3.3 Investigate

Experiment with a Whirligig

Materials

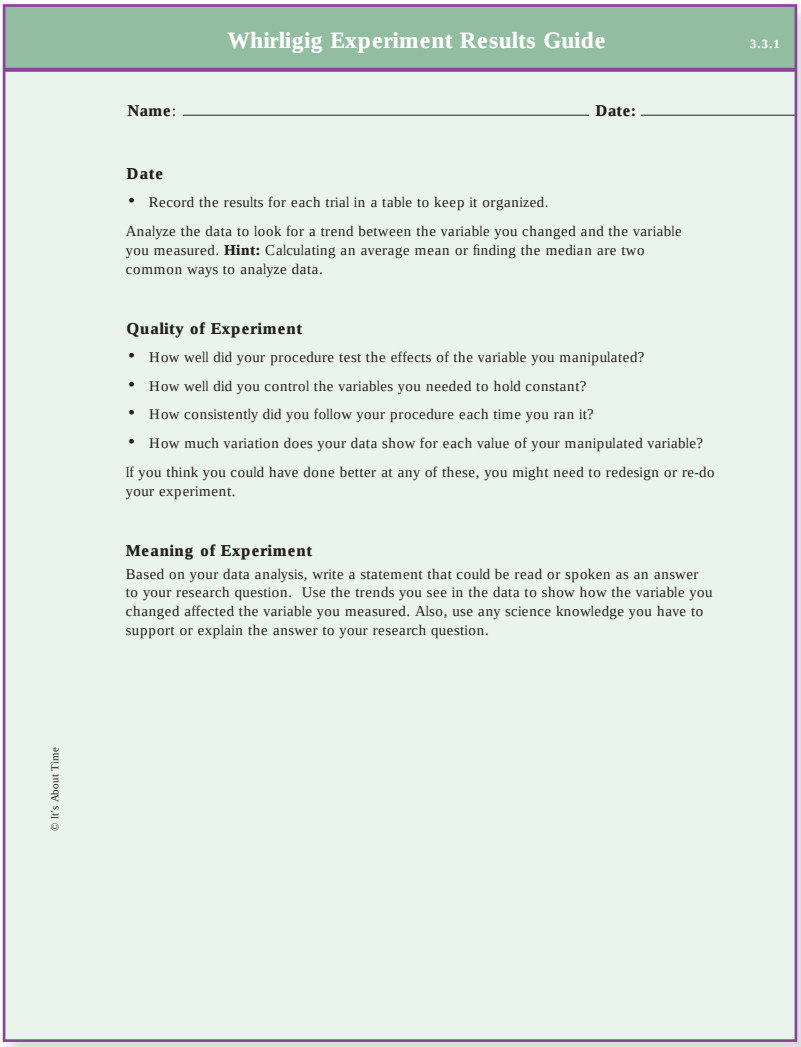
- **cutout whirligigs**
- **stopwatch**
- **paper clips**

Run Your Experiment

It is time to run your whirligig experiment. Use the materials given in the list. You will run the experiment, analyze your data, and then report your results to other groups.

Recording Your Work

As you do the experiment, record your results on your *Whirligig Experiment Results Guide* page. These pages have guidelines on them. They will help you with each task you need to do. Look at the guidelines for hints.



Whirligig Experiment Results Guide 3.3.1

Name: _____ **Date:** _____

Date

- Record the results for each trial in a table to keep it organized.

Analyze the data to look for a trend between the variable you changed and the variable you measured. **Hint:** Calculating an average mean or finding the median are two common ways to analyze data.

Quality of Experiment

- How well did your procedure test the effects of the variable you manipulated?
- How well did you control the variables you needed to hold constant?
- How consistently did you follow your procedure each time you ran it?
- How much variation does your data show for each value of your manipulated variable?

If you think you could have done better at any of these, you might need to redesign or re-do your experiment.

Meaning of Experiment

Based on your data analysis, write a statement that could be read or spoken as an answer to your research question. Use the trends you see in the data to show how the variable you changed affected the variable you measured. Also, use any science knowledge you have to support or explain the answer to your research question.

© It's About Time

Be sure to have your teacher check your plan before you conduct any experiment.

Interpret Your Results

Finding Trends and Making Claims

interpret: **to find the meaning of something.**

trend: **a pattern or a tendency.**

claim: **a statement of what you understand or a conclusion that you have reached from an investigation or set of investigations.**

You've collected data about how your variable affects the time it takes a whirligig to fall. It is time now to **interpret** those results. To interpret means to figure out what something means. Interpreting results of an experiment means identifying what happens as a result of changing a variable. What happened as you added paper clips? What happened as you lengthened or shortened the whirligig's blades? Did the time it took the whirligig to fall increase or decrease as the value of your variable increased?

You'll do two things to interpret your results. First, you'll identify **trends** in your results. Then you'll state a **claim** based on those trends. A trend is a pattern that you can see over several examples. A claim is your statement about what those trends mean. For example, suppose you varied the width of the whirligig's blades. You would find that the whirligig takes less time to fall, as the blades get narrower. This is a trend. Your claim would be your statement: "When the blades are narrower, the whirligig takes less time to fall."

Every time a scientist makes a claim, other scientists look for the evidence the scientist has for that claim. One kind of evidence is data collected in an experiment and the trends in that data. You'll spend a lot of time in PBIS Units making claims and supporting them with evidence. You'll learn more about that in other Units. For now, make sure that the data you collected matches your claim.

Make sure to record on your *Whirligig Experiment Results Guide* page the trends you see in your data. Also include any claims you think you can make so that you can share them with your classmates.

Communicate Your Results

Investigation Expo

You will share what you've found with the class in an *Investigation Expo*.

Remember, no groups in the class investigated both variables. Therefore, others will need your results to complete the challenge. They will rely on your report to design a better whirligig.

Be a Scientist

Introducing an *Investigation Expo*

An ***Investigation Expo*** is like other presentations you've done. However, it is specially designed to help you present results of an investigation. You will include your procedure, results, and interpretations of results.

Scientists present results of investigations to other scientists. This lets the other scientists build on what was learned. You will do the same thing.

There are several things scientists usually want to know about investigations. These include the following:

- questions you were trying to answer in your investigation
- your predictions
- the procedure and what makes it a **fair test**
- your results and how confident you are about them
- your interpretation of the results and how confident you are of it.

To prepare for an *Investigation Expo*, make a poster that includes all of the five items listed above. Present them in a way that will make it easy for someone to look at your poster. Others should be able to identify what you've done and what you found out. If you don't think you ran a fair test as you had planned, your poster should also have a report on how you would change your procedure if you had a chance to run the experiment again.

Sometimes scientists make posters when they present their investigations and results. They set up their poster in a large room where other scientists have also set up their posters. Then other scientists walk around the room. They look at the posters and talk to the scientists who did the investigations. Another way scientists share results is by making presentations. For presentations, they stand in front of a room of scientists. They talk about their investigations and results. They usually include visuals (pictures) showing all the important parts of their procedures and results. They talk while they show the visuals. Then other scientists ask them questions.

Your *Investigation Expos* will combine these practices. Sometimes, each group will formally present their results to the class. Sometimes, each group will put their poster on the wall for everyone to walk around and read. In this *Expo*, because you investigated only two variables, every group will put their posters on the wall. The class will look at all the posters. Then two groups will make presentations to the class. One will present for each variable investigated.

Investigation Expo: **a presentation of the procedure, results, and interpretations of results of an investigation.**

fair test: **things that are being compared are being tested under the same conditions, and the test matches the question being asked.**

There are two parts to an *Investigation Expo*: presentations and discussions. As you look at posters and listen to other groups present their work, look for answers to the following questions. Make sure you can answer this set of questions about each investigation:

- What was the group trying to find out?
- What variables did they control as they did their procedure?
- Is their data scattered, or is it fairly consistent?
- Did they measure the time it took the whirligig to drop in a consistent way?
- Did their procedure cause them to run a poor, uncontrolled experiment?
- What did they learn?
- What conclusions do their results suggest?
- Do you trust their results? Why or why not?

When looking at posters and listening to presentations, you should ask questions if you can't identify a clear answer to any of the questions above. Ask questions that you need answered to understand results and to satisfy yourself that the results and conclusions others have drawn are trustworthy. Be sure that you trust the results that other groups report.

Be a Scientist

Different Kinds of Variables

As you designed and ran your experiment, there were several kinds of variables you worked with:

- One you changed or varied in your experiment. This is called the **independent variable** (or **manipulated variable**).
- Some were ones you worked hard to keep the same (constant) during every trial. These are called **control variables**.
- Some were ones that you measured in response to changing the manipulated variable. These are called **dependent variables** (or **responding variables**). Their value is dependent on the value of the independent or manipulated variable.

Experiments are a very important part of science. When scientists design experiments, they think about the things that might have an effect on what could happen. Then they identify the one thing they want to find out more about. They choose this thing as their independent (manipulated) variable. This is the one they change to see what happens. They must keep everything else in the procedure the same. The variables they keep the same, or hold constant, are control variables. Finally, there is a set of things that they measure. This is the dependent (responding) variable. If they have designed a fair test, then they can assume that changes in the dependent (responding) variables result from changes made to the independent (manipulated) variable.

When you ran your whirligig experiments to find out the effects of the number of paper clips on how a whirligig falls, your independent (manipulated) variable was the number of paper clips attached to the stem. Your dependent (responding) variable was the time it took a whirligig to fall. Everything else, including the shape of the blades, the length of the stem, the height from which the whirligig was dropped, and the way the time to the ground was measured were the control variables. To be sure that what was measured (the dependent or responding variable) was dependent on what was changed (the independent or manipulated variable), it was important to keep the controlled variables exactly the same every time the whirligig was dropped.

independent (manipulated) variable: **in an experiment, the variable that the scientist intentionally changes.**

control variables: **in an experiment, the variables that are kept constant (not changed).**

dependent (responding) variables: **in an experiment, the variables whose values are measured. Scientists measure how these variables respond to changes they make in a manipulated variable.**

Reflect

Answer the following questions. Then discuss your answers and how they may help you better achieve the *Whirligig Challenge* with your class.

1. What variable were you investigating in your experiment? What were you investigating about that variable? How did you vary it to determine its effects?
2. List all of the variables you tried to hold constant in your experiment.
3. How many trials did you perform? Explain why you performed that number of trials. Was this a good number of trials?
4. How consistent was your set of data? Why is consistency in repeated trials important in an experiment?
5. Do you think that the data set you collected was useful in determining the effect your variable had on the fall of the whirligig? Explain why or why not.
6. What do you think you now know about how things fall that would allow you to design a better whirligig than the one you started with? Do you know enough to explain your results?

What's the Point?

You have just investigated how a variable affects the time it takes a whirligig to fall to the ground. You then presented your results in an *Investigation Expo*. In your experiment, you only investigated one possible variable. You needed to rely on other groups to get the data you needed for the other variable. This is the way scientists work. Presenting results of investigations to other scientists is one of the most important things they do. This lets other scientists build on what they learned.

You interpreted the data from your investigation. The trends you found and the claim you made will help you in achieving the *Whirligig Challenge*.