Water is carried in the xylem while sugars and amino acids in the phloem. These experiments look at the evidence for both.

Investigating transport in plants

Ringing experiments:

Woody stems have an outer protective layer of bark on the inside of which is a layer of phloem that extends all round the stem. Inside the phloem layer is xylem.

At the start, **a section of the outer layers is removed around the complete circumference of a woody stem while it is still attached to the rest of the plant. After a period of time, the region of the stem immediately above the missing ring of tissue is seen to swell. Samples of liquid that has accumulated in this region are found to be rich in sugars and other dissolved organic substances.** Some non-photosynthetic tissues in the region below the ring (towards the roots) are found to wither and die while those above continue to grow.

These observations suggest that removing the phloem around the stem has led to:

1. **the sugars of the phloem accumulating above the ring leading to swelling**
2. **The interruption of flow of sugars to the region below the ring and the death of tissues in this region.**

The conclusion is that **phloem is the tissue responsible for the translocation of sugars and amino acids in plants. If xylem was the tissue responsible for this, you would not have expected sugars to accumulate above the ring nor tissues below it to die.**

Tracer experiments:

Radioactive isotopes are useful for tracing the movement of substances in plants. **Radioactive sugars can be traced as they move within a plant using autoradiography. This involves taking thin cross-sections of the plant stem and placing them on a piece of x-ray film. The film becomes blackened where it has been exposed to the radiation produced by the sugars. The blackened regions are found to correspond to where phloem tissue is in the stem.** As the other tissues do not blacken the film, it follows that they do not carry sugars and that phloem alone is responsible for their translocation.

Evidence that translocation of organic molecules occurs in the phloem:

1. **when phloem is cut, a solution of organic molecules flow out.**
2. **Plants provided with radioactive CO2 can be shown to have radioactively labelled carbon in phloem after a short time.**
3. **Aphids penetrate the phloem using their mouthparts, they can therefore be used to extract the contents of the sieve tubes.**
4. **The removal of a ring of phloem from around the whole circumference of a stem leads to the accumulation of sugars above the ring and their disappearance from below it.**