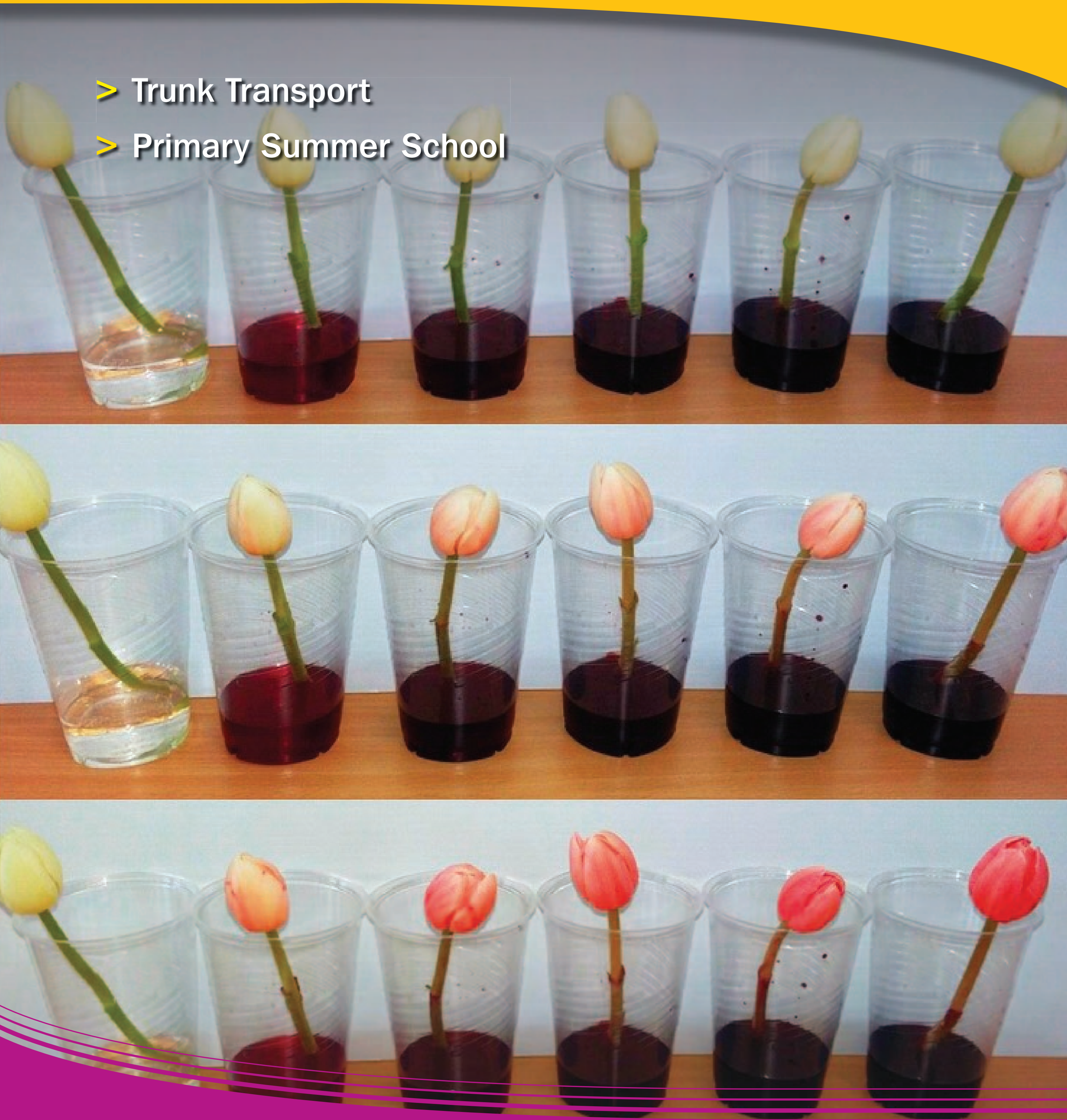
Primary Science & Technology *Bulletin*

SSERC

Ideas and inspiration for teachers in Primary Schools and S1/S2

> Trunk Transport

> Primary Summer School



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Trunk transport

Figure 1 - Cross-section through celery.

When discussing parts of a plant and the function of each it is very easy to gloss over the fact that water needs to get from the roots to the leaves where it can be used for photosynthesis. But how does water travel up the stem of the plant? What about on a bigger scale, how does water travel from the roots to the leaves of an oak tree or a Scots Pine? Water travels from the roots to the leaves by a combination of processes which include transpirational pull and capillary action. Simple demonstrations of these processes can allow for great investigations in class.

In transpirational pull, 'tube-like' structures known as xylem vessels in the stem act like a drinking straws carrying water up the stem. These 'tubes' can be easily seen when you cut through celery (Figure 1).

Therefore, as water is lost from the leaves through transpiration or used in the leaves in photosynthesis more water is drawn from the roots to replace it so that the 'straw' remains full. This can be demonstrated using a clear plastic straw and some juice in a clear plastic cup (we found black-currant was easy to see. Figure 2).

Ask the children how we could move the juice up the straw from the bottom to the top. One of the children can then test this (Figure 3).

If the tree uses all the available water in the soil (the child drinks all the juice in the cup) what will happen to the tree? How could the water supply in the soil be replenished?

Figure 2

Figure 3 *- Juice being pulled up the straw.*

Capillary action occurs when the combination of the force of attraction between the water particles and the force of attraction between the water and the stem are greater than the force of gravity so water can travel up the stem. To demonstrate this you will need a clear plastic cup or container, coloured tissue paper (we find blue paper towels are good for this), some elastic bands and water. Twist the paper towel to make the stem then fold over one end of the 'stem' and secure it with an elastic band (Figure 4). Repeat with the other end of the stem (Figure 5) and then place a small piece of double-sided tape near one end.

Fill the cup to about 1.5 cm depth of water. Hold the stem next to the cup. The end with the double-sided tape should be at the top. Ask the children how far they think the water will travel up the stem. This is a good opportunity to get the class to think in fractions or percentages when making their predictions. You could put a tally on the board for how many people thought water would travel one quarter, half, three quarters or all the way up the stem in a given time. Place the end of the stem into the water so that the elastic band is just below the water surface. Then attach the top of the stem to the wall or notice board with the double-sided tape (Figure 6).

Figure 4 *- Paper towel twisted and secured at one end.*

Figure 5 *- Paper towel twisted and secured at both ends to make a paper 'stem'.*

Figure 6 *- The top of the stem is secured to a notice board with the double-sided tape while the base of the stem is submerged.*

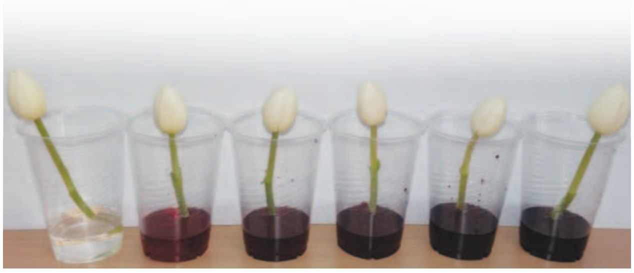

***Figure 7** - Tulips placed in cups with different concentrations of food dye (as per Table 1).*

***Figure 8** - Tulips in cups with different concentrations of food dye (as per Table 1) for five hours.*

This will ensure that the stem stays upright for the duration of this demonstration. It is worth watching this for a minute or so at the start as the initial speed of movement of water will surprise many of the children. After this the rate of movement slows but it is a good idea to nominate one child or one group of children to check on the experiment every fifteen minutes or so and to report back to the rest of the class.

So how can we show this with real plants? The classic experiment using white flowers such as carnations or tulips and coloured food dye can be very effective for this and you can test transport in plants using a range of different colours so that the children can see the different dyes permeating the plant tissues.

In practice we found that not all food dyes produce effective results. Make sure you try out your chosen dye first [1]. We used Blends Food Service food colouring which we ordered from www.tts-group.co.uk and saw an initial effect within thirty minutes.

Why not take this one step further to develop skills of scientific enquiry? Try varying the concentration of the food dye used by diluting the dye with different proportions of water and predict the effect this will have on how noticeable the dye will be in the tissues of the plant. You can use percentages or ratios to describe the different concentrations of food dye used. To ensure a fair test, ensure that all the flower stems are cut to the same length and place one flower in water as your control. The concentrations we used are shown in Table 1 and the effects can be seen by comparing the photographs in Figure 7 (taken at the start of the experiment) and Figure 8 (taken five hours later).

Cup	Volume of water	Volume of of food dye	Total volume of solution
A	50 ml	0 ml	50 ml
B	40 ml	10 ml	50 ml
C	30 ml	20 ml	50 ml
D	20 ml	30 ml	50 ml
E	10 ml	40 ml	50 ml
F	0 ml	50 ml	50 ml

***Table 1** - Concentrations of food dye used.*

***Figure 9** - Tulip stem split along the length with one half placed in blue dye and the other half in red dye.*

As an extension activity, you could split the stem in half along the length, placing one half in one colour of dye and the other half in another colour of dye (as we have done in Figure 9). To see the result, visit our facebook page at https://www.facebook.com/ssercprimary. ◀

Reference

[1] We tested the following food dyes and found that they **did not** produce results: Asda, Dr Oetker, Sainsbury's and Tesco. Alternatively you could use ink. We found that Swan and Quink inks both gave clear results.

Bibliography

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Experiences and outcomes

I have helped to grow plants and can name their basic parts. I can talk about how they grow and what I need to do to look after them - *SCN 0-03a*.

I can help to design experiments to find out what plants need in order to grow and develop. I can observe and record my findings and from what I have learned I can grow healthy plants in school - *SCN 1-03a*.

SSERC Primary Summer School

5^{th} and 6^{th} July 2016

Join us for two days of exciting outdoor science activities at this year's SSERC Primary Summer School. Incorporating aspects of successful summer school programmes from previous years, we will explore the local environment, developing skills which can be transferred to your own location - no matter where you teach.

Delegates will take away resources to support the implementation of the activities in their own schools.

The summer school will be based at SSERC, Dunfermline with overnight accommodation at the nearby King Malcolm Hotel. Closing date for applications is 31^{st} May 2016.

The course fee is £320 to include meals, accommodation and course materials. Local Authority schools will be entitled to receive an ENTHUSE Award of £360 per delegate upon completion of the course. This grant is administered through the Science Learning Network.

Further details are available on our website
www.sserc.org.uk

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