877. He was a trusted colleague, close friend and confidant of Charles Darwin for most of his life and exchanged 1,400 letters with him.