WAMC Lab Template
Math Concept(s): Fun with Stomp Rockets 3
Source / Text: Fun with Stomp Rockets, other internet sources
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Date: Summer Conference 2022

Attach the following documents:

- Lab Instructions
- Student Handout(s)
- Rubric and/or Assessment Tool

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

Students will be able to use right triangle geometry to determine the altitude of a projectile using only a protractor and a level. Lab will occur outside in non-windy conditions

Lab Plan
Lab Title: Fun with Stomp Rockets 3

Prerequisite skills: Students will need to know…

1. Pythagorean theory
2. Relationship between, sine, cosine, tangent in a right triangle
3. Use of a protractor and a tape measure

Lab objective: At the end of this lesson, the student will be able to use right triangle geometry to determine the altitude of a projectile using only a protractor and a level

Standards: *(Note SPECIFIC relationship to Science, Technology, and/or Engineering)*
Mathematics K–12 Learning Standards:

- HS.G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in
- the triangle, leading to definitions of trigonometric ratios for acute angles.
- HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied
- problems.*
-

K-12 Learning Standards-ELA (Reading, Writing, Speaking & Listening):

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K-12 Science Standards

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Technology

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Engineering

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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

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

Materials

- Access to video
- Tape measure
- Protractor
- Level
- Stomp rocket
- Stomp Rocket Launcher

Set-Up Required:

- Video

<u>Lab Organization Strategies:</u>

Leadership (Connect to 21st Century Skills selected):

- See above

Cooperative Learning:

- Work in groups of two. One person measuring angle with protractor, one person spotting first person for accuracy

Expectations:

- Students in groups of two to obtain data and calculate altitude

Timeline:

- 1-2 class periods depending on size and length of clas

<u>Post Lab Follow-Up/Conclusions:</u>

Discuss real world application of learning from lab

- Finding the height of any object

Career Applications

- Surveyor, engineer, tree trimmer

Optional or Extension Activities

- Height of eye (HOE) relationship to base can be used to determine whether to add or subtract indicated altitude to true altitude

WORKSHEET

Materials needed:

- Stomp Rocket from previous build: https://www.jpl.nasa.gov/edu/teach/activity/stomp-rockets/
- Stomp rocket launcher: https://www.jpl.nasa.gov/edu/pdfs/sr_launcher_assembly.pdf
- Altitude Tracker:
- Level
- 12’ tape measure

Stomp Rocket Launcher Assembly Instructions

1 - 1/2" (PVC) 5 feet long (to be cut into smaller pieces) Hardware store or plumbing supply	**2 - 1/2" 45° Elbow** (PVC) Slip* Hardware store or plumbing supply	**2 - 1/2" Tee** (PVC) Slip* Hardware store or plumbing supply
2 - 1/2" Caps (PVC) Slip* Hardware store or plumbing supply	**Duct Tape** Hardware store	

* Slip connectors have no threads

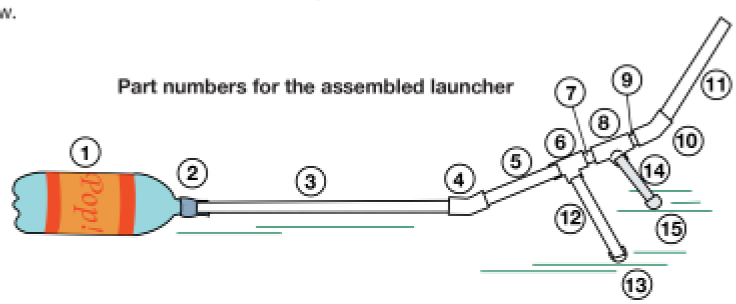
Procedure

1. Cut the PVC pipe into the following lengths:

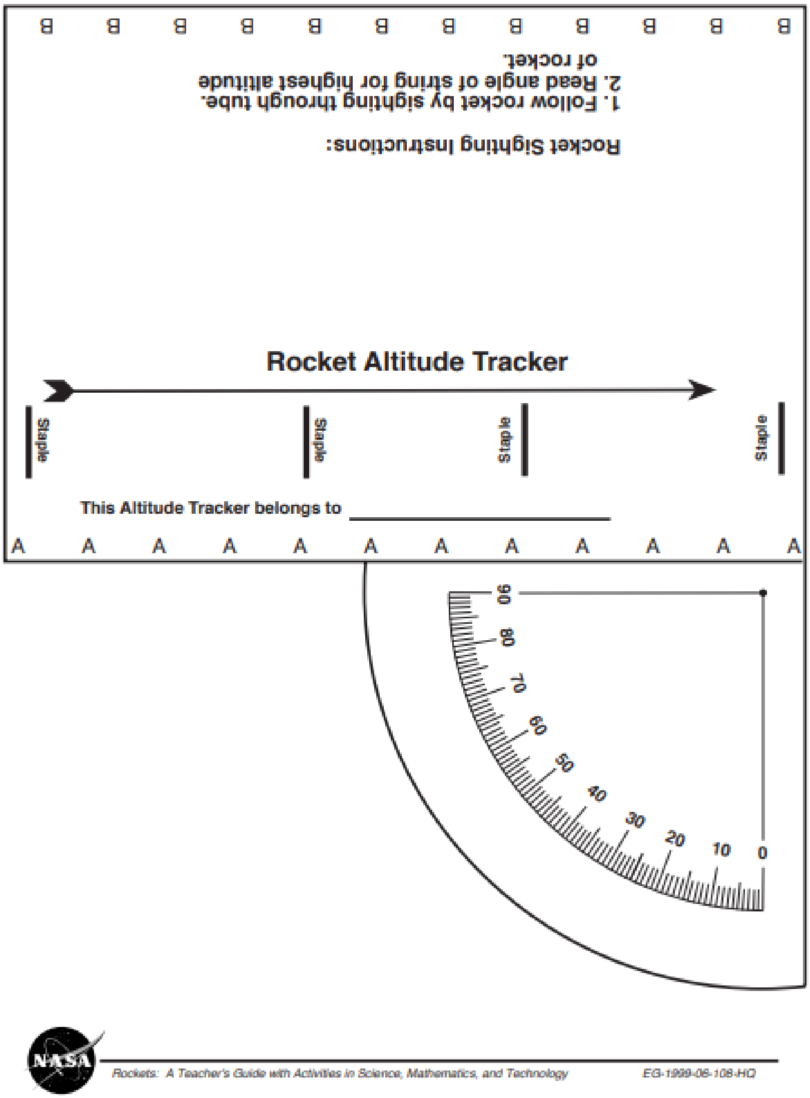
   #3 - 50 cm
   #5 -18 cm
   #7 - 4 cm
   #9 - 4 cm
   #11 - 25 cm
   #12 - 20 cm
   #14 - 25 cm

   The part numbers indicate where each piece is placed in the assembled launcher diagram below.

2. Insert the end of pipe #3 into the neck of the bottle and tape it securely with duct tape.
3. Follow the construction diagram below for assembly of the launcher. Match the pipe lengths with the parts numbers.
4. Swing the two legs outward or inward until each touches the ground to form the tripod. The launcher is ready for use.



For the full Stomp Rocket activity visit: www.jpl.nasa.gov/edu/teach/activity/stomp-rockets



Build the Altitude Tracker:

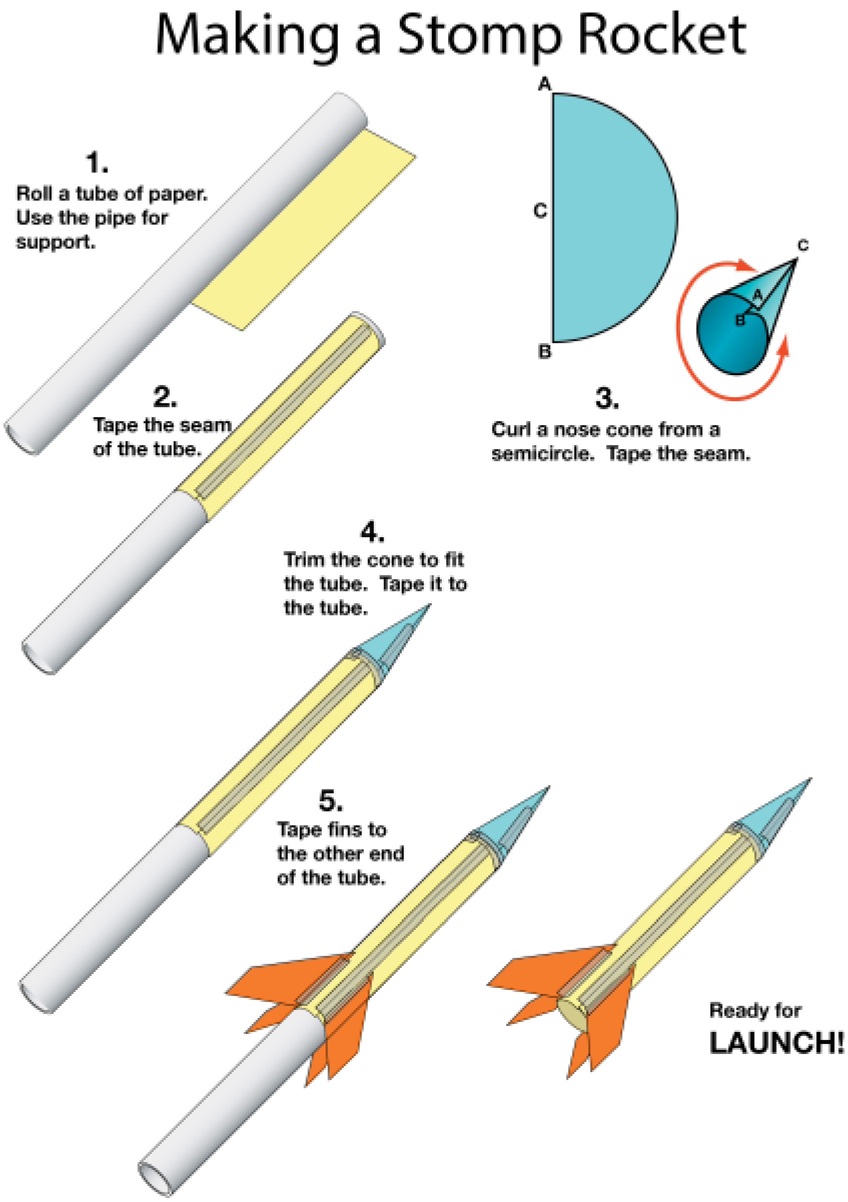
Cut out the Altitude Tracker (copied on card stock), following the outer outline.

Roll the sighting tube so that the line of As and the line of Bs are together, then staple or tape it to form a tube.

Use a paper clip or sharp pencil to poke a hole through the apex of the protractor quadrant on the template.

Slip a thread or piece of string through the hole and tape the small end to the back of the tracker.

Complete the tracker by taping a penny to the other end of the string so the string hangs weighted in front of the protractor.



Build the Rocket:

Roll a piece of 8.5 x 11-inch paper snuggly (but not too tightly) around a 24-inch length of 1/2-inch PVC pipe. Optionally, use one of the custom skins.

Tape the paper to itself (but not to the PVC pipe). Use enough tape to completely seal the seam, making the seam airtight. This will be the body, or fuselage, of your rocket.

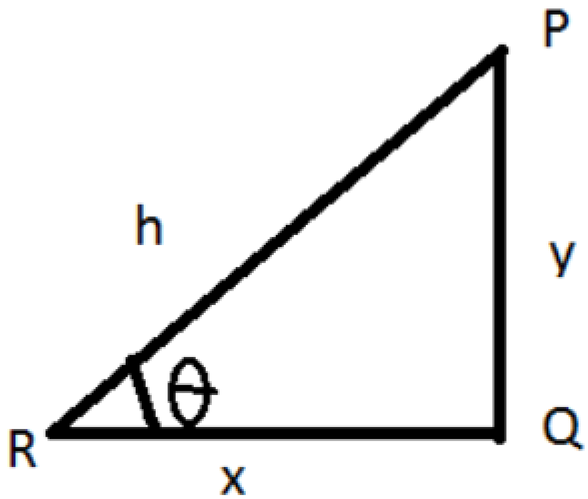
Slide the fuselage off the PVC form. Verify that the fuselage slips easily from the PVC form so that it will fit on the launch tube later.

Make a nose cone either by pinching one end of the fuselage, folding it over and taping it to the rocket body; or by cutting out a 3/4 circle, rolling it into a cone shape and taping it to the fuselage. Secure the nose cone using plenty of tape to make the rocket airtight. (Blow through the rocket from the bottom to check for leaks.)

Cut out fins (of any shape) and attach them symmetrically to the lower part of the fuselage (opposite the nose cone), leaving the opening at the bottom of the fuselage open and clear of tape.

Allow students to experiment with the size and shape of their rocket fins. Through repeated flights, students will discover that proportional, firm fins will provide the most stabilization to their rocket and eliminate drag.

Calculate the Rocket's Altitude:



In the above figure, let

P be the top most point of the rocket.

Q be the bottom point of the rocket (or launch point).

R be the position of the observer's eye.

Then

PQ be the maximum height of the rocket in feet;

QR be the distance between the launcher and observer's eye. Measured prior to launch.

PR be the line of sight or the line along which observer is observing the top of the rocket of.

The angle 'θ' is the angle of elevation. Measured and recorded at rocket's maximum altitude.

Here are the relationships we know about 'θ' using the following formulae:

$\sin \theta = y/h$

$\cos \theta = x/h$

$\tan \theta = y/x$

Since x is already known and we have measured θ, all we have to do is reconfigure the last realationship to

$y = \tan \theta / x$

WAMC Lesson Plan

Name(s): Michael Brenner
Email Address: mikeb@ckschools.org
Lesson Title: Learning Right Angle Trig.
Date: 6/21/22
Text: handouts STEM Correlation: Math Lesson Length: 2 class periods

Big Idea (Cluster): Can use right angle geometry to calculate altitude of a projectile.	
Mathematics K–12 Learning Standards: HS.G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*	
Mathematical Practice(s): right angle trigonometry	
Content Objectives: At the end of this lesson, the student will be able to apply right angle geometry in applied problems	Language Objectives (ELL): SL 9-10.4-5 This topic will contain academic vocabulary such as adjacent, opposite, hypotenuse, tangent. Ensure that ALL students are asking questions about unfamiliar words.
Vocabulary: adjacent, opposite, hypotenuse, tangent	Connections to Prior Learning: Fun with Stomp Rockets 1&2- measurement, Precision and Accuracy lesson
Questions to Develop Mathematical Thinking: • Will I be more/less accurate standing farther/closer to the launcher • Is it more important to be accurate with distance from the rocket, or the measured angle • Where can I use this knowledge in the real world?	Common Misconceptions: • This is too hard • Students need more information to determine real time data.

Assessment (Formative and Summative):

- Engage and connect with students as they take data. Check for understanding (formative)
- Unit test using calculations (summative)

Materials:

-

Instruction Plan:

Introduction: Right angle trig
Explore: Right angle geometry
When I observe students: Check for understanding as they discuss and work on the calculations
Questions to Develop Mathematical Thinking as you observe: What if this projectile was fixed in the sky a million miles a way, how important is the accuracy of the measured angle
Answers: Very important. Brief talk on ancient mariners trying to obtain an accurate 'fix' on a vessel that is moving on all three axes
Summarize: class engagement in discussions

Career Application(s):

- Engineers, tree trimming services

Leadership/21st Century Skills:

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X Guide and Lead Others
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Homework Questions:

For the following questions, please use the following drawing

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$\cos \theta = x/h$

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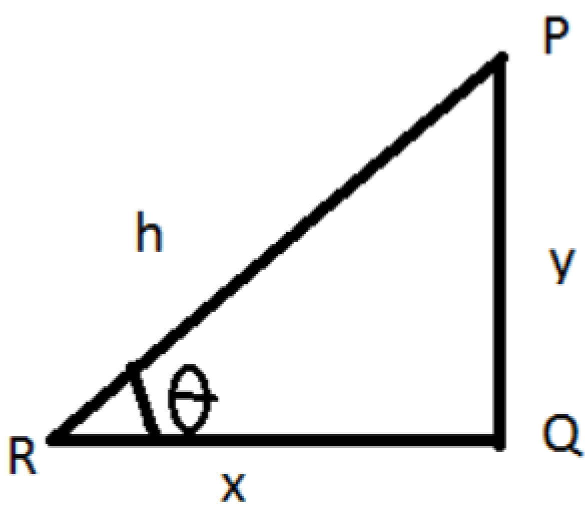
RQ^2 + QP^2= RP^2



1. If RQ=5 and QP=7, what would be the value of θ?
2. If QP= 10 and θ is 42 degrees, what is the value of RQ
3. If RQ=7 and θ is 30 degrees, what is the value of RP?