**ACTIVITY: Fern propagation**

**Activity idea**

In this activity, students learn how to propagate ferns. All species of fern reproduce by means of spores. Some ferns, like the hen and chickens fern, reproduce asexually by means of bulbils.

By the end of this activity, students should be able to:

* understand that all species of fern reproduce sexually by means of spores
* understand that some ferns also reproduce asexually by means of bulbils
* understand the growing conditions needed for fern reproduction and propagation
* have a clearer understanding of the fern life cycle.

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**Introduction/background**

Unlike most other land plants, ferns do not have flowers, fruit or seeds. Ferns produce spores. These are the reproductive unit of a fern. Spores are neither male nor female. Spores produce the gametophyte generation that, following fertilisation, produces the sporophyte generation. Uniquely amongst land plants, ferns have these 2 separate independent living stages of their reproductive life cycle.

While ferns mostly reproduce sexually through spores, there are some ferns that are also able to reproduce asexually through bulbils.

The [Fern life cycle](https://www.sciencelearn.org.nz/image_maps/57-fern-life-cycle) interactive provides a visual overview of the fern reproductive life cycle. You might like to refer to it in conjunction with the following notes.

***Sexual reproduction***

Ferns reproduce from spores, which are usually found on the underside of the frond. Spores are produced in capsules called sporangia. The sporangia are combined into small clusters called sori. Sori can be oval, round, oblong or elongated and are either marginal (on the edge of the pinna) or dorsal (away from the pinna edge). The shape and position of the sori help botanists identify and classify ferns.

In many ferns, the sporangia are protected by the indusium – a thin, transparent flap. When the spores are mature, the indusium opens to release them. Spores are very light and dust-like and travel away from the plant in the air.

A fern does not grow directly from a spore. A spore germinates when it lands in an area with sufficient moisture and light. Within weeks, a prothallus grows. This is the small, flat, green, heart-shaped structure that contains the male organ (antheridium) and female organ (archegonium). The sperm from the antheridium travels to the egg on a film of water. (This is one of the reasons ferns require damp habitats.) If there are several gametophytes present in one area, the gametophyte that grows the fastest will become female and it will release hormones into its surrounding environment that will cause any gametophytes in the surrounding area to be male. Gametophytes can also inbreed. The sperm from a single gametophyte can fertilise its own eggs. After fertilisation, the fern plant, as we usually recognise it, begins to grow.

***Asexual reproduction***

Some ferns are also able to reproduce asexually by means of bulbils. The bulbils develop along the rachis or frond. Bulbils break off and grow into a new plant or they take root when the frond droops and touches the ground. *Asplenium bulbiferum*, the native hen and chickens fern, is a fern that can reproduce by bulbils. The naturalised Australian fern *Polystichum proliferum (*mother shield fern) and *Polystichum setiferum* (soft shield fern), a European cultivar, are other available garden species that produce bulbils as well as spores.

***Timeframes***

Propagating ferns from spores requires a relatively long period of time. The time taken to germinate a spore depends on the species. *Asplenium* and *Blechnum* are species that we recommend trying in this activity, as they should germinate in 2–3 weeks. Other species may take longer. Once germinated, the time taken to produce a fern of a transplantable size is a few months.

Propagating ferns from bulbils is a quicker and more straightforward process.

***Sterilisation is important***

Due to the length of time and the wet humid environment needed for germination, we recommend that you sterilise the soil and pots as a precaution against mould.

**What you need**

* Copies of student instructions: [How to propagate ferns](#howto)

*Propagation through sexual reproduction:*

* Fertile fern fronds (fronds bearing spores)
* Sheets of white paper
* Sterile potting or seed raising mix (see student instructions for how to sterilise)
* Clean, sterile plastic pots (see student instructions for how to sterilise)
* Sealable plastic bags large enough to hold the plastic pots
* Camera to record the process (optional)

*Propagation through asexual reproduction:*

* Bulbils
* Potting or seed raising mix
* Plastic pots

**What to do**

1. Hand out copies of the student instructions and discuss.
2. Assist groups of students to select the items required and propagate the ferns.

**Discussion questions**

* Why do ferns produce so many spores?
* How can you tell when spores are mature?
* What environmental conditions are needed for spores to reproduce?
* It is tricky to propagate ferns indoors. Why can they do it so successfully in the wild?
* Why do you think that some ferns are able to reproduce asexually?
* What is the advantage to sexual reproduction over asexual reproduction?
* How does fern reproduction differ from seed-bearing plants?

**Extension ideas**

Use a camera to keep a photo diary or use another means of media to make a visual record of the propagation process.

Explore regeneration projects in your local area or even your own school. Are there specific fern species you can target? Are there areas you can place the ferns once they are at the planting out stage?

***Vegetative propagation***

Bulbils are only one type of vegetative propagation. Your students may wish to try other ways of growing ferns. Some ferns form large clumps that can be pulled apart to form new plants. (Māori propagated ferns in this manner and planted them around the country in order to establish food banks.) Propagate ferns with creeping rhizomes by dividing the rhizome. Each division must have at least one adult leaf. Place the rhizome horizontally in soil to encourage root growth. Maintain a warm, humid environment until the rhizome has established roots and can be planted out.

Investigate (or establish) a ponga fence. Ponga logs planted upright and watered thoroughly every few days will establish roots and produce fronds within a few months.

**How to propagate ferns**

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| ***Sexual reproduction***1. Gather fern fronds that are producing spores. Various species produce spores at different times of the year. Look for sori on the underside of the fronds. If you use a magnifying glass, you’ll see that fully ripe sporangia look like shiny, round balls or clusters. Choose a frond in which a few of the sporangia have burst open. The rest of the sporangia should be intact and shiny. Fern fronds not used immediately can be sealed in a plastic bag and kept in the refrigerator for up to a week.
 |  |
| 1. In a warm, dry, draught-free area, lay the frond on a piece of white paper, spore side down and leave it to dry overnight. When you lift the frond the next morning, there should be a brown spore print on the paper (see photo.) If there is no print or it is very faint, the frond was collected either too early or too late in the season. Try again with a different plant/species.
2. Sterilise the pots by either immersing in boiling water or soaking in a 10% bleach solution and then rinsing in boiled water.
3. Sterilise potting soil by placing damp soil in an ice cream container with the lid vented, microwave for 5 minutes, seal the lid, and allow the soil to steam for 10 minutes. Cool the soil then put it in the pots. Alternatively, you can sterilise individual pots of soil by placing the potting mix in the sterilised pots, pouring boiling water through the soil and allowing it to cool.
4. Gently pour the spores from one sheet of paper to another. The heavier chaff (fragments from the sporangium) will separate from the lighter spores. Tap the remaining spores over the soil. A light dusting of spores is sufficient.
 | spore_pattern |
| 1. Pour a little water into a sealable bag, add the pot, and seal. For the spores to germinate, they need 100% humidity, warmth and light. Place the pots in a warm, light area and leave them for a few weeks. Seal the bag to keep moisture in and to keep mould spores out (see photo).
 | bagged spores |
| 1. After a few weeks, a green layer of fuzz should form on the soil (see photo). These are tiny prothalli – the small, heart-shaped gametophytes. Once fertilisation occurs, the first frond emerges from the underside of the gametophyte. The fern has moved into its sporophyte phase and will grow into the more recognisable fern. The fern still needs a warm, humid and light environment. Keep it in the plastic bag but only keep it partially sealed to allow some air circulation.
2. Small ferns can be pricked out and potted into sterilised soil. Be patient, though. It can take several months to reach this stage.
 | gametophyte |
| ***Asexual propagation*** |  |
| 1. Collect bulbils from the parent plant (see photo). Ensure part of the old frond is left attached.
2. Place the bulbils in a tray of soil. Keep the tray in a shaded, humid environment. Roots should form within a couple of weeks. Transfer the individual ferns to larger pots once good root systems develop.
 | bulbils |