Roots and Shoots

Seeds contain all they need to start life as a new plant. Normally most of what is going on is hidden beneath the soil but in this project we are going underground to see all of this amazing process.

You will need

- Some bean seeds. Beans are good seeds to choose for this project because they are large (so it is easy to see what is happening) and because they start growing in just a couple of days. We used broad beans but other beans should work just as well.
- Kitchen roll
- A clear glass or plastic jar or pot (to grow the beans)
- A cup (to soak the beans)

You can try this project at any time of the year.

1. Put 3 or 4 beans into the cup, cover them with water and leave to soak for about 24 hours. The beans will swell as water enters inside the hard coat - this is the trigger to start the new plant growing.

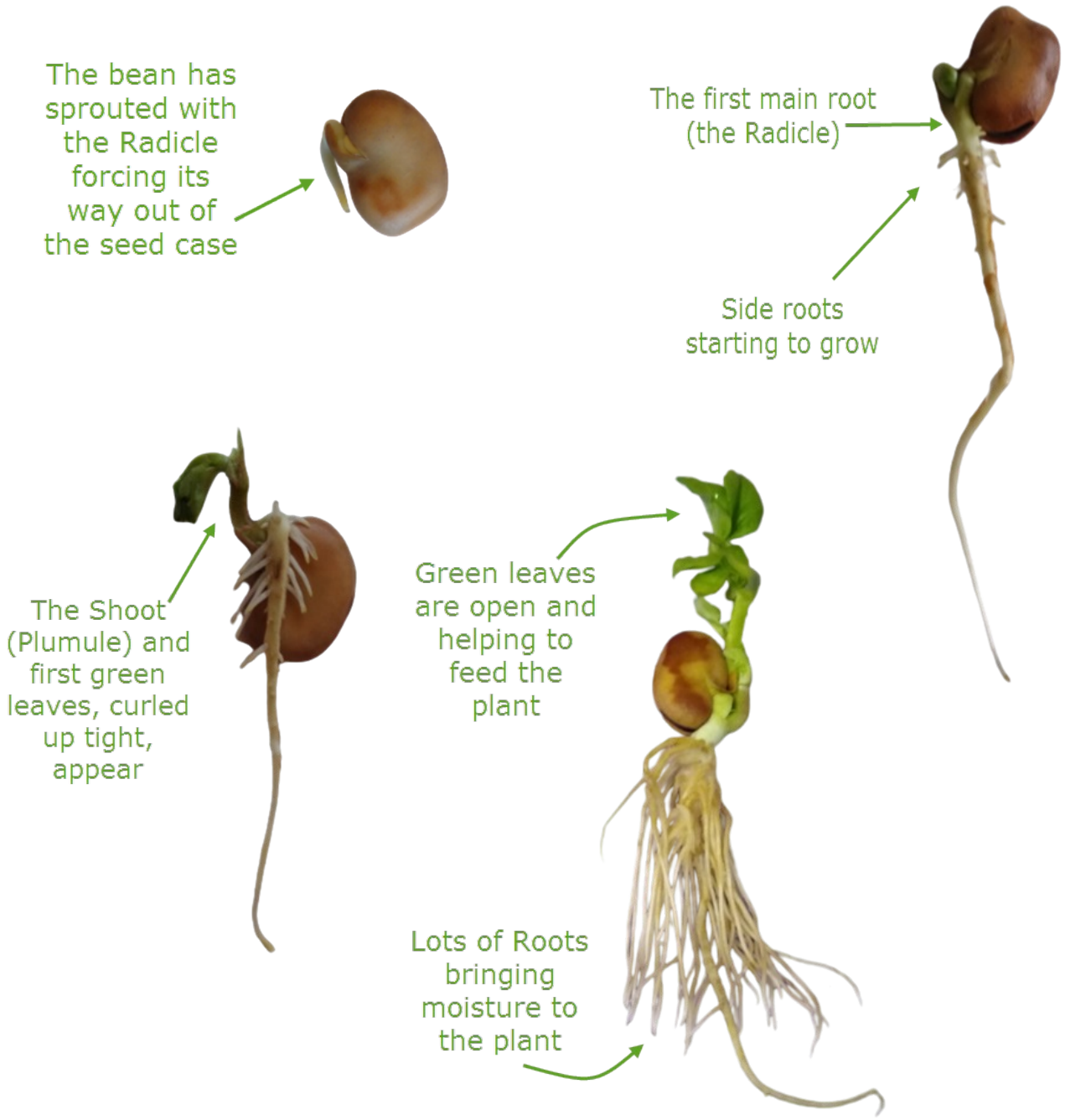
2. When your bean seeds have finished soaking stuff the jar with kitchen roll and then add small amounts of water so that all the paper is damp.

Now take one of the beans and push it in about 2 cm down the side of the jar so that you can see it clearly.

Repeat this for the other beans so they are spread around the jar. (Don't worry about putting the beans the 'right way up' - they will deal with that themselves!)

3. Put the jar somewhere warm and light, a window sill is a good place but try to avoid strong direct sunlight. Make sure you keep the kitchen paper moist by adding a little water to the jar when needed.

4. Keep watching your beans and checking that they do not dry out. Over the next week or so you should look for the following stages of the new plants growing.



We've shown different beans here in each picture because the precise way the root and shoot grow will depend on the position your bean was in when you placed it in the jar.

But notice how the root (radicle) **always** grows downwards and the shoot (plumule) **always** grows upwards whatever the way up the bean is planted.

5 Keep taking care of your plants and watch them grow. Be sure to keep the paper moist.

After about two weeks our beans are looking like proper young plants.

After four weeks the bean plants have produced flowers

Essential Science

Seeds contain all the genetic information and food needed ready to start growing as a new plant but they don't do this until the conditions are just right. They need water and the right temperature but they don't need sunlight to start growing. Sometimes they can remain dormant or asleep for several years.

In particular seeds need water to start them into growth - the process is called **germination**. They soak up water through a tiny hole in the coat of the seed which makes them swell and sets off lots of chemical reactions. The first root (the **radicle**) starts to grow and forces its way out of the seed. Special hormones in the root feel the force of gravity and make the root grow downwards to find water and nutrients.

At the same time the first shoot (the **plumule**) is forming and starts to grow from the seed upwards towards the light. From this shoot leaves appear and quickly start to make food for the whole plant before the food stored in the seed runs out.

What do plants need?

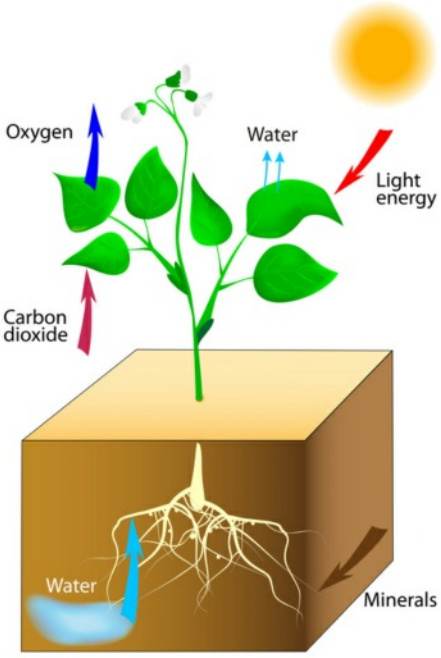
Plants have requirements to live just as we do.

They take in carbon dioxide from the air and use it it to make food. At the same time they produce oxygen and release it into the air. Animals, including humans, need oxygen in order to live.

Plants need water to make their food and to move substances around the plant. Water is taken in through the roots and some is lost from the leaves.

Plants need sunlight to grow. (They can germinate in the dark but the food stores in the seed will quickly run out if they don't have sunlight) They combine carbon dioxide and water to make sugary substances as food. This process is called photosynthesis and uses energy from the sun.

Just like animals, plants need small amounts of minerals like nitrogen, potassium, iron and copper. They normally find these in the soil and absorb them through their roots.



Why is understanding how plants grow important?

Scientists study the way seeds germinate and grow into plants so that they can help farmers improve the amount and quality of the plants that we, and many other animals, eat in order to live.

They also try to find plants that will grow well in places where people do not have enough food to survive.

Plants produce a vast variety of chemical substances. These are important for the plant itself, but also for the environment and for use by humans. Many of the medicines we have today originally came from plants and understanding how they are made can help us find new medicines.