

# High School Science Problem Based Learning

## 30 PBL Activity Bundle

- ✓ Biology, Chemistry, and Physics PBLs
- ✓ Engaging, Student-Led Problem-Based Learning Projects



**No Prep - Ready to Go!**

# Biology Problem-Based Learning (PBL) Bundle

- ✓ Complete Biology PBL Bundle - 10 PBL Activities
- ✓ Engaging, Student-Led Problem-Based Learning Projects

# BIOLOGY



No Prep

# Chemistry Problem-Based Learning (PBL) Bundle

- ✓ Complete Chemistry PBL Bundle - 10 PBL Activities
- ✓ Engaging, Student-Led Problem-Based Learning Projects



No Prep - Ready to Go!

# Physics Problem-Based Learning (PBL) Bundle

- ✓ Complete Physics PBL Bundle - 10 PBL Activities
- ✓ Engaging, Student-Led Problem-Based Learning Projects

# PHYSICS



No Prep - Ready to Go!

# All PBLs include

- Background for Students
- Full Instructions Sets
- Guiding Questions

## PBL – Ecosystem in a Bottle: Model Matter Cycles

### Driving Question

How can a closed terrarium support life over several weeks?

### Background

Matter cycles (water, carbon, nitrogen) and energy flows sustain ecosystems. A balanced terrarium should recycle resources and stay stable.

### Materials (or simple substitutes)

- Clear bottle/jar with lid
- Gravel, activated charcoal, potting soil
- Small plants or moss (teacher-approved)
- Measuring cup, spray bottle
- Labels, camera

### Instructions

Step 1: Design layout and water volume; justify choices for drainage and gas exchange.  
Step 2: Build terrarium layers; plant and lightly water; seal as directed by your teacher.  
Step 3: Monitor weekly: temperature, condensation, plant growth, and any mold; adjust only if permitted.  
Step 4: Explain how observed changes show cycling and energy flow.

### Final Product

- Observation log with photos.
- Short explanation of water/carbon cycles operating in your terrarium.

### Rubric (20 points)

| Criteria          | Excellent (4)                                   | Good (3)                       | Fair (2)                  | Needs Work (1)                 |
|-------------------|-------------------------------------------------|--------------------------------|---------------------------|--------------------------------|
| Design Rationale  | Excellent (4)<br>Layering and volumes justified | Good (3)<br>Some justification | Fair (2)<br>Basic choices | Needs Work (1)<br>No rationale |
| Care & Safety     | Gentle handling; clean setup                    | Minor lapses                   | Occasional lapses         | Unsafe/neglect                 |
| Observations      | Regular, detailed records                       | Mostly regular                 | Sporadic                  | Few records                    |
| Systems Reasoning | Accurate cycles/energy links                    | Mostly correct                 | Basic                     | Incorrect                      |
| Communication     | Clear log & photos                              | Mostly clear                   | Some clutter              | Unclear                        |

## PBL – Heart Rate & Recovery: Body Systems in Balance

### Driving Question

How does activity level affect heart rate and recovery time?

### Background

Circulatory and respiratory systems work together to deliver oxygen. Heart rate rises during activity and returns toward baseline during recovery.

### Materials (or simple substitutes)

- Timer, heart rate measurement (manual pulse or app)
- Space for safe light exercise (teacher-approved)
- Data table

### Instructions

Step 1: Measure resting heart rates; plan safe, brief activity (e.g., step-ups).  
Step 2: Record heart rate immediately after and every minute for 5 minutes.  
Step 3: Graph recovery curves; compare different activity intensities or durations.  
Step 4: Discuss body system interactions and factors that affect recovery.

### Final Product

- Line graph of heart rate vs. time with analysis.
- Short explanation of system interactions.

### Rubric (20 points)

| Criteria      | Excellent (4)                          | Good (3)          | Fair (2)          | Needs Work (1) |
|---------------|----------------------------------------|-------------------|-------------------|----------------|
| Safety        | Appropriate, teacher-approved activity | Minor issues      | Occasional lapses | Unsafe         |
| Data          | Consistent timing; clear records       | Mostly consistent | Some gaps         | Sparse         |
| Analysis      | Well-labeled graph; trends explained   | Mostly clear      | Basic             | Incorrect      |
| Reasoning     | Accurate systems explanation           | Mostly correct    | Basic             | Incorrect      |
| Communication | Neat graph & summary                   | Mostly neat       | Some clutter      | Unclear        |

## PBL – Osmosis in Action: Potato Core Lab

### Driving Question

How does solute concentration affect water movement in plant cells?

### Background

Osmosis moves water across membranes from low solute concentration to high. Plant tissues gain or lose mass depending on surrounding solution.

### Materials (or simple substitutes)

- Potatoes, cork borer or knife to make similar cores (teacher-supervised)
- Cups with different salt (NaCl) solutions, one with plain water (control)
- Balance for mass measurements, labels, paper towels
- Timer, ruler (optional for length change)
- Goggles, cutting board

### Instructions

Step 1: Cut equal-size potato cores; blot dry; measure initial mass for each core.  
Step 2: Place cores in labeled solutions for a set time (e.g., 20–30 minutes).  
Step 3: Remove, blot, and measure final mass; calculate % mass change.  
Step 4: Graph % change vs. solution concentration and interpret net water movement.

### Final Product

- Graph of percent mass change versus solute concentration.
- Brief explanation using the terms hypertonic, hypotonic, and isotonic (age-appropriate).

### Rubric (20 points)

| Criteria            | Excellent (4)                                       | Good (3)        | Fair (2)             | Needs Work (1)     |
|---------------------|-----------------------------------------------------|-----------------|----------------------|--------------------|
| Measurement Quality | Equal core sizes; careful blotting; accurate masses | Mostly careful  | Some inconsistencies | Inaccurate/unequal |
| Data & Graphs       | Complete table and accurate graph                   | Mostly complete | Basic                | Sparse/incorrect   |
| Safety & Technique  | Knife use supervised; tidy lab                      | Minor lapses    | Occasional lapses    | Unsafe             |
| Reasoning           | Correct osmosis interpretation                      | Mostly correct  | Basic                | Incorrect          |
| Communication       | Clear labels and explanation                        | Mostly clear    | Some clutter         | Unclear            |

# Marking Rubrics

# Who is it for?

- **Middle School Life and Physical Science Teachers**
- **Teachers who want to increase their student engagement and retention**
- **Teachers who want low-prep and student-led classroom projects**

# Save yourself the **STRESS AND TIME**



**TWF**

# Spend your time WISELY

