



Name: \_\_\_\_\_

Topic:  
Crystal Growth



**Directions:** While you are working through each step in the lesson, write down your notes and answers to the questions below. You will share this with your teacher, so don't forget to download it, save it and name it the way your teacher suggests.

### Step 1: "Good" Research Question Lesson

Q1: What two types of variables should be included in a "good" research question? Type or write your response below.

Q2: Is the research question below in a good format? Explain why or why not.

**"Will lemon juice cause a plant to grow faster than water?"**

Q3: Rewrite the question below so it is in the correct general format.

**"Do sweet tarts dissolve faster in hot or cold water?"**

Q4: What are the independent and the dependent variables in the research question below?

**"Does the slope of a ramp affect the speed of a ball at the bottom of the ramp?"**

The independent variable is:

The dependent variable is:

Nice progress! Now, go back to the lesson: <https://isp-tutor-project.github.io/demo/>  
and complete Step 2.

## Step 2: Research Question Lesson

Q5: Enter your research question in the box below.

Q6: What is the independent variable in your research question?

Q6a: Is the independent variable measurable? If so, how would you measure it?

Q7: What is the dependent variable in your research question?

Q7a: Is the dependent variable measurable? If so, how would you measure it?

Q8: Is this a good research question? Explain below.

Q8a: List the materials needed to run this experiment:

Nice progress! Now, go back the lesson <https://isp-tutor-project.github.io/demo/>

### Step 3: Conduct Background Research

**Directions:** Scientists conduct background research to find more information for their research questions. Even though they know a lot, they are always learning more! This is what you'll get to do in this step!"

You'll need to re-watch one trial for this experiment. You can do this by clicking on the Crystals Animation button. It looks like this:



It's important to carefully observe the trial to see what happens. If you don't understand how something happens, you'll need to do research to find out. Write down all of the things that happen in this trial below.

For example, "*salt dissolves in water*" could be "Process #1". If you don't know how salt dissolves in water, you'll need to do some research to find out!

Process #1:

Process #2:

Process #3:

Process #4:

Process #5:

Now, you'll find out about each of the processes you wrote down in STEP 2. For example, if the first process you wrote above was "*salt dissolves in water*", you would write notes about what you learn in the Background Research Module about what salt is and what happens when it dissolves in water.

Notes for Process #1:

Where did you find this information? List names of units or search terms:

Source 1:

Source 2:

Notes for Process #2:

Where did you find this information? List names of units or search terms:

Source 1:

Source 2:

Notes for Process #3:

Where did you find this information? List names of units or search terms:

Source 1:

Source 2

Notes for Process #4:

Where did you find this information? List names of units or search terms:

Source 1:

Source 2

In the space below, please write your initial hypothesis for how and why the initial water temperature affects crystal growth. In this hypothesis, use information that you found from your background research such as what happens when salt (NaCl) dissolves in water.

**Nice work so far! Don't forget to save your work in this document. Then, go back to the lesson <https://isp-tutor-project.github.io/demo/> and complete Step 4.**

## Step 4: Hypothesis Lesson

In this lesson, you created a hypothesis for your research question using a concept map. You added different boxes and connected them to your independent and dependent variable. You also downloaded your concept map as an image. Make sure you save that and turn it in with your completed worksheet to your parent or teacher.

### Summary time!

Q12. Now, write your final hypothesis that explains the relationship between water temperature and the weight of crystal growth in the space below. Your hypothesis should include any concepts you added in your concept map (unless you've changed your mind--that's ok!).

The next step would be to actually set up and run this experiment.

If you can find the materials, and your teacher and parents say it's OK, you can try this experiment out in your home!

