**Catapults: Launching into Physics**

**Lesson 2: “Brain”storming the Castle**

**Stem Grant Grade Band Team: 6-8A**

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**Key Terms**

**Math:** Angles, similar, congruent, area, pi, radius, 2-dimensional, 3-dimensional, translate, rotate, and reflect.

**Science:** Gravity, friction, net force, force, balanced and unbalanced forces, input, output, velocity, inertia, and Newton’s Laws of Motion.

**Learning Objectives:**

Students will be able to:

1. calculate the area of two dimensional figures.
2. apply their understanding of factors affecting projectile motion and levers.
3. hypothesize which catapult design will be the most efficient.
4. assess which catapult worked the most efficiently and accurately.
5. construct a catapult.
6. demonstrate how changes in force effects movement.

**WMAS Math (Common Core)**

**7.G.3.** Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

**7.G.4.** Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

**7.G.6.** Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

**8.G.2.** Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

**WMAS Science**

**D.8.5** While conducting investigations, explain the motion of objects by describing the forces acting on them

**D.8.6** While conducting investigations, explain the motion of objects using concepts of speed, velocity, acceleration, friction, momentum, and changes over time, among others, and apply these concepts and explanations to real-life situations outside the classroom

**Information and Technology Literacy**

**A.8.3**. Use a computer and productivity software to organize and create information

* explain the use of basic word processing functions (e.g., menu, tool bars, dialog boxes, radio buttons, spell checker, thesaurus, page layout, headers and footers, word count, tabs)
* use the spell checker and thesaurus functions of a word processing program
* move textual and graphics data from one document to another
* use graphics software to import pictures, images, and charts into documents
* use a graphical organizer program to construct outlines or webs that organize ideas and information
* compose a class report using advanced text formatting and layout styles (e.g., single and double spacing, different size and style of fonts, indents, headers and footers, pagination, table of contents, bibliography)
* classify collected data and construct a simple database by defining fields, entering and sorting data, and producing a report
* construct a simple spreadsheet, enter data, and interpret the information
* plot and use different types of charts and graphs (e.g., line, bar, stacked, scatter diagram, area, pie charts, pictogram) from a spreadsheet program
* incorporate database and spreadsheet information (e.g., charts, graphs, lists) in word-processed documents

**B.8.5.** Record and organize information

* use note-taking strategies including summarizing and paraphrasing
* record concise notes in a prescribed manner, including bibliographic information
* cite the source of specific quotations or visuals using footnotes, endnotes, or internal citation formats
* organize and compare information using graphic organizers, storyboarding, and other relational techniques
* organize information in a systematic manner appropriate to question, audience, and intended format of presentation
* record sources of information in a standardized bibliographic format

**Career Cluster**

Manufacturing, Production Process Development

Quality Assurance

**Materials**

Computer with Internet access

Pictures of catapults

Graph paper/poster

Pencils

Catapult websites and guidelines

Blueprint rubric

Cardboard shoe box (as needed for designs)

Rubber bands

Popsicle/craft sticks

Masking tape

Plastic spoons

Rulers

Scissors

Other supplies as dictated by chosen catapult design

Catapult Journal

**Procedure**

1. Begin the lesson by reviewing the concepts explored the day before when using the **Golf Range** Gizmo. Ask students: What forces act upon objects in motion? How is a balanced force created? What is velocity?
2. Tell students that they are going to work in small groups to research and then build a catapult capable of launching a ping pong, rubber and golf ball. Their goal is to launch one of these balls one to five meters away from a target and come as close to the bullseye as possible.
3. Divide the students into groups. Using computers have the groups explore the provided websites and then choose a design.
4. Have students draw a blueprint of their catapult following the Blueprint Rubric.
5. Gather all materials needed for the construction of the catapults and then give the students time to construct and test their catapults.

**Assessments**

**Pre-assessment:**

Discussion of previous day’s lesson

**Formative assessment**

Evaluation of blueprint using rubric

Lab Journal: Why did you pick this design?

**Summative assessment**

Successful construction of catapult

**REACT**

1. **Relating**

Students will use their knowledge of how an object; such as a baseball, football or golf ball, reacts when acted upon by a force.

1. **Experiencing**

Prior to this lesson, students have used a Gizmo simulation to explore forces acting upon moving objects. During this lesson, students will research, design and build a catapult. Afterwards, they will attempt to hit a designated target. Finally, they will evaluate the effectiveness of their catapult and compare this to other groups.

1. **Applying**

Students will apply their knowledge of forces on moving objects to create a catapult, explain how the catapult works, collect launch data and then evaluate and explain what was occurring during the launching process. They will also use their knowledge of geometric shapes and formulas to draw a blueprint for their catapult.

1. **Cooperating**

Students will research, design and build together in groups.

1. **Transferring**

Students will use the catapult created to further explore the concept of forces acting upon moving objects.

**Catapult Websites and Guidelines**

**Websites**

"How to Build a Catapult", http://www.stormthecastle.com/catapult/how-to-build-a-catapult.htm

Punkin Chunkin: Catapult video, http://www.science.discovery.com

Motion, Forces, Energy and Electricity, http://www.discoveryeducation.com

Catapults, http://www.knightforhire.com

Circle Tool, <http://illuminations.nctm.org>

**Guidelines**

* Materials are limited to what is available. Please check with me before choosing a catapult to check on material availability.
* You may bring in materials from home to be used in the construction of your catapult.
* Catapults need to be assembled in class. No outside assembly is allowed.
* No single part may be longer than 30 cm.
* Catapults must make use of a lever arm of some kind. Slingshots are not allowed.
* The effort, or force, providing the launch may not be supplied by a person.
* Launching will be done only in designated areas and only during practice time.

**Rubric: Catapult Blueprint Design**

Using graph paper provided, draw a blueprint for your selected catapult following the guidelines.

Barely there Almost You Got It!

All parts of the catapult are included 1 2 3

Parts are drawn 2-dimensionally in two views (top/side) 1 2 3

(As close as possible to actual size)

Parts are labeled with 2-dimensional and 3-dimensional names 1 2 3

Area has been calculated for all parts 1 2 3

Work is shown for all calculations 1 2 3

Congruent figures are indicated by shading the shapes red 1 2 3

Similar figures are indicated by horizontal/vertical stripes 1 2 3

Identify one shape that is rotated (labeled in blue) 1 2 3

Identify one shape that is translated (labeled in blue) 1 2 3

Bonus: Identify one shape that is reflected (labeled in blue) 1 2 3

Dimensions are labeled in metric units 1 2 3

Materials needed for construction are attached to blueprint 1 2 3

Total Points: \_\_\_\_\_\_\_\_\_\_