Plants and Human Affairs – Biol106

**Analyzing van Helmont's Willow Experiment**

Jean Baptista van Helmont (1577-1644) performed one of the classic experiments in plant

physiology. His research was published posthumously in Ortus Medicinae (in 1648) and is one of

the first examples of the use of the "scientific method". Interestingly, this work was not truly

original (it was mentioned by the Greeks and Da Vinci did a similar unpublished experiment with

pumpkins).

In the following paragraph, van Helmont describes his experiment. Read the paragraph

and then analyze the experiment by answering the questions that follow.

*I took an earthen pot and in it placed 200 pounds of earth which had been dried out in*

*an oven. This I moistened with rain water, and in it planted a shoot of willow which*

*weighed five pounds. When five years had passed the tree which grew from it weighed*

*169 pounds and about three ounces. The earthen pot was wetted whenever it was*

*necessary with rain or distilled water only. It was very large, and was sunk in the ground,*

*and had a tin plated iron lid with many holes punched in it, which covered the edge of*

*the pot to keep air-borne dust from mixing with the earth. I did not keep track of the*

*weight of the leaves which fell in each of the four autumns. Finally, I dried out the earth*

*in the pot once more, and found the same 200 pounds, less about 2 ounces. Thus, 164*

*pounds of wood, bark, and roots had arisen from water alone." (Howe 1965)*

*According to Hershey (2003) Van Helmont’s experiments were almost certainly inspired by*

Nicolaus of Cusa's 1450 book *De Staticus Experimentis in which he stated:,*

*"If a man should put an hundred weight of earth into a great earthen pot, and then*

*should take some Herbs, and Seeds, and weigh them, and then plant or sow them in tha*

*t pot, and then should let them grow there so long, untill hee had successively by little*

*and little, gotten an hundred weight of them, hee would finde the earth but very little*

*diminished, when hecame to weigh it againe: by which he might gather, that all the*

*aforesaid herbs, had their weight from the water."*

**Questions/Analysis**: Now, considering these experiments, let’s analyze the van Helmont

experiment.

1. What was van Helmont's reason for conducting the experiment? In other words, what

question did he set out to answer?

2. What was van Helmont's hypothesis?

3. Briefly restate in your own words the experiment performed by van Helmont.

4. List at least five variables that might affect this experiment. Which variable(s) is(are)

controlled? Which is the experimental variable(s)?

5. Identify the experimental group and control group in this experiment.

6. van Helmont did not describe his methods in sufficient detail. For example, how did he

actually remove the soil from the roots without destroying or loosing too many? Name one other

method that needs to be clarified.

7. Scientific papers should always include the identity, source and method of the

preparation of any living materials used. What information are we missing?

8. How big was the pot that van Helmont used in his experiment? Was it the size of a gallon

ice cream pail, a five gallon bucket, a 20 gallon garbage can or a 30 gallon garbage

can?

9. Why did van Helmont sink the pot in the ground?

10. While van Helmont’s observations are fact (you can see and measure the mass of the soil and the mass of the tree), his conclusion was ***WRONG***. His experiment was helpful in proving that the mass of a plant does not come from the soil - but water contains only hydrogen and oxygen. The mass of a tree, like all living things, is mostly carbon!

***WHERE DID*** most of the 169 lb and 3 oz ***MASS OF THE PLANT ACTUALLY COME FROM***?

(hint: if you know the equation, then you only have a few options to choose from)

**Reference**:

This exercise is adapted from D Hershey, “Misconceptions about van Helmont's Willow Experiment;” *Plant Science Bulletin* 49: 78 (2003) at the following URL:

http://www.botany.org/bsa/psb/2003/psb49-3.html#Misconceptions