

The Great Carrot Chlorophyll Experiment

One of the Mars Base 1 botanists recently planted some carrots inside a transparent container. Most of the carrots grew normally, but one seed germinated against the side of the container and the root was exposed to light throughout its growth process (see photo below). **Can you tell which one?**

The color of plants is caused by different pigments in their roots, stems, leaves, flowers, and fruits. Carrot roots are usually orange because they contain a lot of **beta carotene** (a yellow pigment), and carrot tops are green because they contain **chlorophyll** (a green pigment).

Chlorophyll is a substance in plants that allows them to absorb energy from light and turn it into food. This process is called **photosynthesis**. Most photosynthesis occurs when plants are exposed to light frequencies in the red (600-700nm) and blue (400-500nm) ranges, which is why the lights in the Mars Base 1 greenhouse are mostly red and blue. White light (such as sunlight) contains all the colors of the rainbow. Because chlorophyll absorbs almost no green light, this color is reflected back to our eyes and makes leaves look green.



Botanists can measure the amount of chlorophyll in a plant using a SPAD meter. (SPAD stands for Soil-Plant Analyses Development.) **Which of these carrots would you expect to have the highest SPAD reading?**

To conduct this experiment for yourself you will need:

- Carrot seeds (try different varieties to see which ones will produce the most chlorophyll)
- Clear plastic cup
- Opaque plastic cup
- Potting soil (use the kind that has nutrients already in it)
- a light source (a window works well)
- long tweezers (optional but very helpful in positioning the seeds)
- water

Fill each cup with potting soil. Do not pack it tightly and leave about 1cm at the top so the soil won't overflow when you add water.

Plant three carrot seeds in the transparent cup by using the tweezers to position them against the inside wall of the cup so they can be seen from outside.

Plant three carrot seeds in the opaque cup. To minimize variables, plant these against the wall of the cup also (even though you won't be able to see them through the opaque plastic).

Add enough water to each cup to moisten the soil without flooding it. Check every few days to make sure the soil stays moist and add water as needed. To minimize variables, add the same amount of water to each cup.

Place both cups in a window (or under a lamp) where they will receive the same amount of light.

Observe the cups every few days. Take notes and photos of what you are seeing.

When the carrots in the transparent cup are big enough (roots about 6-8cm long), pull them up and compare them with the carrots that have been growing in the opaque cup.

Make a record of your observations.