Doing Darwin's experiments

Weed garden
Activity 3: Create a weed garden
Subject: Science
30 minutes for tasks 1 and 2
40 minutes to clear and prepare land plots
(Darwin's plot was 90cm x 60cm)
5 minute regular monitoring for 6 months.

Suggested preparation

Presentation:
Doing Darwin's experiments

What do I need?

Letter 2075 Charles Darwin to Joseph Hooker
Letter 2101 Charles Darwin to Joseph Hooker
Extract from Darwin's experiment notebook
Extract from On the Origin of Species
Letters questions
Who's who?
Tools to clear ground (if used)
Or a seed tray with sandy/clay/acid or neutral soil
Labels
Coloured wires
Weed identification chart

Darwin's garden was a site of scientific experiment. He cleared a small patch of ground to watch the progress of emerging weeds over a period of time. He was surprised at how many seedlings came up and was even more surprised at how few survived. Try repeating his observations in a small patch of land in school grounds (or use seed trays filled with different soil types to make additional comparisons).

What do I do?

1. Read through the letters and Darwin's notes and answer the questions.

2. Discuss how the seeds might arrive in your weed garden and what might be the factors influencing their survival.

3. In early spring, prepare the plots of land by clearing any annual or perennial plants. Or put the prepared compost in your seed tray (ensure tray has drainage holes). Place in a sunny position outside.

4. After 2 weeks observe and log any progress.

5. Place a coloured wire in the spot where seedlings emerge.

6. Use the chart to identify as many weeds as possible.

7. Use the table provided to show the number of seedlings, date that they germinated, and the numbers/ percentage survival rate at designated intervals.

8. Check seedlings regularly, removing any wires as a seedling dies.

9. Update the table regularly.

10. Discuss what factors have impacted on the survival of weeds in your garden.

Letter 2075: Charles Darwin to Joseph Hooker, 12 Apr, 1857

Down Bromley Kent
Ap. 12th

My dear Hooker

…I have been interested in my "weed garden" of 3x2 feet square: I mark each seedling as it appears, & I am astonished at number that come up. & still more at number killed by slugs &c.— Already 59 have been so killed; I expected a good many, but I had fancied that this was a less potent check than it seems to be; & I attributed almost exclusively to mere choking the destruction of seedlings.— Grass-seedlings seem to suffer much less than exogens.—…

Letter 2101: Charles Darwin to Joseph Hooker, 3 June, 1857

Down Bromley Kent
June 3d

My dear Hooker

…My observations, though on so infinitely a small scale, on the struggle for existence, begin to make me see a little clearer how the fight goes on: out of 16 kinds of seed sown on my meadow, 15 have germinated, but now they are perishing at such a rate that I doubt whether more than one will flower. Here we have choking, which has taken place likewise on great scale with plant not seedlings in a bit of my lawn allowed to grow up. On other hand in a bit of ground 2x3 feet, I have daily marked each seedling weed as it has appeared during March, April & May, and 357 have come up, & of these 277 have already been killed chiefly by slugs….

'On the Origin of Species'.
Charles Darwin, 1859, pp. 67-8

'With plants there is a vast destruction of seeds, but, from some observations which I have made, I believe that it is the seedlings which suffer most from germinating in ground already thickly stocked with other plants. Seedlings, also, are destroyed in vast numbers by various enemies; for instance, on a piece of ground three feet long and two wide, dug and cleared, and where there could be no choking from other plants, I marked all the seedlings of our native weeds as they came up, and out of the 357 no less than 295 were destroyed, chiefly by slugs and insects.

If turf which has long been mown, and the case would be the same with turf closely browsed by quadrupeds, be let to grow, the more vigorous plants gradually kill the less vigorous, though fully grown, plants: thus out of twenty species growing on a little plot of turf (three feet by four) nine species perished from the other species being allowed to grow up freely.'

Extract from Darwin's Experiment Book

Weed garden

Weed garden – Old shrubbery & then Strawberry neglected Bed. Piece of foul (but not very foul judging from rest) ground in Orchard, which had been (Shrubbery & then for a year or two) strawberry Bed— in size 36 inches by 24 inches.—(protected from large animals)
Dug in January & cleared of all perennials— Early in March seeds began to spring up: marked each daily.

March 31st About 55 marked, of which about 25 Killed already.

April 10th Pulled up 59 wires marking where seedlings before development of two leaves had been devoured, I suppose by slugs, & many drawn out by worms, & apparently some beaten out by heavy rain. All, or nearly all earliest seedlings thus destroyed. I think certainly grass seedlings escape better than others. [No doubt they suffer more by being open & exposed to weather & only few, so better chance of being devoured]

April 20th Pulled up 28 wires, dead. – (I think dry weather is beginning to tell against some)

May 8th Pulled up 95 wires. – (I suspect that some seedlings are Killed by drought.)

June 1st Pulled up 70 wires. – Left still 80 still living of several Kinds most Ranunculus & Grass Spergula – Labiatae Thistle (1 Nettle, some Crucifers (Extremely few have come up during all May)

July 1st 13 of the 80 are now dead, leaving 67 alive a few more & but a few more seedlings have come up now there are 67/357 alive ie not 1/5 alive. Evidently the risk is in early state.

Aug 1 5 more of the 80 now dead – leaving 62 alive 62/372 62/310 – say between 1/5 & 1/6 have survived.

Letter questions:

1. Using the extract from his experiment book, describe Darwin's weed garden experiment.

2. In letters 1201 and 2075 what factors have contributed to the destruction of the seedlings? What additional factors are mentioned in his experiment book?

3. From the letters, what is his reaction to this?

4. In the extract from *On the origin of Species* Darwin says that he calculated that 9 out of 20 plant species did not survive in his plot of land. Why was this?

5. Describe what scientific concept you think that Darwin was testing with his weed garden.

Weed survival recording table

Record	dd/mm	dd/mm	dd/mm	dd/mm	dd/mm	dd/mm	dd/mm	dd/mm	dd/mm
Number of seedlings									
Type of seedlings									
Germination rate									
Survival rate %									

*To calculate the survival rate: (number of seedlings on dd/mm) x 100 / (total number of seedlings first recorded)

Doing Darwin's experiments

Who's who?

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.