**PBL Learning Experience Design: Locker Problem**

**Summary of the Problem Topic (role and situation):**

Students in grades 6,7 and 8 tend to be very disorganized, have a lot of things to put in a small space, are late to class and are forced due to the number of lockers to share lockers with another student. Because of these factors, they are often late to class, which may result in a lunch detention as well as a loss of instructional time in class.

**Learner Characteristics:**

Orchard middle grades students are:

* (grade 6) new to middle school.
* (grades 7 and 8) accustomed to using lockers.
* have some knowledge of measuring and geometry
* have some knowledge of the scientific method
* have limited knowledge of the methodology of formal research
* have some knowledge of the use of the internet but mostly for leisure rather than for formal research.

**Learner Outcomes:**

Students will be able to:

solve authentic problems in group settings.

communicate and express ideas through formal presentations.

make connections between subject areas through the solution to a formal problem.

**Ohio Learning Standards and Performance Indicators:**

**Math**

grade 6

Geometry

1. Classify and describe two-dimensional and three-dimensional geometric figures and objects by using their properties; e.g., interior angle measures, perpendicular/parallel sides, congruent angles/sides.
2. data analysis and probability: Select,create and use graphical representations that are appropriate for the type of data collected.

grade 7

geometry

1. Determine and use scale factors for similar figures to solve problems using proportional reasoning.

9. Draw representations of three-dimensional geometric objects from different views.

Data Analysis and Probability:

1. Read, create and interpret box-and-whisker plots, stem-and-leaf plots, and other types of graphs, when appropriate. 2. Analyze how decisions about graphing affect the graphical representation; e.g., scale, size of classes in a histogram, number of categories in a circle

Measurement:

1. Estimate a measurement to a greater degree of precision than the tool provides.

Geometry and Spatial Sense

2. Determine sufficient(not necessarily minimal) properties that define a specific two-dimensional figure or three-dimensional object. For example:

a. Determine when one set of figures is a subset of another; e.g., all squares are rectangles.

grade 8

data analysis and probability:

\* identify different ways of selecting samples, such as survey response, random sample, representative sample and convenience sample.

measurement:

Use appropriate levels of precision when calculating with measurements.

* Demonstrate understanding of the concepts of perimeter, circumference and area by using established formulas for triangles, quadrilaterals, and circles to determine the surface area and volume of prisms, pyramids, cylinders, spheres and cones.
* Use conventional formulas to find the surface area and volume of prisms, pyramids and cylinders and the volume of spheres and cones to a specified level of precision.

Geometry

* Draw nets for a variety of prisms, pyramids, cylinders and cones.

**ELA Standards:**

Grades 6, 7, and 8

Reading Processes:

* Establish and adjust purposes for reading, including to find out, to understand, to interpret, to enjoy and to solve problems.
* Summarize the information in texts, recognizing important ideas and supporting details, and noting gaps or contradictions.
* Select, create and use graphic organizers to interpret textual information.

Reading Application:

* Analyze examples of cause and effect and fact and opinion.
* Compare and contrast important details about a topic,using different sources of information, including books, magazines, newspapers and online resources
* Analyze information found in maps,charts,tables,graphs,diagrams and cutaways.

Writing Processes:

* Conduct background reading, interviews or surveys when appropriate.
* Use organizational strategies (e.g., rough outlines, diagrams, maps, webs and Venn diagrams) to plan writing.
* Use available technology to compose text.
* Prepare for publication (e.g., for display or for sharing with others) writing that follows a format appropriate to the purpose, using such techniques as electronic resources, principles of design (e.g., margins, tabs, spacing and columns) and graphics (e.g., drawings, charts and graphs) to enhance the final product.

**Grade 6 ELA:**

*Research*

2. Identify appropriate sources and gather relevant information from multiple sources (e.g., books, online/electronic resources)

4. Select an appropriate structure for organizing information in a systematic way (e.g., notes, charts, and graphic organizers)

7. Use an appropriate form of documentation, with teacher assistance, to acknowledge sources (e.g., bibliography, works cited).

 Communication - Oral and Visual

1. Apply active listening strategies (e.g., monitoring message for clarity, selecting and organizing essential information, noting cues such as changes in pace).

8. Deliver informational presentations (e.g., research) that:

    a. demonstrate understanding of the topic and present events or ideas in a logical sequence.

    b. support the controlling idea or thesis with well-chosen and relevant facts, details, examples.

       quotations, statistics, stories, and anecdotes).

    c. include an effective introduction and conclusion and use a consistent organizational

       structure (e.g., cause and effect, compare-contrast, problem-solution).

    d. use appropriate visual materials (e.g., diagrams, charts, illustrations) and available technology.

    e. draw from multiple sources and identify sources used.

**Science**

Grades 6, 7 and 8

Science and Technology

* Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.
* Give examples of how technological advances, influenced by scientific knowledge, affect the quality of life.

Scientific Inquiry

* Explain that there are differing sets of procedures for guiding scientific investigations and procedures are determined by the nature of the investigation, safety considerations and appropriate tools.
* Analyze and interpret data from scientific investigations using appropriate mathematical skills in order to draw valid conclusions.

Scientific Ways of Knowing

* Use skills of scientific inquiry processes (e.g., hypothesis, record keeping, description and explanation).
* Explain the importance of reproducibility and reduction of bias in scientific methods.
* Give examples of how thinking scientifically is helpful in daily life.

**Resources:**

**Math**

videos of students during hallway passage time

you tube video of locker issues

**ELA**:

* article about locker
* books from library
* internet
* expert opinion (NASA engineers)
* articles from online resources

**SCIENCE**

**Assessment tools:**

**Math**

summative assessment:

survey results in a graph. (grades 6 and 7)

measurements of the locker

scale model sketch of the locker

final model of the organizer (cost of materials, measurements: need to do a rubric for this piece)

formative assessment:

observation of the students using the tape measures and how they precisely measure the lockers’ dimensions.

graph of the survey results.

**ELA:**

* persuasive letter
* research sheets
* oral presentation rubric
* peer (group) rubric

**Science**

Prompt questions

Plans and sketches of their designs

List of materials needed

Developed hypothesis

List of procedures

Creation of locker organizers

Data

Completed Conclusion

Presentation and model

**Journal Prompts:**

ELA

1.) How do you think the locker problem/ project is going so far? Elaborate. Any suggestions?

2.) Did your research influence your final group project?

3.) How would you evaluate your finished locker project?

Science:

-What questions do you still have about the problem?

-What possible solutions exist? What are the pros and cons of each solutions?

**Debriefing Prompts:**

Science:

-What did you find out about the variety of materials that help you to better understand the problem and solutions?

-What were the similarities and differences between the types of materials you used?

-How will your organizer help other students in keeping their lockers organized?

-Is your locker organizer cost, safety, and time efficient, and does it look good?

Math:

grade 8:

-What are the locker’s actual measurement?

* How can you write/create a visual representation of the organizer?
* What is the area of the shelf? Is it a square/ rectangle? How do you find rectangle’s areas?
* If you put an organizer on the door, what are the dimensions of the door? How can you use that information to find the surface area?

grade 7:

* What are the measurements of the organizer? How can you use the locker’s dimensions to assist you with finding this information?
* What materials will you use? How will your materials influence your design? your dimensions?
* What will you do to hold the organizer in place?

grade 6:

-What are the dimensions of the locker?

-What is the size of the shelf?

* How can I find the area of a rectangle? How will that help me with the locker organizer?
* Is there enough space on the shelves for my bookbag? coats? wet boots? etc.
* What tools do I need to construct my organizer?
* Is superglue strong enough to hold my organizer in place?
* How much will my materials weigh? How thick are they?

**Role:**

Students take on the role of locker organizer insert creators.

**Situation**:

The teachers are tired of telling the kids to clean the hallway, of the kids being late for class and the lockers being an issue in general.

**Anticipated Problem Statement:**

How can students design an organizational insert for their lockers in such a way that:

you work in groups,

consider the size of the lockers,

share with another student,

considers that the materials may only be available to make a prototype.

cost of the materials,

3 minute bell time

personal belongings in the locker.

**Anticipated Need to Know Questions:**

* size of lockers
* how many books can fit in the lockers
* weight and dimensions of books
* what other designs exist in the market already?
* how do you design the product
* how do you safely use measuring tools
* how do i compile research and present the report
* how do i keep materials together

**Performance Assessment Rubric**

| **component** | **exceeds expectations** | **meets expectations** | **does not meet expectations** |
| --- | --- | --- | --- |
| appropriateness to audience (style, vocabulary) | style, form and vocabulary are purposefully targeted to audience. | style, form and vocabulary are appropriate for the audience. | style, form and vocabulary are too casual (slang) |
| math content | shows strong knowledge of measuring with precision. | shows some knowledge of measuring with precision | shows little knowledge of measuring with precision |
| math content | shows strong knowledge of scale model | shows some knowledge of scale model | shows little knowledge of scale model |
| math content | shows strong knowledge of calculating area measures and surface area | shows some knowledge of calculating area measures and surface area | shows little knowledge of calculating area measures and surface area |
| fit of solution to the problem statement | strong evidence that all criteria of problem statement were met | evidence that most criteria of problem statement were met | little evidence that criteria of problem statement were met |
| graphics (charts, graphs, etc.) | effective graphics enhanced the presentation, including but not limited to scale drawing | clear graphics supported the presentation, including, but not limited to scale drawing | few or no graphics, no scale drawing |

Oral Presentation Rubric

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Category | 4 | 3 | 2 | 1 |
| Research Content | Group shows full understanding of the use of small space design and possible materials for locker organizer. | Group shows good understanding  of the use of small space design and possible materials for locker organizer. | Group shows a partial understanding  of the use of small space design and possible materials for locker organizer. | Does not seem to understand the use of small space design and possible materials for locker organizer. |
| Comprehension | Group is able to accurately answer all questions posed by classmates about the topic. | Group is able to accurately answer most questions posed by classmates about the topic. | Group is able to accurately answer a few questions posed by classmates about the topic. | Group is unable to accurately answer questions posed by classmates about the topic. |
| Preparedness | Group is completely prepared and has obviously rehearsed. | Group seems pretty prepared but might have needed a couple more rehearsals. | The group is somewhat prepared, but is clear that rehearsal was lacking. | Group does not seem at all prepared to present. |
| Stays on Topic | Stays on topic all of the time. | Stays on topic most of the time. | Stays on topic some of the time. | It was hard to tell what the topic was. |
| Speaks Clearly/Volume | Speaks clearly and distinctly all of the time. | Speaks clearly and distinctly most of the time. | Speaks clearly and distinctly part of the time. | Often mumbles or cannot be understood majority of the time. |
| Comments |  |  |  |  |

Science Rubric

**Exceeds Expectations:**

Makes highly detailed plans of models and a complete list of appropriate material

Makes an accurate sketch on graph paper and accurately constructs a complete scale model that includes boundaries of the organizer and all objects within the boundaries

Appropriately uses and describes safety methods used during investigations

Uses all steps of the scientific method (Purpose, research, hypothesis, materials, procedure, analysis and conclusion)

Creates an organizer, taking into account for time, materials, safety, aesthetics and needs

Thoroughly explains how their design will affect the quality of life for students

**Meets Expectations:**

Makes mostly detailed plans of models and a complete list of appropriate material

Makes an accurate sketch on graph paper and adequately constructs a complete scale model that includes boundaries if the organizer and all objects within the boundaries

Appropriately uses and describes safely methods used during investigations

Uses all steps of the scientific method except one (possibly)

Creates an organizer, taking into accounts constraints and needs (can miss one)

Explains effectively how their design will affect the quality of life for students

**Does Not Meet Expectations:**

Makes average plans of models and an average list of materials

Makes a sketch but does not construct a complete scale model that includes boundaries of the organizer and all objects within the boundaries

Uses and describes some safety methods used

Creates an incomplete organizer

Is not effective in explaining how their design will affect their quality of life