**PBL Procedure[[1]](#footnote-0): What is in a PBL Unit?**

Use this page as a reference. The PBL procedure may be one lesson or may be the process throughout the whole unit. Lessons may focus on a small part of the procedure or highlight the iterative process needed to get closer to a solution**.**

**Understand the Problem*:*** Describe how you will launch your problem. In this portion of the unit, students will work towards a common understanding of what the problem is and what they need to know in order to solve the problem.

* Introduction / Problem launch
* Brainstorm what students know / Need to know
* Define / Refine the problem

**Explore the Problem*:*** How will students explore multiple ideas and pathways and challenge their current conceptions? How will all students access the information / context? Student groups will develop multiple solutions to the problem based on their evidence that will be shared in the next section.

* Gather information
* Share information
* Generate possible solutions

**Resolve the Problem*:*** Students should be able to provide an argument for each of the possible solutions and be given an opportunity to share and critique arguments. How will students reflect upon and share what they’ve learned? How will students synthesize their learning? If there are presentations involved with this PBL, how do you plan to help the non-presenters learn from presentations?

* Determine best fit solution
* Present the solution
* Debrief the problem

**Unit Overview**

**PBL Power Generation Unit**

Target Grade Level(s): Middle school/ High School

Subject(s): SpEd math/science/communication

Author(s): Brian Magraw, Katherine Woodard, Diane Zech Ed.D., Andrew Zaborski

**Problem Statement:**

How can a sustainable power source be developed to ensure all workers continue to be connected even without conventional power using agriculture?

Boeing wants to make sure their employees working from home can always be connected to their work groups. In the PNW during the winter, there are storms that knock out power sometimes for days at a time. How can a power source be developed to ensure all workers continue to be connected even without conventional power?

Scenario:

Mt. Rainier has had a partial eruption which caused lahars (a landslide caused by a volcanic eruption). The lahars have wiped out the hydroelectric dams, destroying their ability to produce electricity. An alternative to traditional electric power is needed now! Fossil fuels are not available but there are plenty of animals to help produce electric energy. How can a sustainable power source be developed to ensure all workers continue to be connected even without conventional power using agriculture?

**Unit Overview and Table of Contents**

**Clinical Interview Questions**

What is energy?

What is electricity? How do we harness it? How do we make it work for us?

| Skills/concepts | Instruction | Activity |
| --- | --- | --- |
| Launch | Story | Videos, articles? |
| Energy/power/electricity | Misconceptions about energy, prior knowledge | KWL  Webquest |
| Ways of harnessing energy | Instructional Videos | Webquest |
| Assign groups  Kids Choose a focus  Electronics? Animal? Treadmills/wheel/contraption? | Groups | Worksheet-google form?  Jamboard? |
| Research their animal-linear speed (burst Vs. Sustained), food, | Force\*Speed=Power  Power=[Watt]  Volts \* Amps = Watts |  |
| Research power of device | Efficiency (power lost) Friction |  |
| Formulas and Unit Conversion | Money, cooking, Time, Calories, cost per pound, cost per calorie (food labeling) | Math worksheet building to application to the project |
| Research how much power their contraption can produce-size of wheel? |  |  |
| Final Project |  | Powerpoint/slides? If still remote |

**Provide the following items for the entire unit:**

**Standards (NGSS, CCSS, CTE):**

**Soft Skills:**

Communication

Critical Thinking

Research

**Locally and/or Personally Relevant for Students:**

Understanding the power demands of technology and where it comes from

**Connections to career and educational pathways:**

Power Generation

Alternative Energy

Battery

Electrical Engineer

Physicist (lab)

Transmission Engineer

Trade career:

eletrictain

meter reader

Maintenance person

Animal care person

**Lesson 1: Introduction to the Problem**

**Problem statement:** Boeing wants to make sure their employees working from home can always be connected to their work groups. In the PNW during the winter, there are storms that knock out power sometimes for days at a time. How can a power source be developed to ensure all workers continue to be connected even without conventional power?

Scenario:

Mt. Rainier has had a partial eruption which caused lahars (a landslide caused by a volcanic eruption). The lahars have wiped out the hydroelectric dams, destroying their ability to produce electricity. An alternative to traditional electric power is needed now! Fossil fuels are not available but there are plenty of animals to help produce electric energy. How can a sustainable power source be developed to ensure all workers continue to be connected even without conventional power using agriculture?

You have been asked by Governor Inslee to figure out how to generate enough power to meet your household requirements such as lights, heat, power for electronics, etc.

**Learning objectives: Develop a basic understanding of power, how it works, and how it is measured.**

**Lesson standards (NGSS, CCSS, CTE):**

#### [CCSS.MATH.PRACTICE.MP1](http://www.corestandards.org/Math/Practice/MP1/) Make sense of problems and persevere in solving them.

#### [CCSS.MATH.PRACTICE.MP2](http://www.corestandards.org/Math/Practice/MP2/) Reason abstractly and quantitatively.

#### [CCSS.MATH.PRACTICE.MP3](http://www.corestandards.org/Math/Practice/MP3/) Construct viable arguments and critique the reasoning of others.

**Soft skills:**

* Habits of mind and ways of working together help students build their capacity for workplace expectations.
* Communication
* Collaboration with peers
* Critical Thinking
* Research
* evaluating data

**Locally and/or personally relevant for students:**

Understanding the power demands of technology and where it comes from

**Connections to career and educational pathways:**

**Power Generation**

Alternative Energy

Battery

Electrical Engineer

Physicist (lab)

Transmission Engineer

Trade career:

eletrictain

meter reader

assembly/ factory/

Maintenance person

Animal care person

**Materials:**

Videos <https://www.youtube.com/watch?v=cX4s-bxn4fs>

What is electricity?

spreadsheet

shared document

**Lesson preparation:**

Pre made links

Time required: 30 min.

Grouping of students for instruction:

Whole group with possible break out groups for comparison

**Understanding the Problem**

| **Teacher** | **Student** |
| --- | --- |
| Introducing the problem:  watch edited (for time) video of hamster power generation  <https://www.youtube.com/watch?v=01iDVrKmi9w>  Edit down for time\* | Researching elements around the launch and then defining what the problem actually is.  Student will discuss:  What is power?  How is it made?  How is harnessed?  How much is needed to power different devices?  How is it measured? |
| Guided teacher instruction/discussion:  Know Want Learn (KWL)  What do you already know?  What do you want to learn?  What have you learned? | Research size/speed of animals (google or premade links).  Research power generation methods |
| Facilitating a discussion in groups and the whole class using the following protocol…  Making predictions  Think Pair Share  Overview of math and spreadsheet | Brainstorming what they already know and what they need to know about this problem…  Form Hypothesis based on animals Size  (Jamboard/whiteboard/onenote ect)  ie. big/medium/small |

**Accommodations:**

All students have IEP with individualized modifications and accommodations.

Print out material if needed.

Prepare leveled reading material.

Access to Text to speech on digital text.

Create sentences starters for writing.

Prepare premade topics for discussion for students with communication or ELL needs.

**Extensions:**

Sketch prototypes of devices

Introduction of math formulas

**Assessment: Google Form**

**Lesson 2 and Animals and power what are they good for?**

**Problem statement:** How can a sustainable power source be developed to ensure all workers continue to be connected even without conventional power using agriculture?

**Learning objectives: Using data to evaluate concepts and experiment with power generations as a team.**

**Lesson standards (NGSS, CCSS, CTE):**

#### [CCSS.MATH.PRACTICE.MP1](http://www.corestandards.org/Math/Practice/MP1/) Make sense of problems and persevere in solving them.

#### [CCSS.MATH.PRACTICE.MP2](http://www.corestandards.org/Math/Practice/MP2/) Reason abstractly and quantitatively.

#### [CCSS.MATH.PRACTICE.MP3](http://www.corestandards.org/Math/Practice/MP3/) Construct viable arguments and critique the reasoning of others.

**Soft skills:**

* Communication
* Collaboration with peers
* Critical Thinking
* Research
* evaluating data

**Locally and/or personally relevant for students:**

We have all been in power outages. They are more than just an inconvenience they can be life threatening especially for elderly of people with health concerns.

**Connections to career and educational pathways:**

Different jobs that deal with power, engineering, agriculture, social services, public works, transportation, any industry that relies on power (that's all of them!)

Trade career:

* eletrictain
* meter reader
* assembly/ factory/
* Maintenance person
* Animal care person

**Materials: Power generation spreadsheet**

[**Power spreadsheet**](https://docs.google.com/spreadsheets/d/15G3HUr7NTcGO4mNOeMvDFy--MmrbE6q_663NlAsySU8/edit?usp=drive_web)

**Lesson preparation:** Review spreadsheet and select level for your class. Be sure to include detailed math lesson extensions for minimal spreadsheet.

Time required: 30 min

**Grouping of students for instruction:**

Group student in small groups 3-4 students

| **Teacher** | **Student** |
| --- | --- |
| Reviewing the problem  Reviewing Hypothesis | Restate problem and hypothesis  research animals average speed and mass |
| Spreadsheet to compare data  Which animals make most sense for power generation  \*scaffolding limit # of animals  -Spread sheet has 3 levels of scaffolding Maximums support , mid level support and minimal support | Generating conclusions with class.  Share out/ evaluating hypotheses  End on feasibility of using animals for power generation  Asking each team questions for later lessons |

**Accommodations:**

All students have IEP with individualized modifications and accommodations.

Print out material if needed.

Prepave leveled reading material.

have access to Text to speech on digital text.

Have sentence starters for writing.

Have premade topics for discussion for students with communication or ELL needs.

**Extensions:**

**Explore careers**

* electrician
* meter reader
* assembly/ factory/
* Maintenance person
* Animal care person

**Assessment:**

Spreadsheet

Choose animals

Restate Hypothesis

**References/Resources:**

* Attach any materials students will use during the lesson; e.g., handouts, questions to answer, and worksheets. Alternatively, student materials may be stored as separate files.
* <https://www.youtube.com/watch?v=01iDVrKmi9w>
* Power Spreadsheet

**Lesson 3 Bringing it together**

**Problem statement:** How can a sustainable power source be developed to ensure all workers continue to be connected even without conventional power using agriculture?

**Learning objectives: displaying outcomes and conclusions**

**powerpoint slide/jam board/white board**

**Lesson standards (NGSS, CCSS, CTE):**

#### [CCSS.MATH.PRACTICE.MP1](http://www.corestandards.org/Math/Practice/MP1/) Make sense of problems and persevere in solving them.

#### [CCSS.MATH.PRACTICE.MP2](http://www.corestandards.org/Math/Practice/MP2/) Reason abstractly and quantitatively.

#### [CCSS.MATH.PRACTICE.MP3](http://www.corestandards.org/Math/Practice/MP3/) Construct viable arguments and critique the reasoning of others.

**Soft skills:**

* Communication
* Collaboration with peers
* Critical Thinking
* Research
* evaluating data

**Materials:** Poster, Jambaord, Whiteboard, Onenote ect.

Lesson preparation: Review of hypothesis with students. Drawing on group discussion from class. setting up Jamboard/White board for groups

**Time required: 30 min**

**Grouping of students for instruction:**

Continuing pre-made groups from previous lessons.

Roles: facilitator, writing/note taker, time keeper, resource manager

**Resolving the problem**

Take your conclusion from the worksheet and create a way to communicate your findings. ie. Animal(s) you choses, power generated, feasibility, and any other learning you may have thought of or want to talk about.

**Break student back into preset groups and assign roles (**facilitator, writing/note taker, time keeper, resource manager)

Give instruction to relay conclusions on a given platform (Poster, Jambaord, Whiteboard, onenote ect.)

Share out findings to class.

**Accommodations:**

All students have IEP with individualized modifications and accommodations.

Print out material if needed.

Prepave leveled reading material.

have access to Text to speech on digital text.

Have sentence starters for writing.

Have premade topics for discussion for students with communication or ELL needs.

**Extensions:**

Career Exploration

Alternative power generation

Battery technology and exploration

**Assessment:**

How will you assess student learning during the problem? Through collaborative board with results

Will there be both whole group elements and individual accountability? Check out form with peer evaluations

| **Expectations Rubric** | **Exceeding** | **Meeting** | **Beginning** |
| --- | --- | --- | --- |
| Participation | * Took on leadership role * engaged in each lesson with group in a meaningful way ie. asked questions, choose a role * contributed ideas | * Engaged in each lesson with group in a meaningful way ie. asked questions, choose a role * contributed ideas | Particaited in 1 or 2 lessons. |
| Critical thinking skills | * creating hypothesis and drawing conclusion from the worksheet * evaluate data | Creating hypothesis and drawing conclusion from the worksheet | Restated the problem clearly |
| End product | * contains compare and contrast * evaluates thinking in clear and concise terms * contains all of meeting expectations | Contains at least:   * Why you chose the animal(s) you choses * power generated, * feasibility * any other learning | Choses animals and are able to show power generated. |

**Resources used for the whole unit can be captured at the end. Resources used only in one lesson should be noted individually for that lesson plan and at the end**.

**References/Resources:**

* Power spreadsheet
* access to collaborative tool ie Jam board/white board

**Self Evaluation: circle the area for each skill you achieved**

**Peer Evaluation: circle the areas for each skill your group achieved**

| **Expectations Rubric** | **Exceeding** | **Meeting** | **Beginning** |
| --- | --- | --- | --- |
| **Participation** | * Took on leadership role * engaged in each lesson with group in a meaningful way ie. asked questions, choose a role * contributed ideas | * Engaged in each lesson with group in a meaningful way ie. asked questions, choose a role * contributed ideas | Particaited in 1 or 2 lessons. |
| **Critical thinking skills** | * creating hypothesis and drawing conclusion from the worksheet * evaluate data | Creating hypothesis and drawing conclusion from the worksheet | Restated the problem clearly |
| **End product** | * contains compare and contrast * evaluates thinking in clear and concise terms * contains all of meeting expectations | Contains at least:   * Why you chose the animal(s) you choses * power generated, * feasibility * any other learning | Choses animals and are able to show power generated. |

1. The sub-sections of the procedure section (e.g., Understand the Problem, Explore the Problem) are from the Illinois Math and Science Academy’s PBL Teaching and Learning Template. The descriptions were developed by WABS and do not necessarily represent the views of IMSA. [↑](#footnote-ref-0)