

GOVERNOR'S INSTITUTE FOR CONSTRUCTION TECHNOLOGY CAREERS
MAKING ACADEMIC COURSES MORE VOCATIONALLY RELEVANT
SAMPLE LESSON PLAN

PROGRAM: MATHEMATICS

COURSE: APPLIED GEOMETRY (10th grade)

UNIT: VOLUME

LESSON TITLE: CREATING A "CONCRETE" SPREADSHEET

TERMINAL OBJECTIVE: Working in groups of three, students will be able to create a spreadsheet that will calculate the amount of concrete needed to pour a:

A. Square Pier - *Square Prism*: $V = s^2h$

B. Round Pier - *Circular Prism or Cylinder*: $V = r^2h$

C. Battered or Tapered Pier - *Square Frustrum*: $V = \frac{1}{3}h \left(A_B + A_b + \sqrt{(A_B A_b)} \right)$

D. Continuous or Spread Footer:

Rectangular Prism within a Rectangular Prism: $V = LWh - lwh$

E. Foundation Wall:

Rectangular Prism within a Rectangular Prism: $V = LWh - lwh$

F. Grade Beam: *Rectangular Prism*: $V = lwh$

G. Slab with a Foundation: *Rectangular Prism*: $V = lwh$

H. Slab with a Thickened Edge (Monolithic Slab or Pour)

Rectangular Prism with a Rectangular Frustrum Cutout:

$$V = LWH - \frac{1}{3}h \left(A_B + A_b + \sqrt{(A_B A_b)} \right)$$

Note: No stepped piers or continuous stepped footers are used in this exercise. Since the answers need not be exact, the concrete displaced by rebar shall be ignored.

ENABLING OBJECTIVES (4):

- A. Students are able to identify various 3-dimensional geometric shapes.
- B. Students are able to calculate area and volume of composite shapes.
- C. Students are able to convert units of linear and cubic measurement.
- D. Students are able to create spreadsheets using the correct formulas.

INTRODUCTION: Using an overhead projector and geometric models, each of various concrete forms to be included in the spreadsheet will be shown. As a class, each of the forms will be identified as a specific 3-dimensional shape or composite shape, and the appropriate formulas for finding their volume will be reviewed. All measurements will need to be entered in "feet" and the answer converted to "cubic yards".

BODY: The teacher will distribute a worksheet containing the basic format to be used in the spreadsheet and the dimensions to be used. Since this an activity that is being used to reinforce the student's knowledge of calculating volume, the teacher should only need to assist when necessary and to answer student questions. It is hoped that each group will contain at least one student with some basic understanding of concrete, and that each

group will contain at least one student with skills in creating spreadsheets. When each student group has created a spreadsheet for calculating the concrete needed for a specific form, the teacher will check the accuracy of their spreadsheet by asking the group to change the form dimensions originally listed to different pre-determined values.

MAIN POINTS: The square pier, the round pier, the battered pier, the grade beam, and the slab with a foundation are specific 3-dimensional geometric shapes for which the student has a formula for calculating the volume. The continuous footer, the foundation wall, and the slab with thickened edges are composite geometric shapes that will require the student to create the necessary formulas for finding the volume. For those students in the construction-related vocations, it is hoped that this lesson might show the need to acquire skills for estimating or bidding a job.

SUMMARY: This is a lesson that would be taught very near to the end of unit on volume. If the students have difficulty creating formulas for calculating the volume of the various concrete forms, it may be necessary to reteach parts of the unit before administering the unit test. If students do not have much experience with group projects, it may be necessary to take two days for this lesson to be completed.

TOOLS & MATERIALS NEEDED:

- A. Overhead projector with overheads
- B. Three-Dimensional Geometric Models
- C. Computers with Spreadsheet Capabilities

PENNSYLVANIA ACADEMIC SKILL STANDARDS BEING INTEGRATED:

READING, WRITING, SPEAKING, AND LISTENING

- A. 1.1.11(F) - Understand the meaning of and apply key vocabulary across the various subject areas.
- B. 1.6.11(A) - Listen to others, Ask clarifying questions, Synthesize information, ideas and opinions to determine relevancy, Take notes.
- C. 1.6.11(D) - Contribute to discussions, Ask relevant questions, Respond with relevant information or opinions when asked, Listen to contributions of others, Facilitate total group participation, Introduce relevant information to enrich the discussion.

MATHEMATICS

- A. 2.2.11(A) - Develop and use computation concepts, operations, and procedures with real numbers in problem-solving situations.
- B. 2.2.11(B) - Use estimation to solve problems for which an exact answer is not needed.
- C. 2.2.11(F) - Demonstrate skills for using computer spreadsheets.
- D. 2.5.11(A) - Select and use appropriate mathematical techniques from different areas of math and apply them to solving non-routine and multi-step problems.
- E. 2.5.11(B) - Use symbols, mathematical terminology, and mathematical rules, to communicate concepts, procedures, ideas, and results.
- F. 2.5.11(C) - Present mathematical procedures and results clearly, systematically, succinctly, and correctly.