University of Wyoming
AstroCamp
Rocketry

Premise: Rockets are an excellent format on which to build the concepts of Newton's Laws of Motion. Specifically, Newton's 3rd Law is easily introduced and explained through simple rocketry. Students will be building rockets to demonstrate Newton's 3rd Law, but will also be making predictions about trajectory based upon one of three launch angles. Students will use inquiry to come to meaningful conclusions about other possible variables that affect the launching of rockets.

Purpose: To introduce students to the concept of Newton's 3rd Law through rocketry.
To introduce students to the concept of trajectory and how it affects the distance the rocket travels.
To expose students to simple trigonometric functions.
To provide a hands on/minds on experience that will enrich the students understanding of rocketry, and Newton's 3rd Law.

Wyoming State Science Standards Addressed:

Standard 2:

Students demonstrate knowledge, skills, and habits of mind necessary to safely perform scientific inquiry. Inquiry is the foundation for the development of content, teaching students the use of processes of science that enable them to construct and develop their own knowledge. Inquiry requires appropriate field, classroom, and laboratory experiences with suitable facilities and equipment.

Benchmark 2:

Students use inquiry to conduct scientific investigations.
Ask questions that lead to conducting an investigation.
Collect, organize, and analyze and appropriately represent data.
Draw conclusions based on evidence and make connections to applied scientific concepts.

Benchmark 4:

Students recognize the relationship between science and technology in meeting human needs.

Standard 3:

Students recognize the nature of science, it history, and its connections to personal, social, economic, and political decisions. Historically, scientific events have had significant impacts on our cultural heritage.

Benchmark 1:

Students explore the history and nature of science.
1a. Students explore how scientific knowledge changes and grows over time, and impacts personal and social decisions.

Benchmark 2:

Students explore how scientific information is used to make decisions.
2a. The role of science in solving personal, local, and national problems.
2b. Interdisciplinary connections of the sciences and connections to other subject areas are careers in science or technical fields.

Goals:

Students will gain an understanding of Newton's 3rd Law as applied to rocketry.

Students will gain an elementary understanding of basic trigonometric functions.
Students will use inquiry to come to meaningful conclusions about variables that affect trajectory.
Students will use eye/hand coordination to build a rocket.
Students will use reading skills to follow directions.
Students will use inquiry skills to determine what launch angle will result in the highest and furthest distances.
Students will use data collecting tools to determine actual angle of launch and record data accordingly.

Entry Level:

Students will need an explanation about how Newton's 3rd Law applies to rocketry.
Students will need an explanation about the trigonometric functions.
Students will need to understand angles and trajectory.
Students will need to be able to work with small pieces to put together rockets.

Supplies:

Rocket Kits (1 per student)	Rocket Engines	Rocket Igniters	
Rocket Launch Pad	Rocket Launcher	Elmer's Glue	Scissors
Markers to decorate	Protractors	String	Paperclips
Data Sheets	Work Sheets		

Instruct:

In 1926, an American university professor, Robert Goddard, designed and built the first modern liquid-fueled rocket. His work, along with that of German scientists after World War II helped to launch the modern space age. In 1969 humans first landed on the moon. By the 1980's human space flight had become routine thanks to the advances in rocket engineering technology. Still, no human has ever set foot on any celestial body except the earth and moon, but plans are underway to send the first humans on Mars in the next couple decades. Young scientists and engineers who are entering high school and college today will be the ones who send astronauts on the first Mars journey. Will you help humans reach this historic achievement?

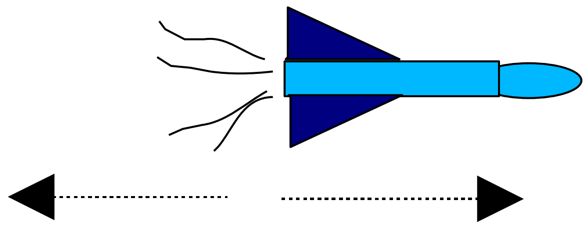
I. Build a Model Rocket

Follow the instructions of your teacher to assemble a model rocket.

Paint your rocket.

II. What makes rockets fly?

All rockets and jet aircraft are powered by the principle of physics known as Newton's Third Law, named after 1t[th] century scientist Issac Newton.   Simply stated, "*For every action there is an equal and opposite reaction*". In the case of rockets, hot gases expelled at high speed from the rear of the rocket produce a force the propels the rocket in the opposite direction. As a simple example of this phenomenon, try throwing a ball while you are on roller skates or ice skates, and see what happens.



Force of exhaust gases: Opposite force on rocket

III. Predict the Height and Distance of a rocket.

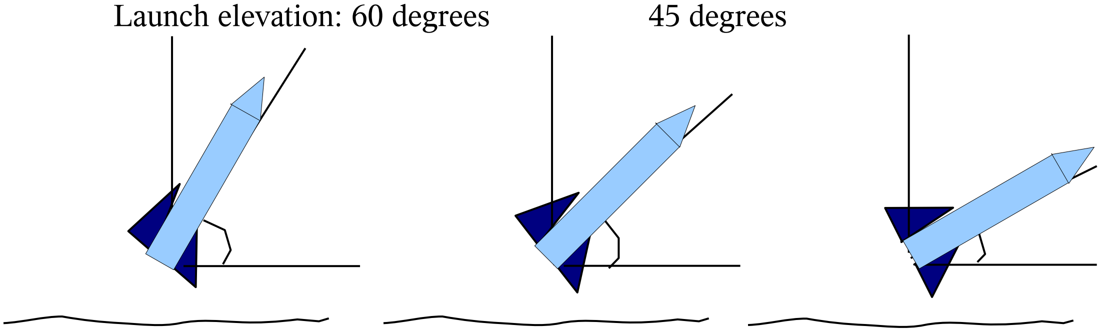
Make a list of some factors that determine how high and how far a rocket will go?

_____________________ _____________________ _____________________

_____________________ _____________________ _____________________

You will launch your rockets at different elevation angles and measure which ones fly the highest and farthest.

Launch elevation: 60 degrees   45 degrees   30 degrees



Make a prediction. Which rocket will fly the farthest? __________________
Which rocket will go the highest? ___________________
Give some reasons for your prediction.

Choose a launch angle for your rocket (30, 45, or 60 degrees) : _________________________

IV. Launch your rocket and measure other students' rockets

Launch your rocket using an elevation angle assigned by the instructor. Measure and record the distance that each rocket travels along with its launch angle and elevation. Include units for your measurements!

Name for Rocket	Launch Angle i	Horizontal Distance D	Elevation (degrees) A	Height (m) H	Describe rocket & what happens
1 ____________________	_____	_______	________	________	____________________________

2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
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14						
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17						
18						
19						
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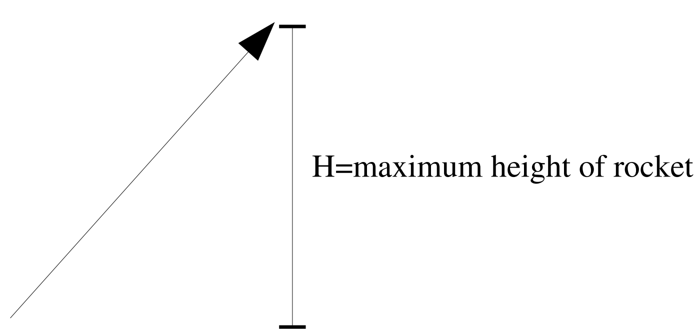
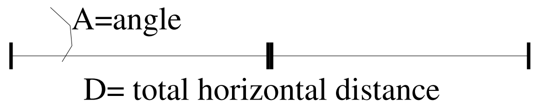
21						

V. Draw some Conclusions

Compute the true height of each rocket based on the angle of elevation and the distance it flew. As the picture below shows, use half the total distance in your calculations. This gives us the rocket's horizontal distance at it's maximum height.





Tan(A) = H/d/2 or H = Tan(A)(D/2)

Summarize your results by launch angle below

30 degree launch angle

Name	Description	Horizontal Distance D	Max Elevation	Avg Elevation A	Tan(A)	True Height H

45 degree launch angle

Name	Description	Horizontal Distance D	Max Elevation	Avg Elevation A	Tan(A)	True Height H

60 degree launch angle

Name	Description	Horizontal Distance D	Max Elevation	Avg Elevation A	Tan(A)	True Height H

Did the launch angle always equal the angle of greatest elevation? If not, why do you think it did not?

Which elevation caused rockets to fly the farthest? ________________ The Highest? ___________
What reasons can you come up with for this pattern?

Were your predictions correct? Give some reasons for the results that you observed?

Teaching Strategy: Conceptual Change Model (Constructivism)

<u>Strengths:</u> The teaching strategy used in this activity is conceptual change model. The conceptual change model is used to challenge students to confront their beliefs about the properties of light, make predictions about these properties, and then challenge those predictions by performing a variety of activities. Each activity within the lesson is based upon a teaching philosophy called Constructivism, and allows for hands on/minds on interaction by the students. This philosophy tends to engage the most students because it is student-driven and student-focused. Hopefully any misconceptions about rocketry will be confronted, addressed, and corrected during the lesson. It is important to assess understanding as frequently as possible by using effective inquiry skills.

<u>Weaknesses:</u>

It is easy for students to get lost and not know what is going on depending on the level of instruction and the abilities of the students to follow written and verbal directions. Follow the K.I.S.S. Philosophy and Keep It Simple Stupid. It is important to ensure that each student has the required materials and understands what is happening and what they should be doing. Provide as many adult supervisors as possible to aid with the construction of the rockets.

Created by Chad Sharpe & Chip Kobulnicky, University of Wyoming AstroCamp, June 2005