

2.3 Redesign Your Investigation

Getting to a Better Procedure

Your class probably did not agree on how much water can fit on a penny. Your line plot may have shown that your lab couldn't produce reliable results. You will now see if you can find a way to make the results more consistent across groups.

Think about what went wrong. You were all trying to answer the same question. You all dropped water onto pennies. You all counted how many drops of water fit on the penny. You also all had the same materials. But every group probably used a slightly different procedure. You all collected data in different ways. No wonder results were so varied.

Scientists only trust experimental results that are **repeatable** by other scientists. In order for other scientists to **replicate** the results of an experiment, the procedures must be reported very precisely. Then someone else can run the procedure again and get the same results.

For example, suppose you wanted to investigate the effect of a fertilizer on the growth of plants. You would need to keep many other factors the same. For example, you would need to control:

- soil type
- time spent in sunlight each day
- amount of water, and
- type of plant



repeatable: when someone follows the reported procedure, they get similar results.

replicate: to run a procedure again and get the same result.

trial: **one time through a procedure.**

precision: **how close together the measured values are.**

range: **the zone between the largest and smallest solution results.**

Think about one factor, water. You would need to make sure that each group of plants got the same amount of water. They would need to be watered the same number of times. Also, they would need to be watered in the same way. You would need to follow these rules for watering every single time you watered each plant.

It is also important to make the same measurement each time. In this example, you could count the number of leaves on each plant. You could also measure the height of each plant.

The tools you use can often affect measurement. You have limits to what you can see when you make a measurement. Be sure to consider how accurate the tools you use are.

Here is a checklist that you can use to make sure your measurements are consistent:

- Measure from the same point.
- Measure with the same units.
- Repeat **trials** for more **precision**.
- Start fresh. Don't compare data from before you make a change to the data after you make a change.
- Measure under the same conditions.

Revise Your Procedure

With your class, work out a procedure for finding out how many water drops will fit on a penny. Try to describe each step in detail so it can be replicated. This way, maybe you'll collect more reliable results. Record your new class procedure.

Reflect

Review and answer the following questions:

1. What are three or four key differences between your previous procedure and the new class procedure?
2. What are you now controlling better in the new procedure?
3. What effect do you think this new procedure will have on the **range** of results across groups?

What's the Point?

The points you thought about in this section are important to the *Sandwich-Cookie Challenge*. Every group was using a similar procedure. However, your procedures were probably not identical. In fact, some of the groups may not have followed the same procedure each time they tested how many drops of water fit on a penny. You probably saw a wide spread of data in the line plot. This is called **variation**. It is important to use the same procedure every time you test. Your results will then be consistent, and they will probably be repeatable.



variation:
a wide spread of
data.

