

Information about Historical Investigations

Is soil the source of matter in plants?

In the 1600s, a man named Jan Baptista van Helmont was investigating how plants take in mass. He asked the question, “Do plants get their mass by taking up minerals from the soil?” For 5 years, he grew a tree inside a pot and measured the mass of the tree and the soil. His measurements showed that the tree weighed 74 kg more compared to the start of his experiment, but the mass of the soil had hardly changed at all. He concluded that the increase in mass as a plant grows does not come from the soil. Van Helmont thought that the extra mass was coming from the water that plants absorb.

Things to consider:

Evaluate the investigation plan, the data collected from the plan, and the conclusions drawn from the data.

How do the results of the investigation help us think about how the transfer of energy is driving the motion of the matter moving into and out of the tree (system)?

Information about Historical Investigations (continued)

Is water the source of matter in plants?

Building on the work of Van Helmot, John Woodward designed an experiment to test the idea that the increase in tree mass comes from water. In the late 1600s, he conducted a series of experiments to measure the water consumed by plants.

Over the course of 77 days, Woodward's evidence showed that plants gained very little mass compared to the amount of water they absorbed. For example, one plant had gained 1 gram of mass but had received almost 76,000 grams of water. Woodward concluded that most of this water was not staying in the plant itself but was absorbed and then moved through the pores of the leaves and released into the air. This led him to reject the hypothesis that water was the source of the additional mass.

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Information about Historical Investigations (continued)

Does the air have something to do with the source of matter in plants?

It would not be until 1771 that Joseph Priestley designed an experiment to investigate how plants interact with the air. In his experiment, Priestley placed a branch of mint (plant) and a candle in a transparent closed space. He observed that the candle would burn until the air was used up (oxygen was not discovered yet) and then the candle would quickly go out. He waited 27 days and then he relit the extinguished candle without opening the closed space. Priestley observed that the candle was able to burn again in the same air that had previously failed to support it. To light the candle without opening the space, Priestley focused beams of sunlight with a mirror onto the candlewick.

Priestly's evidence showed that plants somehow change the composition of the air.

In another experiment, Priestley kept a mouse in a closed jar of air until it collapsed. When he placed a plant in the jar with the mouse, the mouse would survive. DO not repeat this experiment. Do not endanger animals.

His observations from these experiments led Priestley to an interesting hypothesis: plants put back into the air whatever material is taken out by breathing animals and burning candles.

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Information about Historical Investigations (continued)

Even though light is not matter, why is it important to plants?

Jan Ingenhousz built upon Priestley's work. In 1779, Ingenhousz placed a plant and a candle into a transparent closed space. This was similar to the design of Priestley's experiment, but Ingenhousz did not light the candle. Ingenhousz let the system stand in the sunlight for two or three days. He wanted to make sure that the plant had made the air inside the container pure enough to support a candle flame. He then placed a black cloth over the closed container and left it covered for several days. When Ingenhousz tried to light the candle, it would not light.

Ingenhousz concluded that plants must act like breathing animals when placed in darkness. Plants must also breathe, and plants need sunlight in order to purify the air.

In his next experiment, Ingenhousz, placed a small green aquatic plant in a transparent container of water. He placed the container in bright sunlight and observed the plant. He saw gas bubbles forming around the leaves and around the green parts of the stems. When Ingenhousz moved the system into darkness, the bubbles stopped forming. Ingenhousz thought that the bubbles could be the material produced by plants that purifies air after it has been changed by animals or candles.

His experiments showed, for the first time, that light is needed for plants to complete the process that purifies the air.

Things to consider:

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