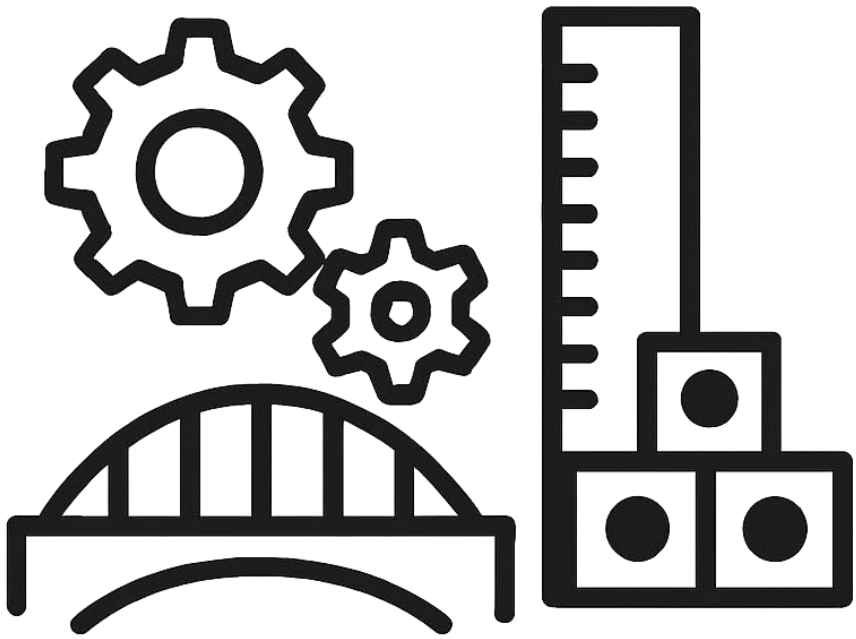


ELEMENTARY ENGINEERING LOGBOOK

Name: _____

Grade: _____

Engineering Project Schedule

Week #	Date to be completed	Assignment
Before you Start	Complete Elementary Science, Technology, Engineering and Math (STEM) Fair Application/Safety Assessment/Media Release Form. Must be signed by teacher, student, and parent.	
1		**Complete Section 1:** *Pages 1-4* Need Statement Research Design Requirements
2		**Complete Section 2:** *Pages 5-7* Draw Design Materials Procedure
3-6		**Complete Section 3:** *Pages 8-9* Build Prototype Test the Prototype, Record Data Analyze
		Complete Section 4: *Pages 10-14* Redesign Retest Record Data Analyze
7		**Complete Section 5:** *Pages 14-17* Graphs Conclusion
8		Complete your STEM Fair presentation and finalize your logbook.

Date: _____

Section 1

Define a Need

Brainstorm topics of interest to generate ideas for your engineering project.
Example: I am interested in plants, helping my family, saving water, and building things.

State the need (problem). This is a description of a problem that needs to be solved and why it is important. Engineers design solutions to help people and improve everyday life.
Example: The need for this project is to find a way to keep houseplants watered when someone is away from home. This project will help people take care of their plants, so they stay healthy even when no one is there to water them.

Use the need to help determine a design goal for your project.
While there could be many possible solutions, it is important to focus on ONE clear goal. A design goal explains what you are trying to create and how it will solve the problem. It should describe what your solution will do and how well it should work.
Example: I want to design a device that slowly waters a plant over time. The design should release water in a controlled way, so the soil does not become too dry or too wet.

Record what you will change or design (your solution)?

Record how you will know if your design works (what you will observe or measure)?

Write your design goal using the information above.

Date: _____

Researching the Problem

Research helps you understand the problem and learn how others have solved similar problems. It can also help you understand what plants need to stay healthy.

Example:

Source #1: Article: Automatic Plant Watering System Using Moisture Sensors and Microcontrollers by Delisha Gupta

Summary: This source explains that plants need the right amount of water to grow well, and too much or too little water can be harmful. It describes systems that slowly deliver water to plants and use soil moisture to decide when watering is needed. These systems help save water and keep plants healthy by making sure the soil stays at a good moisture level. This information helped me understand that my design should provide a steady amount of water over time instead of all at once.

Use a minimum of 3 research sources and write a summary of what is learned.

Source #1: _____

_____

Summary:_____

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Date: _____

Source #2: _____

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Summary:_____

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Source #3: _____

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Summary:_____

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Date: _____

Design Requirements

Design requirements are the rules your solution must follow. These help you plan your design and decide if it is successful. Good design requirements are clear, specific, and something you can check or observe after testing. Try to include at least one requirement that you can observe or measure during testing to help you know if your design works. Think about:

- **Size:** How big or small should it be? Will it fit where it is needed?
- **Cost:** Should it be inexpensive? What materials can you afford to use?
- **Materials:** What will it be made from? Are the materials safe and easy to find?
- **Performance:** What should it do? How well should it work?
- **Time:** How long should it work without help?
- **Ease of Use:** Is it easy for someone to set up and use?
- **Safety & Cleanliness:** Will it avoid spills, leaks, or damage?

Example: The device must slowly release water to keep the plant alive for at least 5 days without needing to be refilled. It should be made from low-cost, easy-to-find materials like a plastic bottle. The device must be small enough to fit in a plant pot and easy for a person to set up before leaving. It should not leak or make a mess around the plant. During testing, I will check each day to make sure the soil is still moist and the plant is not drying out or getting too much water.

Record your design requirements.

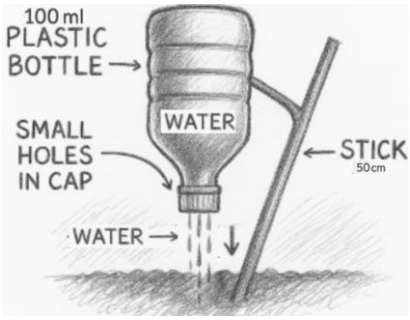
Date: _____

Section 2

Draw Design: Prototype #1

Engineers often draw before they build. Draw your idea clearly. Label all parts so someone else can understand your design. Use arrows to show movement in your design.

Example:



Draw the design of the prototype and be sure to label all parts.

Date: _____

Procedure

A procedure is a detailed, step-by-step list of everything done to build and test the prototype. Experiments must be replicable. This means the procedure is clearly written, making sure another scientist can repeat the experiment and get similar results.

Example:

Building the Prototype:

1. *Take a 100 ml plastic bottle and make sure it is clean and empty.*
2. *Use a push pin to make 3 small holes evenly spaced in the bottle cap.*
3. *Fill the bottle with 100 ml of water.*
4. *Screw the cap back on tightly so no water leaks from the top.*
5. *Take a 50 cm wooden dowel to support the bottle. Push the dowel or pencil firmly into the soil near the plant so it stands straight and stable.*
6. *Attach the bottle to the stick by wrapping a large rubber band (about 10 cm across when unstretched) around the middle of the bottle and the top of the stick. Twist the rubber band to make it tight and secure so the bottle will not fall.*
7. *Turn the bottle upside down so the holes are facing downward.*

Testing the Prototype:

1. *Gather data about soil moisture without the prototype. Use a soil hygrometer probe to measure the moisture of the soil near the plant. Insert the probe into the soil at the same spot each day and record the reading.*
2. *Repeat this measurement every day for 5 days to gather data to compare to the prototype data.*
3. *Use a soil hygrometer probe to measure the moisture of the soil near the plat when the prototype is in placet. Insert the probe into the soil at the same spot each day and record the reading.*
4. *Repeat this measurement every day for 5 days to see how the water from the bottle affects soil moisture.*
5. *Record measurements in the data table.*
6. *Redesign and retest the prototype as needed.*

Write step-by-step directions so someone else can follow them exactly. Number each step and be clear.

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Date: _____

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Material List

All the materials and equipment you will use for building and testing the prototype should be listed. It is suggested that you use descriptive words to describe your materials and equipment. Any materials that are measured should be measured in **metric units** (centimeters (cm), meters (m), milliliters (mL), liters (L), degrees Celsius (°C), etc.). The procedure should mention every material on the list.
Example: I will need a house plant in soil, a 100 ml plastic bottle, a push pin, and 100 ml of water measured with a measuring cup. I will also need a 50 cm wooden dowel and a size 33 rubber band. To test the soil moisture, I will use a soil hygrometer probe. Additionally, I will have a notebook or data sheet and a pen or pencil for recording my measurements.

Record a detailed list of all the materials needed to build the prototype.

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- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Date: _____

Section 3

Build the Prototype

Building a prototype means creating a working model of your design so you can test it and see how well it works. A prototype doesn't have to be perfect—it is a first version that lets you experiment, make changes, and improve your design. When you build it, you are trying out your ideas in a real, hands-on way. Based on your design requirements, drawn design, list of materials and equipment, and by following the step-by-step procedure build your design.
Example: While building my drip bottle prototype, I filled the 100 ml bottle with water and attached it to the 50 cm wooden dowel with a size 33 rubber band. At first, I made three push pin holes in the cap, but the water came out too quickly and flooded the soil. I realized the holes were too big, so I carefully made smaller holes to slow the drip. I also noticed the bottle wobbled on the dowel, so I twisted the rubber band tighter to secure it. After these adjustments, the water dripped slowly and evenly into the soil, just as I wanted.

Write to describe what happened as you built your design. Include any challenges or changes you had to make.

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Date: _____

Testing and Data Recording

After your prototype is built you need to test it to see if it works according to the testing procedure. You need to write down everything that happens during the testing. You should be as descriptive as possible. You must test your prototype three times.

Example:

Prototype #1	***Day 1***	***Day 2***	***Day 3***	***Day 4***	***Day 5***	***Mean***
Without Prototype (Control)	*28%*	*25%*	*23%*	*22%*	*20%*	*23.6%*
With Prototype	*55%*	*57%*	*56%*	*55%*	*56%*	*55.8%*

Record the data from each test in the data table.

Prototype #1	Without your invention (control)	With your invention
Test #1		
Test #2		
Test #3		
Totals		
Mean (Average)		

Observations:

Data Analysis of Prototype #1

Analyze your data from your test of prototype #1. What worked? What did not work? How could you redesign the prototype, so it solves the problem more effectively?

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Date: _____

Section 4

Redesign and Retest

After the first test you may need to adjust your prototype by redesigning parts that need changing. You need to show the adjustments with diagrams and labeling. Keeping accurate notes of the changes is very important in this part of the engineering project.

Draw the design of prototype #2 and be sure to label all parts.

Date: _____

Procedure Prototype #2

Follow each step carefully and write down everything you do. Since this is your second attempt, note any changes you make from the first prototype.

Write step-by-step directions so someone else can follow them exactly. Number each step and be clear.

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Date: _____

Material List Prototype #2

Keep track of all the materials you use and their amounts, so you know exactly what is needed for your improved design.
Record a detailed list of all the materials needed to build the prototype.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
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- _____
- _____
- _____
- _____
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- _____

Build the Prototype #2

Write to describe what happened as you built your design. Include any challenges or changes you had to make.

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Date: _____

Redesign, Test, and Analyze

Retesting is necessary after any redesign. Each time you retest, conduct three tests and record what happens. Analyze your data to see if the results meet the design requirements. If not, redesign and retest your prototype. Keep clear notes of all changes and results so you can see what was done and how it affected performance. Continue redesigning and retesting, recording data each time, until the prototype works efficiently and meets the design requirements. Once it does, you can move on to the conclusion.

Record data and observations for each redesign.

Prototype #2	Without your invention (control)	With your invention
Test #1		
Test #2		
Test #3		
Totals		
Mean (Average)		

Observations:

Prototype #3	Without your invention (control)	With your invention
Test #1		
Test #2		
Test #3		
Totals		
Mean (Average)		

Observations:

*Add more pages to record additional Prototype's design, procedure, materials, and build notes as needed.

Date: _____

Discuss your data from Prototype #1 and Prototype #2 (and Prototype #3 if necessary).

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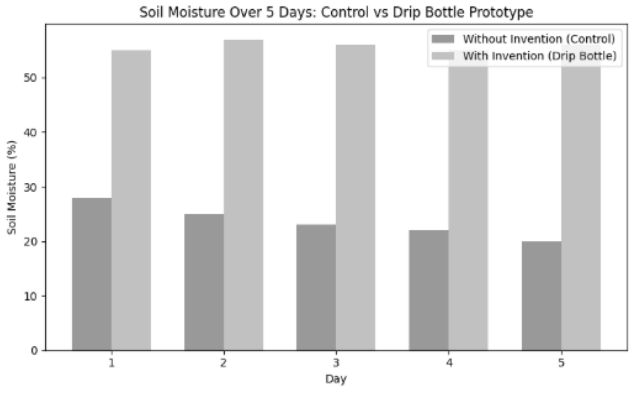
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Section 5

Using Graphs to Display Data

Graphs help you see patterns in your data and make it easier to compare results. You will create graphs to show what happened in each test and to summarize your overall results. Create a graph for each prototype test. Be sure to label your x-axis and y-axis with the correct axis labels. Create an overall results graph to show the general pattern and whether your prototype worked as expected. Give each graph a clear title and include a key or legend if you are comparing and labels for the x-axis and y-axis. Make sure your data is easy to read with accurate measurements and labels. Finally, look at your graphs to notice trends or patterns, which will help you explain your results in your conclusion.

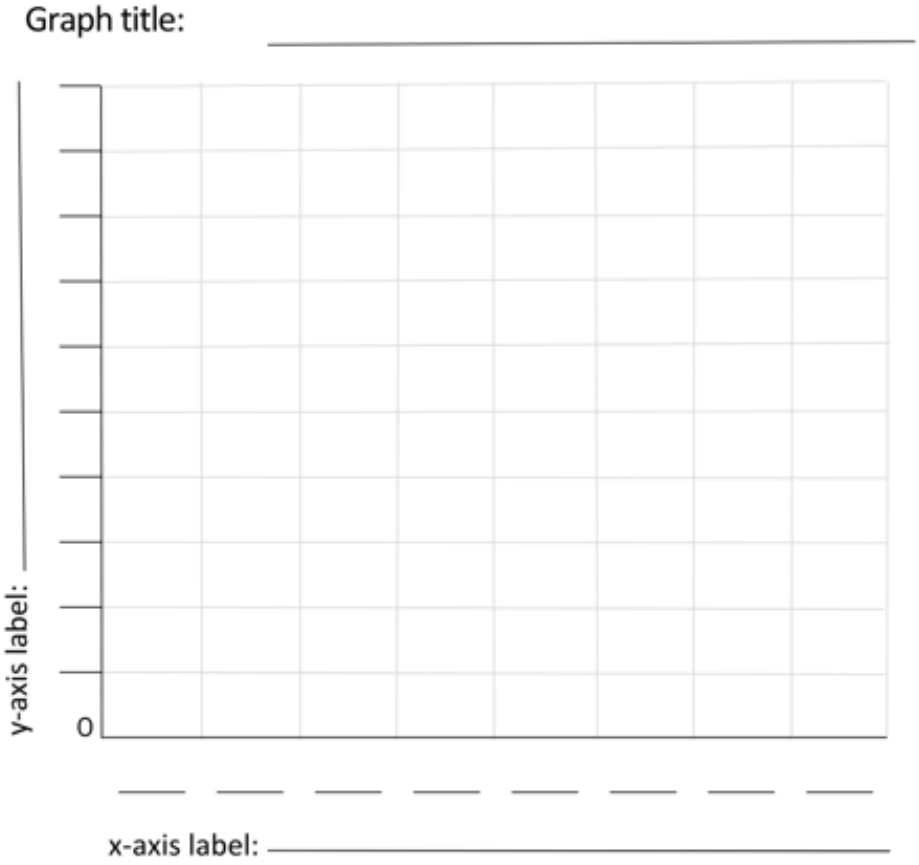
Example:



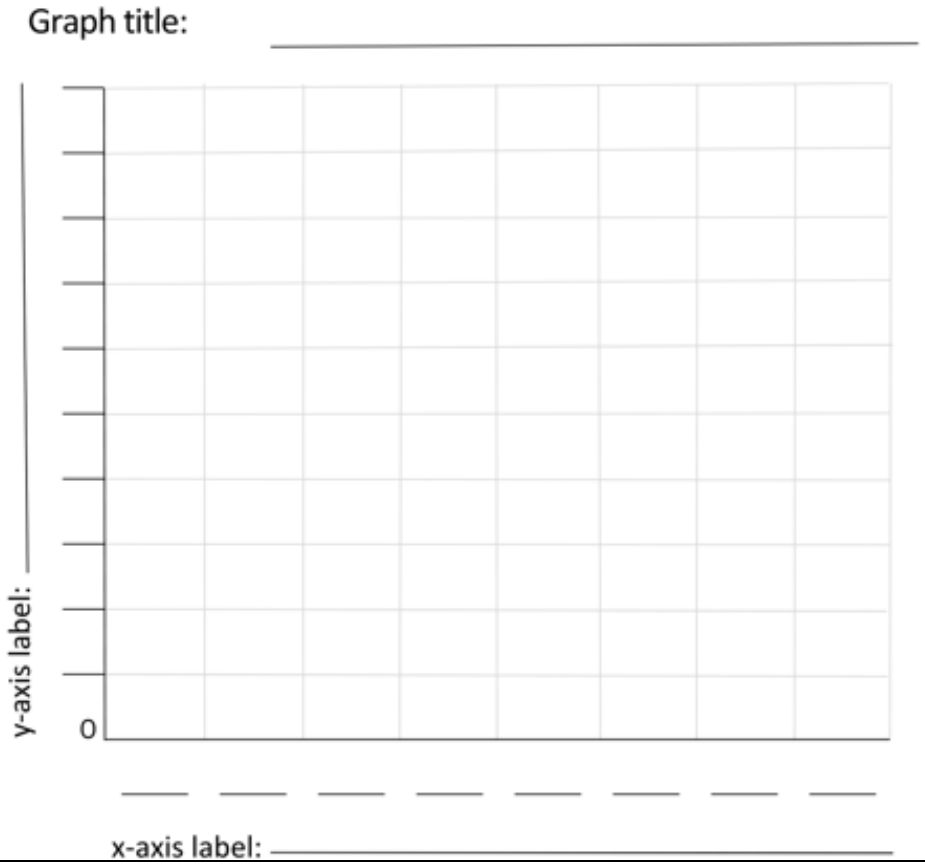
Create a graph for each test and an overall results graph.

Date: _____

Prototype #1 Graph

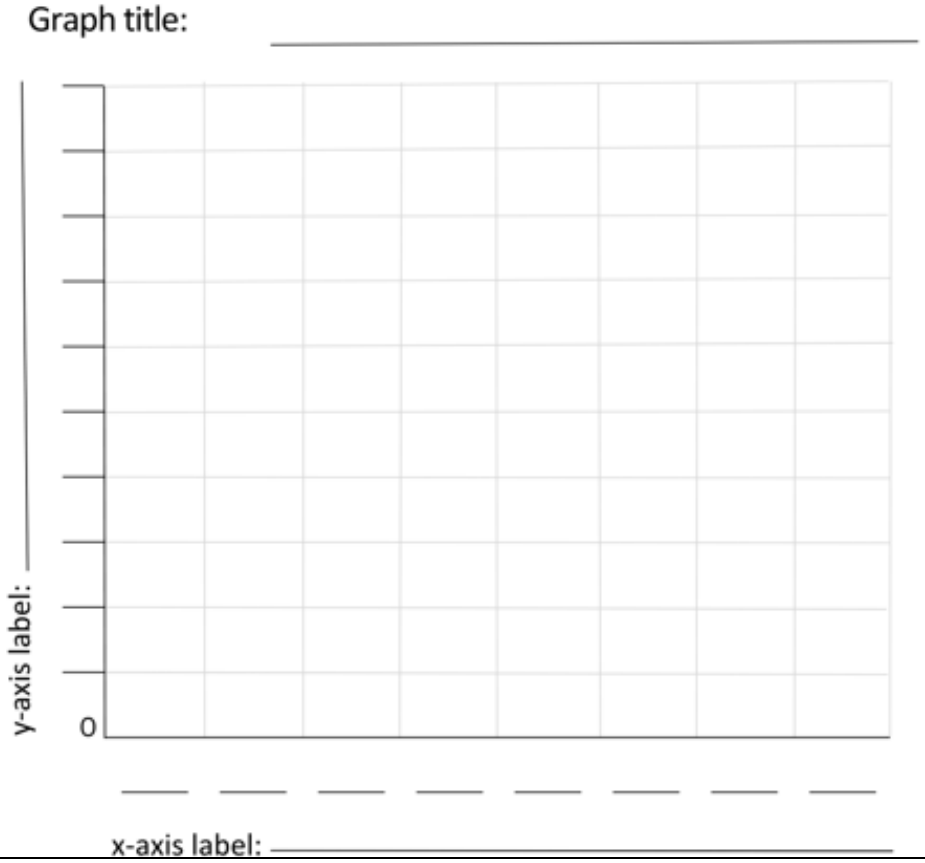


Prototype #2 Graph

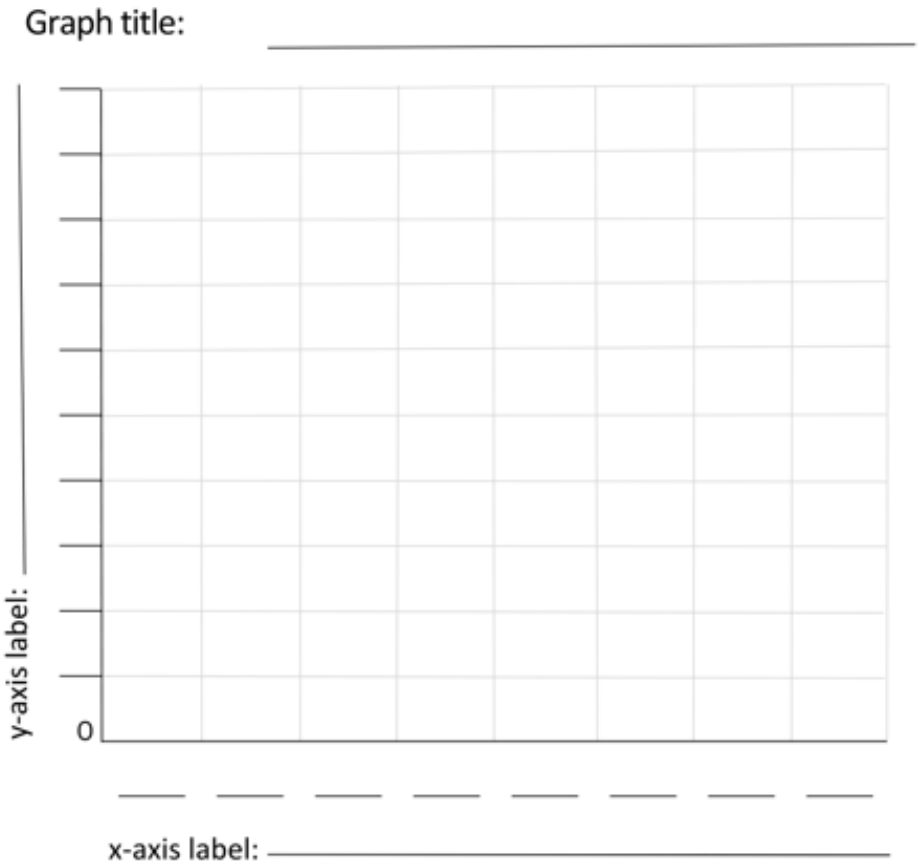


Date: _____

Prototype #3 Graph



Overall Results Graph



Date: _____

Explaining My Graphs

When you explain your graph, it is important to do the following:

- Describe the pattern: Look at your graph and explain if the numbers went up, down, or stayed about the same.
- Compare your tests: Explain how your invention did compared to the control (without the invention).
- Use real numbers: Include some numbers from your graph to show your points.
- Connect to your goal: Say what the patterns tell you about how well your invention worked.

Example: Looking at the graph, the control (without the invention) slowly decreased from 28% on Day 1 to 20% on Day 5. The drip bottle stayed higher and more consistent, between 55% and 57% each day. This pattern shows that the drip bottle helped improve and stabilize the results compared to doing nothing. From this, we can conclude that the invention worked as expected and helped maintain better performance over time.

Record trends or patterns you see in your data.

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Writing My Conclusion

A conclusion statement summarizes your design process and answers your needs statement using evidence. It should explain whether your results matched your expectations, what you learned from building and testing your prototype, and if it met your design requirements. Include why your prototype is important, how it could be improved, and how it can be used in real life. Your conclusion should highlight the value of your project and what new understanding you gained from the experience.

Example: The results of my drip bottle prototype matched my expectations because it kept the soil moist while the control dried out. I learned that small changes, like adjusting the hole size and securing the bottle, improved how well it worked. This prototype is important because it shows an easy way to water plants efficiently. Overall, it met my design requirements and could be useful in real life for caring for plants.

Record your conclusion statement.

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Date: _____