

TIES
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Teachers in Industry for Educational Support

Pavement and Exterior Building Maintenance Using Similarity and Cost Analysis

Developed by:

John Barrera, Brookville High School, Mathematics

Ann Bertke, Carroll High School, Mathematics

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Curriculum Unit Overview

Summary

This unit relates how similarity and cost analysis relate to tasks in the civil engineering field. Principles from Geometry and Algebra I will be linked to “real world” situations. Applications of map making and scaling will also be incorporated. Scientific analysis of durability of materials will be included as well as requiring students to articulate in both written and oral form their findings and strategies of their project. Other topics that can be related to this project are architecture, construction, materials engineering, and marketing. This project is geared towards high school students of all abilities. The ideal amount of time for this unit would be small projects and overall compilation taking nine weeks or one quarter with class time once a week devoted to questions and instruction. Approximately nine hours of class time in the quarter would be used.

Big Picture

One hook activity which could be used to jump start this project is an examination of your school’s parking lot and exterior grounds. Have students list items they would like to see repaired or changed. Talk about ways to improve the parking situation or exterior impression which your building has.

Preparation for the Unit

Work with science teachers to research durability of different construction materials such as concrete, asphalt, luminous paint, and exterior paint. Work with English teachers to develop a rubric which non-English teachers are comfortable with in order to grade persuasive and research papers. Call different companies to find prices of materials for pavement, curbs, sidewalks, and exterior paint, lights, windows, and railings. Compile worksheets to explain the principles of similarity, how to read a map, and cost analysis.

Overview

On the following page is a summary of the unit including brief summaries of each Authentic Learning Task (ALT). This table provides an overview of the tasks in the unit sections and shows how the activities in the different teaching areas relate to each other.

**Pavement and Exterior Building Maintenance Using Similarity and Cost Analysis
Curriculum Unit Summary**

Math Application	Science Application	English Application
<p>ALT 1 - Parking Lot Maintenance Competencies: Determination of area, maximization of space, cost analysis of materials, creation of maps to scale Method of learning: Pair learning</p>	<p>ALT 1 – Parking Lot Maintenance Competencies: compilation of needed materials, study of environmental impact of materials, research of durability of materials Method of learning: Pair learning</p>	<p>ALT 1 – Parking Lot Maintenance Competencies: learn how to incorporate research in writing, write persuasive essay to prove which proposal is best situated to the problem Method of learning: Pair learning</p>
<p>ALT 2 –Exterior Building Maintenance Competencies: Similarity of model to figure, area formulas and applications Method of learning: Pair learning</p>	<p>ALT 2 – Exterior Building Maintenance Competencies: compilation of needed materials, environmental impact of materials, durability of materials Method of learning: Pair learning</p>	<p>ALT 2 – Exterior Building Maintenance Competencies: learn how to articulate ideas of actual projects in writing, use of persuasive writing Method of learning: Pair learning</p>
<p>ALT 3 – Exterior Landscaping Competencies: use of modeling to develop plan, use of volume and area applications, cost analysis Method of learning: Pair learning</p>	<p>ALT 3 –Exterior Landscaping Competencies: research of which types of flora fit particular areas, research of care and maintenance for chosen plants Method of learning: Pair learning</p>	<p>ALT 3 – Exterior Landscaping Competencies: Write proposal including research for plants and costs Method of learning: Pair learning</p>
<p>Transfer or Culminating Activity</p> <p>Students will work in pairs to create their own building and grounds using a three-dimensional model. All parking, sidewalks, curbs, landscaping, and exterior building materials will be displayed. Students will show in report form all materials needed and costs. They will also include why they chose the layout in the form of a fact-based persuasive essay and oral presentation.</p>		

Section One: Math, Science, and English Applications

ALT One: Parking Lot Maintenance

Summary

Students will work in pairs to examine the school's parking lot. They will measure sections of asphalt, curb, and sidewalk. They will designate which portions are in need of repair. They will create a map to scale, find cost estimates, and materials needed. Final activity will require a written proposal.

Competencies

1. Similarity principles 70% or above on all worksheets
2. Area formulas 70% or above on all worksheets
3. Cost analysis 70% or above on all worksheets
4. Research and Application of materials Bibliography of resources and cost worksheet
5. Ability to translate research into essay form Use of rubric developed online

Time

One to two hours of instruction time will be needed for this ALT. Students will need to use homework time to complete all tasks.

Materials

Yardsticks or tape measures; worksheets on similarity, area formulas, and cost analysis; compilation of resources in which students can find environmental effects of materials; art paper to create scalar maps; pens, pencils, crayons, and markers for maps; essay guidelines for written proposal.

Instructions

We suggest starting this ALT with the worksheets on similarity and area. Next take students (working in pairs) to parking lot to measure areas which need repair. You may wish to divide your parking lot into sectors in order to utilize your time more effectively. Show how to develop a map from measurements. Walk through the formulas to figure out cost analysis and have students complete a worksheet. Have students look up materials needed and environmental impact of those materials. At the end have students submit written proposal of cost and the need to repair and upkeep their particular sector. Stress the need for at least two options (asphalt versus concrete for example). All project work is done in pairs. All worksheets are done on an individual basis.

Evaluation/Assessment of Student’s Competency

Worksheets will be graded on percentage correct.

Map will be graded on accuracy of scale.

Durability will be graded on proper citation of resources.

Written proposal will be graded on proper grammatical structure and incorporation of research.

Reminder: Worksheets are on an individual basis and everything else is one per pair.

Closure

This ALT will cover parking lot maintenance. This leads directly into Exterior Building Maintenance. Students will continue to apply similarity, area, and cost analysis to real world situations. This activity will move students from two dimensional to three dimensional objects.

Section Two: Math, Science, and English Applications

ALT Two: Exterior Building Maintenance

Summary

Each team of two will be assigned a portion of the school's building to examine the need for repair or upkeep. They will measure the building, develop a scale model, develop cost analysis, and research durability of materials. Students will also be required to submit a written proposal of their research.

Competencies

- | | |
|--|--|
| 1. Reinforcement of Similarity | Quiz 70% or higher |
| 2. Reinforcement of Area | Quiz 70% or higher |
| 3. Three-dimensional models | Accuracy of scale |
| 4. Research and application of materials | List of websites and citation of information |
| 5. Cost analysis | Paper showing all calculations and work |
| 6. Transfer of research to written word | Essay rubric |

Time

One to two hours of class time. Additional homework time will be required from students.

Materials

Tape measures or rulers; building plan in order to compare measurements; list of costs for materials; research sites to find durability of materials; art paper to create scalar maps; pens, pencils, crayons, and markers for maps; essay guidelines for written proposal.

Instructions

Start this section with quizzes and worksheets. Have students survey their assigned areas of the school's building. Students should measure amount of area covered by paint, windows, and lighting. Students should create a scale model of their area. The scale should be a three-dimensional drawing to show realism. Students need to list materials needed for their portion of the building along with costs for materials. Students should figure out total cost for their specific sector. Students need to write a cost proposal incorporating research to support their findings.

Evaluation/Assessment of Student's Competency

Quizzes and Worksheets 70% or above.

Research will be graded on accuracy of citations and sources.

Essay will be graded based on rubric developed from the rubric website.

Closure

ALT Two reinforces topics learned in ALT One. Students continue to use topics of math, science, and English to work out real world problems. ALT Three will focus more on aesthetic plans for exteriors of buildings.

Section Three: Math, Science, and English Applications

ALT Three: Exterior Landscaping

Summary

Each pair of students will create a model for landscaping a 20 yd. by 20 yd. exterior commons area. Model can incorporate gathering area, plants, shrubs, trees, and walkways.

Competencies

1. Use of space 100% of area must be accounted for .
2. Development of two-dimensional model which includes sketches drawn to scale and key of symbols.
3. Research of flora and ground cover which can be used in this space.
4. Essay which summarizes and explains choices made including cost analysis of materials used.

Time

One to two hours of instruction time. Students will be required to use additional homework time.

Materials

Same materials as ALT Two.

Instructions

Students will work in pairs to create a landscaping plan for a 20 yd. by 20 yd. sector. Students will mark all walkways, seating areas, lawn, plants, and trees. Materials for each item will be listed along with a key to show where each is used in the model. Students will formulate a cost analysis for materials used and write a proposal for cost and utilization of space. The essay should also include reasons for the selection of all plants, trees, and other materials.

Evaluation/Assessment of Student's Competency

A rubric which can be developed online will be used to grade the essay. The model will be graded on total use of space and thoroughness of key.

Closure

ALT Three incorporates all principles from ALT One and ALT Two with an extension to nonmaterial space. Students are required to visualize a set area without actually seeing it. This leads into the transfer activity where students will create their own building lot.

Transfer Activity

Title: Creating Your Own Building Site

Summary:

Each team will be given a three-dimensional object to represent their building and a poster board to represent their lot. Students will develop a plan for building placement, parking lots, and landscaping. Cost analysis of parking lot and landscaping will be formed and included in a written essay explaining how they developed their lot. Teams will also give a five minute oral presentation on their lot.

Time:

Two to three hours of class time will be needed. Students will be required to use additional homework time.

Materials:

Various three dimensional objects to use as buildings; poster boards; rulers; compasses; pens, pencils, crayons, and markers; materials which can be used for three dimensional representation of landscaping; students will need the three ALT projects back for reference.

Instructions:

Each team will be given one three-dimensional object and a poster board to do their model. Students need to include at least 30 parking spaces for their building and landscaping along $\frac{3}{4}$ of the perimeter of their lot and building. Students need to create a scaled model along with three-dimensional representation of all landscaping on poster board. Essay should include reasons for placement of building, parking lot design, and choices for landscaping. Essay should also include cost analysis of parking lot and landscaping on summary and reasons for their choices including cost and visual appeal. Oral report needs to explain why the layout was chosen and the model must be ready to display.

Evaluation/Assessment of Students' Competency:

Three separate rubrics will be needed to grade this project. One rubric for the model, one rubric for the essay, and one rubric for the oral presentation will need to be developed. We have included online resources for you to use to develop your rubrics.

Appendices:

Due to the nature of mathematics textbooks, we have not included particular worksheets. Instead we are providing some websites which might help you develop worksheets suited to your school's particular curriculum. I would like to note that the particular series I use in my school comes with both a teacher and students support website that allows me to access worksheets and lesson plans for my topics. My particular publisher is McDougal Littell and I am sure they are not alone in this service. Some other websites which can help you with evaluation are as follows.

Rubrics: These can be used for all essays, models, and research portions of the projects. You are lead through a step by step process which allows you to incorporate those areas which you wish to stress.

The website which both John and I are familiar with is <http://rubistar.4teachers.org/>.

Here are a few others you might find helpful:

http://landmarks4schools.org/classweb/tools/rubric_builder.php3

http://webpdp.gator.com/v3/webpdp_v3_plugin.php?yic=HIC_L90DT

(the one above works great to create a math rubric)

<http://www.cloudnet.com/~edrbsass/edmath.htm#rubrics>

(also great for math rubrics)

Worksheets and Quizzes: Obviously worksheets on similarity, area, and cost analysis are usually included with the resources of your own textbook. As mentioned before, your textbook most likely has a website with alternative resources for you. We are including a website that will give you problems for the topics you wish to stress.

<http://www.edhelper.com/math>

I am also including my email address for anyone who has questions. Please put TIES somewhere in the subject line or your message could be deleted.

To contact Ann Bertke my school email is abertke@carrollhs.org.