
Doing Darwin's experiments



Fly traps and sundews

Activity 1c: What does an insectivorous plant eat?

Subject: Science

30 minutes for task 1, 40 minutes for tasks 2-4, 40 minutes for tasks 6-8 , (plus set-up time and time to monitor progress and outcome over several days)

Suggested preparation

Presentation:

[Doing Darwin's experiments](#)

What do I need?

Letter 8719 Charles Darwin to Mary Treat, 1 Jan 1873

Letter 9485: Mary Treat to Darwin, 28 July, 1873

Extract from Darwin's book 'Insectivorous plants'

Letters questions: Activity 1c

Who's who?

Observations recording table

1 Venus Flytrap (*Dionaea muscipula*) plant per group

Different food types cut into small pieces:

e.g.: ham or other cooked meat, cooked egg white, cheese, polo mint

A pair of tweezers

Dishes for food

American naturalist Mary Treat exchanged several letters with Darwin about the feeding habits of insectivorous plants. Following their observations and experiments you can find out more about nutrient uptake and then compare your findings with Darwin's own.

What do I do?

1. Read through the letters and answer the questions.
2. Observe and make notes on your chart on the state of your plant before experiment, eg. size, position, tilt, colour, health, condition of soil. (Use separate plants for each experiment as it will affect the health of the plant.)
3. Add a sample of selected food to your plant (make the size of the food consistent).
4. Observe how the plant reacts at intervals over a fixed period of time, comparing whether leaves of Venus fly trap close fully or partially, and monitor the health of the plant, recording your findings on your chart.
5. Open the leaves after a fixed time (eg 7 days). Extract the remains of food and observe changes.
6. Record findings on your chart. Compare your findings with the class.
7. Read the extract from Darwin's book, *'Insectivorous Plants'*. Compare your results to Darwin's own findings. Consider why might there be different results and what might be the same?

Letter 8719 Charles Darwin to Mary Treat 1 Jan 1873

Down,
Beckenham, Kent.
Jan 1. 73

Dear Madam,

...Does the *Dionæa* grow in your neighbourhood? If so

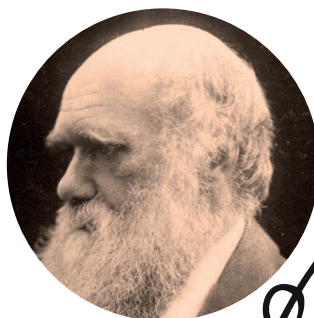
I much wish to learn what sort of insects it commonly catches, more especially whether large or small kinds. I have sometimes suspected that its structure and movements favour the escape of small insects.



Dr. Gray has given a rather free translation of what I said to him

about nerves; and this related only to *Drosera*. I have found that by pricking a particular point in the leaf I can paralyze half of it; but I must make many more trials next summer before coming to any nal conclusion.

With my best thanks
I remain Dear Madam
Yours very faithfully
Charles Darwin



Charles Darwin

Letter 9485 Mary Treat to Charles Darwin, 8 June 1874

June 8, 1874. Vineland, New Jersey

Dear Mr. Darwin,

Some time ago you asked me some questions with regard to *Dionæa*. I was not at that time prepared to answer, but since the latter part of April I have been giving the closest attention to these wonderful plants—now in their best working condition—I am with them during a large part of each day, while the insects are the most active. I have over thirty good, strong, vigorous plants; twenty-five of these I have numbered, and keep a record of the closing of each leaf, and the kind of insect it captures, and the number of days before it uncloses, with many other items. The remainder of the plants I am working with, with a view to see if there is any other point so connected with the bristles on the upper surface of the leaf-trap—the seemingly nervous centre—so that I can make any perceptible effect upon this centre.

One plant has caught two of the sprawling rose-chafers (*Macroductylus subspinosus*). These beetles are quite strong, and one of the fellows escaped from two traps, but was finally captured by a vigorous leaf that closed over him so quickly, there was no space left for his head to get through.

About two weeks ago a leaf captured a homopterous insect (*Metapodius nasalus*), nearly as large as the squash-bug (*Coreus tristis*). When caught it emitted a disagreeable odor, peculiar to this class of insects; and to my surprise the leaf opened yesterday in good condition, and there was nothing left of the insect but the shell....

You asked what kind of insect *Dionæa* commonly caught. It most commonly catches Dipterous flies, frequently much smaller than the house-fly. If a fly is large enough to move a bristle, so as to close the trap, I never saw it escape from a vigorous leaf—one that acts quickly...

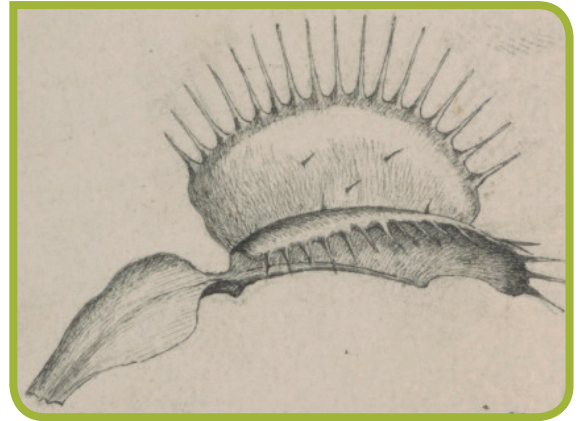
Yours most truly

Mary Treat.



Insectivorous plants, Charles Darwin, 1875, (extracts from pp. 302–303)

Chapter 13: *Dionaea muscipula*



Experiment 2.—A bit of albumen $\frac{1}{10}$ of an inch square, but only $\frac{1}{20}$ in thickness, and a piece of gelatine of the same size as before, were placed on a leaf, which eight days afterwards was cut open. The surface was bathed with slightly adhesive, very acid secretion, and the glands were all in an aggregated condition. Not a vestige of the albumen or gelatine was left. Similarly sized pieces were placed at the same time on wet moss on the same pot, so that they were subjected to nearly similar conditions; after eight days these were brown, decayed, and matted with fibres of mould, but had not disappeared ...

Experiment 7.—A bit of half roasted meat (not measured) and a bit of gelatine were placed on the two ends of a leaf, which opened spontaneously after eleven days; a vestige of the meat was left, and the surface of the leaf was here blackened; the gelatine had all disappeared ...

Experiment 10.—A cube of $\frac{1}{20}$ of an inch of cheese and another of albumen were placed at opposite ends of the same leaf. After nine days the lobes opened spontaneously a little at the end enclosing the cheese, but hardly any or none was dissolved, though it was softened and surrounded by secretion. Two days subsequently the end with the albumen also opened spontaneously (i.e. eleven days after it was put on), a mere trace in a blackened and dry condition being left ...

These experiments are sufficient to show that the secretion from the glands of *Dionaea* dissolves albumen, gelatine, and meat, if too large pieces are not given. Globules of fat and fibro-elastic tissue are not digested. The secretion, with its dissolved matter, if not in excess, is subsequently absorbed. On the other hand, although chemically prepared casein and cheese (as in the case of *Drosera*) excite much acid secretion, owing, I presume, to the absorption of some included albuminous matter, these substances are not digested, and are not appreciably, if at all, reduced in bulk.

Letter questions:

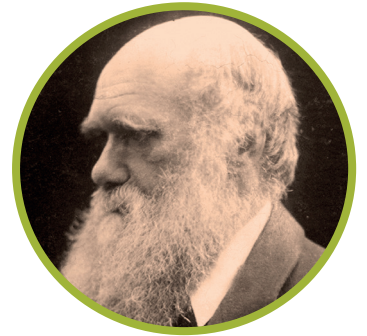
1. What does Darwin ask Mary Treat to observe and why?
2. Describe Treat's observational experiment of *Dionaea* in letter 9485. What is she recording and why?
3. What happened when the leaf captured a homopterous insect and what bearing did it have on the plant? What does this show?

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.



Doing Darwin's experiments: Who's who?

Mary Treat

Mary Lua Adelia Treat (1830-1923) was born in Trumansburg, New York but after marriage moved to Vinelands, New Jersey. Her studies of the natural world gave her respect and reputation during her lifetime. Like Darwin she worked at home, creating what she referred to as her 'Insect Menagerie'; an enclosed space from which she observed the minutiae of the natural world around her. After Treat separated from her husband, Dr Joseph Burrell Treat, in 1874, she supported herself by writing popular science articles for widely read magazines and published 5 books. Treat carried out experiments and collected plants and insects for leading naturalists including Asa Gray and Charles Darwin. Darwin commented: 'Your observations and experiments on the sexes of butterflies are by far the best, as far as is known to me, which have ever been made.' Treat exchanged at least 15 letters with Darwin and he acknowledged her work in his book *'Insectivorous Plants'* (1875).



Image of Mary Treat © Vineland Historical and Antiquarian Society

What does an insectivorous plant eat? Observations and record of digestion process

Date and time	Action taken (e.g. addition of food sample and subsequent observations)	Description of leaves	General health of plant	Additional notes
Day 7 - open up leaves				