MeTEOR Learning Modules

STEM MEA (Model Eliciting Activity)

Creating a Hoop Glider

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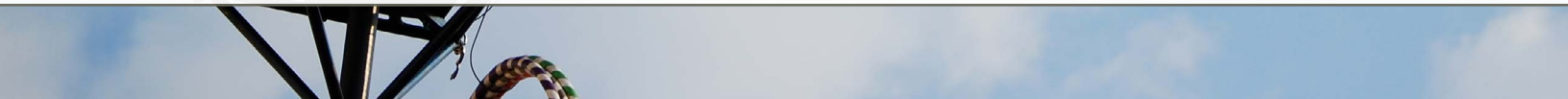
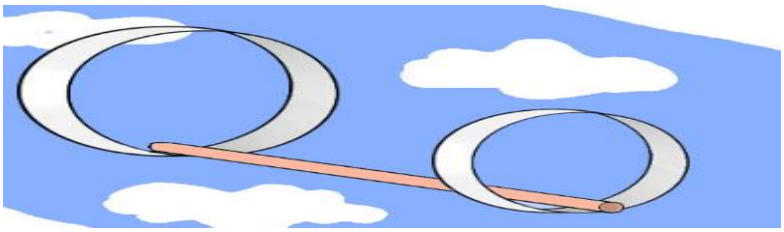
METEOR
CONNECTING THE DOTS





How Far Will It Fly: Hoop Glider Competition

Reflective Planning

Description/Summary of Lesson:
In this activity students are challenged to build a glider that will glide as far as possible. Working in groups, students will cut and tape various hoops to their straw. They will experiment with hoops of different sizes, positioning and throwing styles. This activity is designed to demonstrate mastery of the STEM engineering design, build and modify process.

Essential Questions:

- What are the specific qualities that go into engineering and design of a hoop glider?
- How is math used in the planning stages of designing a hoop glider?
- What type of base lengths and circumferences will maximize the distance of the projectile?

Suggested Grade Level: Grades 4-5

Approximate Time: Two days (30 minute class periods)

Teacher's Role: Demonstrator and Facilitator

Class Set-Up: Groups of two students at tables or desks put together

Success Standards:

- Students can plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
- Students can define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Students can generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and the constraints of the problem.
- Students can develop and use models.

Learning Purpose:

- Students will plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- Students will make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
- Students will ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Vocabulary:

- Hoop Glider
- Potential Energy
- Kinetic Energy
- Landing Point
- Maximum Distance
- Lift
- Force

Math Practices:

- MP 1: Make sense of problems and persevere in solving them.
- MP 3: Construct viable arguments and critique the reasoning of others.
- MP 4: Model with mathematics.
- MP 6: Attend to precision.

Depth of Knowledge:

- DOK Level 3: Strategic Thinking

Materials: (per group)

- 3-4 Index Cards (3X5)
- Roll of Tape (scotch or masking)
- Scissors
- 3-4 Straws
- Markers (optional)

Summary of Tasks/Experiences

Spark Activity: Professional Paper Airplane Competition Video

- Have students watch this 3.48 video of a professional paper airplane competition: https://www.youtube.com/watch?v=SUyqakRMrxo.
- Representatives from each country walk in the opening procession proudly sporting their country's flags on their backs. They proceed to compete for longest air time,

longest distance and other titles, all with paper air planes. Worth the 4 minutes and the discussion that will follow.

- Tell the students they are going to make a hoop glider. They will compete against others for the longest distance. (You can also include a competition for longest airtime.)

Lesson Descriptions:

Introduction: Day 1

The teacher will:

- share with students that this challenge will test their group's ability to work together in building a hoop glider.
- remind students to put their names on a piece of masking tape to mark their best distance on the ground.

Construction

The students will:

- take a note card and cut it into thirds lengthwise.
- take one strip of a note card and form a loop by overlapping the edge about ½ inch.
- put tape over the seam to hold it. This will be your small loop.
- take the other two strips and make one big loop the same way.
- tape their straw to the inside of the loops.

Teacher facilitates class asking guiding questions as students work in groups or provides the questions in the form of a worksheet:

- What do you think would work better, a shorter straw or longer straw? Why?
- Do you think the small hoop should be the front of your glider or the back?
- Based on your trial throws, what works best?

Practice Time

The students will:

- test their hoop gliders and compete against each group.
- make some changes to the gliders changing only one variable at a time.

Day Two

The students will:

- repeat Day 1 making modifications to their glider.
- Complete the exit slip questions:
    - How did your glider perform?
    - Approximately how far did your glider go?

- If you could change something or perform more trials, what would you change about your glider and why?
- How was force and lift used this activity?

Student Engagement

Social/Emotional Engagement:

- Students show positive, respectful and supportive small group interpersonal relationships and skills that provide friendship.
- Students share materials and work load.
- Students are involved together respectfully in the learning process as teacher and tutors as they give feedback to one another.

Physical Engagement:

- Students are involved with face-to-face interaction of student team members.
- Students complete all processes of building the hoop glider as a group, each sharing in the responsibility.
- Positive group processing about their working relationships and response.

Cognitive Engagement

- Students monitor their own progress and thinking relative to their learning toward the Success Standard.
- Students support each other in clarification of the Success Standard, ensuring that each member of the group meets the standard.

Evidence of Learning

Checks for Understanding/Expected Outcomes:

- Students will build their hoop gliders.
- Students will demonstrate mastery of the engineering design/build/modify process.
- Students will articulate how lift and force were used in this activity.
- Students will be evaluated using the included rubric.

Teacher Notes:

- Students should discover that if the smaller loop is on the front, it will fly better.
- Students should adjust their glider by making loops of various sizes, on top or below the straw, and change straw lengths.

- Through this STEM activity, students should be able to explain and reference the engineering process of design, build and modify on their Reflections and Understandings Sheet.

- Optional research activity: Students research how real-world gliders work. Encourage the students to write down a couple of things they've learned, any questions they still have, and be willing to share it with the class the next day. Related video: http://www.youtube.com/watch?v=3qOhdl9c7rs.

Hoop Glider
Rubric

Category	4	3	2	1
Problem Solving	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions but is willing to try other's solutions.	Does not try to solve problems or help others solve problems. Lets others do the work.
Contributions	Routinely provides useful ideas. Leader.	Occasionally provides useful ideas. Strong team leader.	Rarely provides useful ideas. A satisfactory team member.	Provides no useful ideas or refuses to participate.
Attitude	Never is publicly critical of the project or others. Positive attitude.	Rarely is publicly critical of the project or others. Often has a positive attitude.	Occasionally is publicly critical of the project or others. Sometimes has a positive attitude.	Often is publicly critical of the project or others. Has a negative attitude.
Focus on the Task	Constantly stays focused on task.	Mostly stays focused on task.	Hardly stays focused on task.	Rarely stays focused on task.
Working with others	Almost always listens and shares with others.	Mostly listens and shares with others.	Occasionally listens and shares with others.	Rarely or never listens and shares with others.
Comprehension of Concepts	Demonstrates understanding of concepts.	Demonstrates understanding of most concepts.	Demonstrates understanding of a few concepts.	No demonstration of understanding of concepts.

Total _____/24 Points

How Far Will It Fly: Hoop Glider Competition
Reflections and Understandings Sheet

1. Describe each phase of the engineering process:

a. Design

b. Build

c. Modify

1st Glider	Distance

2. How did you apply Design to your hoop glider?

3. How did you apply Build to your hoop glider?

2nd Glider	Distance

4. How did you apply Modify to your hoop glider?

5. Based on your experiment, what are your recommendations for creating the best Hoop Glider?

3rd Glider	Distance

How Far Will it Fly: Hoop Glider Competition

1. Describe each phase of the engineering process:

a. **Design** Possible answers: considering material constraints; design the structure to be built

b. **Build** Possible answers: utilizing materials, create structure

c. **Modify** Possible answers: Recognizing failures in design and build, redesign and build to new understanding. Repeat until satisfied with results.

1st Glider	Distance

2. How did you apply design to your hoop glider?
Possible answers: sketch, label

3. How did you apply Build to your hoop glider?
Possible answer: built according to design

2nd Glider	Distance

4. How did you apply Modify to your hoop glider?
Possible answers: changed to make better, trying to only change one variable at a time

5. Based on your experiment, what are your recommendations for creating the best Hoop Glider?
Possible answers: smaller loop on front, longer straw

3rd Glider	Distance