Lab 1: Introduction to Scientific Measurement

BIOL-1

Name: _____ **Date:** _____

Objectives

By the end of this lab, you will be able to:

- Identify physical aspects of objects that can be measured
- Select appropriate measurement devices and units
- Make real measurements and document your methods
- Formulate scientific questions based on careful observations
- Design measurement approaches to investigate questions
- Communicate scientific findings and propose next steps

Part 1: Object Selection

> ***Learning Goal:*** *Practice selecting appropriate subjects for scientific study and recognizing that measurement approaches differ based on accessibility.*

Choose two objects to study throughout this lab—one that you can directly access and one that you cannot.

Object Selection

Object in room: _

Object NOT in room: _

Tip: Choose objects you find genuinely interesting. Object B could be something far away (the moon), very small (a single cell), or simply in another location (your car).

Part 2: Identifying Physical Aspects

> ***Learning Goal:*** *Develop the ability to systematically identify measurable properties and match them with appropriate tools and units.*

For each object, identify **5 different physical aspects** that could potentially be measured. Physical aspects are quantifiable properties such as length, mass, temperature, volume, surface area, color intensity, hardness, or density.

Object A (In Room)

Physical Aspects — Object A

#	Physical Aspect	Measurement Device	Measurement Unit
1			
2			
3			
4			
5			

Object B (NOT in Room)

Physical Aspects — Object B

#	Physical Aspect	Measurement Device	Measurement Unit
1			
2			
3			
4			
5			

Part 3: Evaluating Measurement Feasibility

> ***Learning Goal:*** *Understand the practical constraints of scientific measurement and identify what resources are needed for different investigations.*

Not all measurements are equally accessible. Consider what you could measure *right now* versus what would require additional resources.

For Object A (In Room)

Which physical aspects could we measure tonight with available resources?

For aspects we cannot measure tonight, what would be required?

Check all that apply:

- [ ] Internet access (for reference data or remote sensing)
- [ ] Money or funding (to purchase equipment)
- [ ] Institutional review or permission
- [ ] Equipment from another location
- [ ] Specialized training or expertise
- [ ] Other:

Explain your reasoning for one aspect that requires additional resources:

For Object B (NOT in Room)

What would be required to measure this object's physical aspects?

What additional challenges exist compared to Object A?

Check all that apply:

- [ ] Physical access to the object
- [ ] Transportation of measurement equipment
- [ ] Time constraints
- [ ] Cost considerations
- [ ] Safety concerns
- [ ] Other:

Explain the most significant challenge:

Part 4: Making Measurements

> ***Learning Goal:*** *Practice the actual act of measurement, including choosing methods, recording data systematically, and documenting your methodology clearly.*

Now make some actual measurements of **Object A**. You may use formal instruments, estimation, or comparisons—the key is to document what you did and why.

Describe what you measured and how you did it for Object A:

Include: What aspects did you measure? What tools or methods did you use? What values did you obtain (with units)? What challenges did you encounter?

For Object B, describe how you would obtain measurements (or explain why direct measurement is not possible):

Part 5: Generating Questions from Observations

> ***Learning Goal:*** *Transition from pure measurement to scientific inquiry by using observations to generate meaningful, testable questions.*

Having examined your objects, now look at them with fresh eyes. What do you notice? What makes you curious?

Object A

What did you observe about Object A? *(Write 2 observations—things you noticed while measuring or examining the object)*

1.
2.

What questions do you have about Object A? *(Write 2 questions that your observations raised)*

1.
2.

Object B

What did you observe about Object B? *(Write 2 observations)*

1.
2.

What questions do you have about Object B? *(Write 2 questions)*

1.
2.

Tip: Good scientific questions often start with "How does...?", "What causes...?", "Why does...?", or "What would happen if...?"

Part 6: Designing an Investigation

> ***Learning Goal:*** *Connect questions to testable investigations by identifying relevant measurements, expected outcomes, and experimental conditions.*

Select **one question** from Part 5 for each object and develop an investigation plan.

Investigation for Object A

Selected question:

What situations or conditions would help answer this question?
(Example: Different temperatures, times of day, locations, or states of the object)

Which measurements from your list would be most relevant?

What range of values would you expect to observe, and why?

Investigation for Object B

Selected question:

What situations or conditions would help answer this question?

Which measurements would be most relevant?

What range of values would you expect, and why?

Part 7: Predicting and Representing Results

Learning Goal: *Practice scientific prediction and data visualization—essential skills for testing hypotheses and communicating findings.*

Choose one investigation from Part 6 and think through what results might look like.

What might typical results look like?
(Describe specific numbers, patterns, or trends you might observe)

How would you interpret different possible outcomes?
(What would high values mean? Low values? No pattern? An unexpected pattern?)

How would you visually represent this data?
(Describe or sketch: bar graph, line chart, scatter plot, table, diagram, etc. Explain why this format is appropriate.)

Part 8: Communicating Your Research

Learning Goal: *Understand that scientific work is incomplete until it is shared. Practice explaining your findings and identifying how this work could continue.*

Science is a collaborative endeavor. Discoveries only advance knowledge when they are communicated clearly to others.

Why is it important to communicate scientific findings?

Consider: How does sharing results benefit other scientists? How does it benefit society? What happens when research is not shared?

Summarize what you learned from this investigation in 2-3 sentences, as if explaining to a classmate:

What are the next steps you would take in this investigation, and why?

Consider: What follow-up questions emerged? What would you measure differently? What new conditions would you test? What equipment would help?

What limitations or uncertainties exist in your current findings?

Summary

In this lab, you practiced the complete arc of scientific measurement and inquiry:

Part	Skill	What You Learned
1	Object Selection	Choosing appropriate subjects for study
2	Physical Aspects	Identifying measurable properties
3	Feasibility	Evaluating practical constraints
4	Measurement	Collecting and documenting data
5	Observation	Generating questions from data
6	Investigation Design	Planning testable experiments
7	Prediction	Anticipating and representing results
8	Communication	Sharing findings and proposing next steps

Key Takeaway: Scientific measurement is not just about collecting numbers—it begins with curiosity, requires careful planning, and culminates in communicating discoveries and identifying new questions to pursue.