Three: Variables are defined and investigations are designed to test hypotheses …

In a teacher-led class discussion, students will use the basic concepts of experimental design to plan a whole-class experiment designed to test the hypothesis.

Students will identify the independent (IV) and dependent (DV) variables.

1. Use the term **variable** to describe each factor that changes in an experiment. Distinguish between the variable that are purposefully changed or manipulated, the **independent variable**, and the variable that responds, the **dependent variable**.

Lead students to identify the **independent variable** in the experiment by asking them what must be purposefully changed to answer the research question. In this experiment the independent variable will be the concentration of hydrogen peroxide.

2. Lead students to identify the **dependent variable** by asking them how they determined the response to changing the concentration of peroxide. The dependent variable in this experiment will be the time that it takes the disc to rise.

How can I he my students remember th difference between independent dependent variables? L them keep practicing, not with the labs th they do in class also by giving scenarios like t ones provided i chapter 2 of Stu and Research.

Students will identify the factors that will be kept constant in the experiment.

3. Specify **constants** by asking students what factors should remain the same, or unchanged during the experiment. The students will be able to make a very long list of constants based on their discussion of the observations that they recorded during their explorations of the floating disc assay. The list of constants could include:
   · volume of solution in each well
   · whether the solutions are stirred after being mixed
   · temperature
   · grade of filter paper used for making the discs
   · mixing the yeast suspension before taking samples
   · how the filter paper is dipped into the yeast suspension
   · how long the filter paper is dipped into the yeast suspension
   · whether a disc is blotted to allowed to drip before putting it in a well
   · whether the disc is dropped on the top of a well or placed at the bottom
   · the same bottle of peroxide is used (concentration might vary)
   · the same yeast suspension is used by everyone
   · how is the timing done
   · when is timing started and stopped
   · same size drops

What if my students don come up witl of these? It i important that t students recogn that the volume solution in eacl must be the sam For the rest, go along with wha they say. The students will co to see that varia that are not the independent or dependent varia or held constan become sources experimental er

Students will describe a control for their experiment.

4. Identify a **control** or controls. The control is a standard for comparing experimental effects. The control is used to detect or measure the effects of unforeseen factors, such as the peroxide is too old and almost completely decomposed, or the filter paper itself has something on it that causes the peroxide to fizz. In some experiments, the control is the group that receives no treatment, for example plain water with no peroxide, or a disc soaked in plain water and not in the yeast suspension. Or, the control might be a standard selected based on previous observations, such as peroxide with no water.

Students will specify the number of trials to be done in the experiment.

5. The more data that is generated the better. Will students work individually or in pairs? How many trials will each student/student pair do, that is, how many times will they each go through the entire procedure? How many replicates will each student/student pair test for each concentration of peroxide?