WAMC Lab Template

Math Concept(s):

1) Similarity, Right Triangles and Trigonometry: Define trigonometric ratios and solve problems involving right triangles

2) Geometric Measurement and Dimension: Explain volume formulas and use them to solve problems.

Source / Text: Geometry: Learning in Context

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Date: Summer In-service 2013

Attach the following documents:

Lab Instructions: see attached

Student Handout(s): see attached

Rubric and/or Assessment Tool: none required

Short Description (Be sure to include where in your instruction this lab takes place):

After introducing students to the three basic trig functions and after some individual practice of using the ratios, students will build a rocket with a specified volume to launch on a launch pad made of PVC pipe and 2 liter bottles. Additionally, students will build an inclinometer to use as a tool to measure the angle of elevation of the rocket they launch in order to determine how high their rocket launched.

Lab Plan

Lab Title: Rocket Launch

Prerequisite skills: Students should already know basic trig ratios, how to solve for one variable in an algebraic equation, how to use a scientific calculator, the formula for the volume of a cylinder, how to draw and label an isometric drawing. Already complete paper/pencil application problems that account for the angle of elevation not being at ground level. Must be able to read a protractor.

Lab objective(s): 1) Student will be able to make sense of the problem and apply trigonometric ratios correctly to calculate the height of the rocket. This will be evidenced by their written explanation and showing all steps including the original trigonometric ratio needed. 2) Students will be able to apply

the formula for the volume of a cylinder to determine the volume of their paper rocket as evidenced by their diagram, labeling of all dimensions, and correct volume calculation.

Standards:

CCSS-M:

- G-SRT 8: Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
- G-GMD 3: Use volume formulas for cylinders, pyramids, cones and spheres to solve problems.

Standards for Mathematical Practice:

- Make sense of problems and persevere in solving them
- Use appropriate tools strategically
- Attend to precision
- Look for and express regularity in repeated reasoning

State Standards addressed (2008 Washington State Mathematics Standards):

- G.6.A
- G.7.B

Reading:

- Grade 9-10: 3.3.1

Writing:

- Grade 9-10: 3.2.1

Leadership/21st Century Skills:

21st Century Interdisciplinary themes (Check those that apply to the above activity.)

☐ Global Awareness ☐ Financial/Economic/Business/Entrepreneurial Literacy ☐ Civic Literacy
☐ Health/Safety Literacy ☐ Environmental Literacy

21st Century Skills (Check those that students will demonstrate in the above activity.)

LEARNING AND INNOVATION
Creativity and Innovation
☒ Think Creatively
☒ Work Creatively with Others
☒ Implement Innovations
Critical Thinking and Problem Solving
☒ Reason Effectively
☐ Use Systems Thinking
☒ Make Judgments and Decisions
☒ Solve Problems
Communication and Collaboration
☒ Communicate Clearly
☒ Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS
Information Literacy
☒ Access and Evaluate Information
☐ Use and manage Information
Media Literacy
☒ Analyze Media
☐ Create Media Products
Information, Communications and Technology (ICT Literacy)
☒ Apply Technology Effectively

LIFE & CAREER SKILLS
Flexibility and Adaptability
☒ Adapt to Change
☒ Be Flexible
Initiative and Self-Direction
☒ Manage Goals and Time
☐ Work Independently
☒ Be Self-Directed Learners
Social and Cross-Cultural
☒ Interact Effectively with Others
☒ Work Effectively in Diverse Teams

Productivity and Accountability
☒ Manage Projects
☒ Produce Results
Leadership and Responsibility
☒ Guide and Lead Others
☒ Be Responsible to Others

Teacher Preparation: (What materials and set-up are required for this lab?)

Materials

- Cardstock
- Protractors
- String
- Washers
- Straws
- Empty 2 liter soda bottles
- 1/2in PVC Pipe
- 1 in. elbow barbed fittings
- 3 ft. of 1 in. tubing
- Duct tape
- 1/2in. dowel
- Paper

- Calculator (slide rule)

Set-Up Required:

- Build and set up launch pad using materials listed above. Students build clinometer and rockets in class.

Lab Organization Strategies:

Grouping/Leadership/Presentation Opportunities:

- Groups will share out their reflections of the learning experience and their results of the rocket launch. Students will reflect upon what they learned and what they want to learn more about as well as what they would do differently if they were going to repeat this lab.

Cooperative Learning:

- Students will work in groups of two. Grouping will depend upon the work habits of the individual class.

Expectations:

- I expect students to build a reliable and accurate clinometer and rocket. Students must also conduct the rocket launch in a safe and mature manner. Students must work cooperatively to define and carry out given group roles (stomper, reader, sighter).

Timeline:

- At least five hours of instruction will be needed to complete this lab. One class period, students will build the clinometer. Another class period, students will build the rocket. Students will launch their rockets for one class period. One class period for calculations, reflection and share out.

Post Lab Follow-Up/conclusions:

Discuss real world application of learning from lab

- Forestry: tree height, mountain and hill height
- Crane operators: spotter monitors boom angle of the crane
- Finding the pitch and roll of aircraft and boats

Career Applications

- Civil Engineering
- Structural design
- Surveying
- Construction
- mapping

Optional or Extension Activities

- Modify aspects of rockets to see if height can be increased
- Use clinometer to find heights of objects on campus indirectly

Height Site

Making Your Inclinometer

Here's how to make a tool that you can use to measure how tall something is—or how high a rocket or kite flies.

What Do I Need?

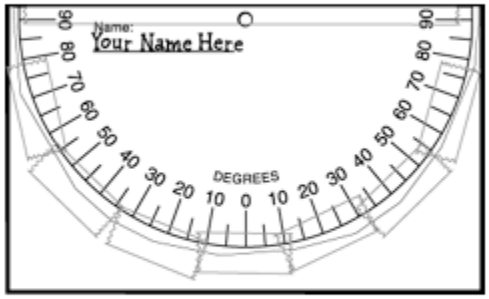
- Copies of Protractor for Inclinometer
- Scissors
- Clear tape
- A 3" x 5" card
- A hole punch
- 50 cm of string
- A washer or other small weight with a hole in it
- A sheet of 8 1/2 " x 11" paper (you can use paper from the recycling bin)

Step 1

Print out a protractor. Cut very carefully on the straight line on one edge of the protractor.

Step 2

Tape the protractor to the 3" x 5" card so that the straight side of the protractor matches up with the long side of the card.

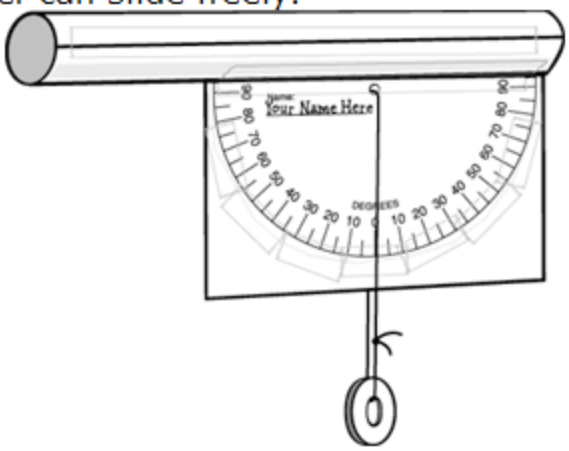


Step 3

Use the hole punch to punch a hole through the circle on the protractor.

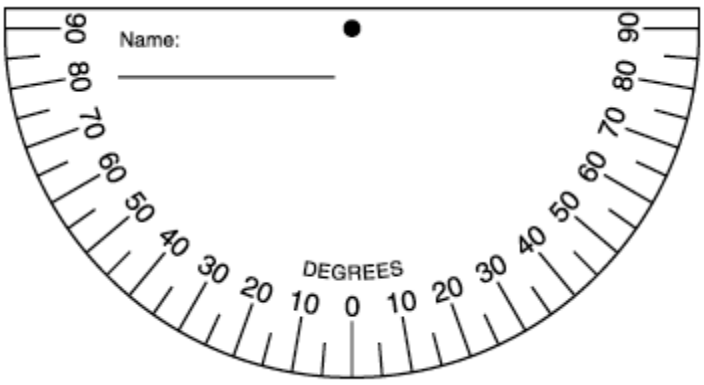
Step 4

Push one end of the string through the hole and through the washer. Tie the two ends of the string together making a loop on which the washer can slide freely.



Step 5

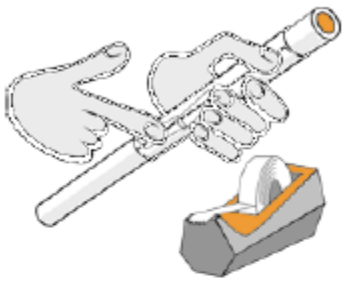
Roll a sheet of paper into a cylinder that's 8 1/2" long and about 1 inch across. Put tape on the seam so the paper stays rolled, then tape this cylinder to the card along the straight edge of the protractor. One end of the cylinder should line up with the edge of the card.

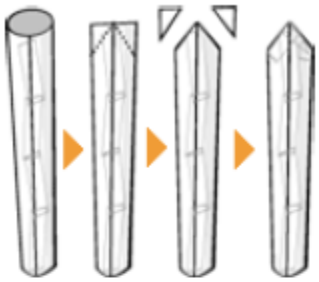


Project (30-40 min)

Building the Rockets:

1. Wrap paper loosely around the PVC pipe (if you wrap the paper too tightly around the pipe, friction will keep the rocket stuck on the pipe during launch)



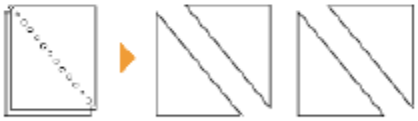


2. Tape the seam, then slide the paper off the pipe
3. Flatten the tube at one end, use scissors to cut the flat edge into a sharp point
4. Tightly tape the point so air does not escape

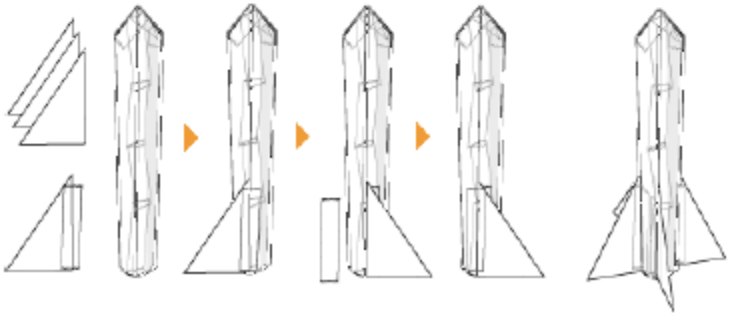
Adding Fins:

1. Fold a 3 x 6 index card in half, open at fold and cut along the fold

2. Cut along the diagonals of the half cards



3. Tape the fins on the rocket, spaced equally apart from each other



Rocket Data Sheet

Name/Team:

Rocket: Length _____

Trial Number	Launch Angle	Distance from Launch pad	Height
1			
2			
3			
4			
5			
Average			

Set up the launcher and draw a straight line downrange in line with the launch tube. This is your reference line.

Make rockets as needed. For each, measure it then record the result.

As you launch each rocket:

1. Ensure that the launch tube is as close to vertical as possible
2. Designate a "stomper" and a "spotter"
3. The stomper will launch the rocket by stomping on the 2-liter bottle
4. The spotter will use the sight tube to observe the tip of the rocket as it reaches the apex of its flight
5. The instructor will observe the inclinometer and note the angle at the apex
6. Using the correct trigonometric ratio, calculate how high your rocket flew and record it on the table above