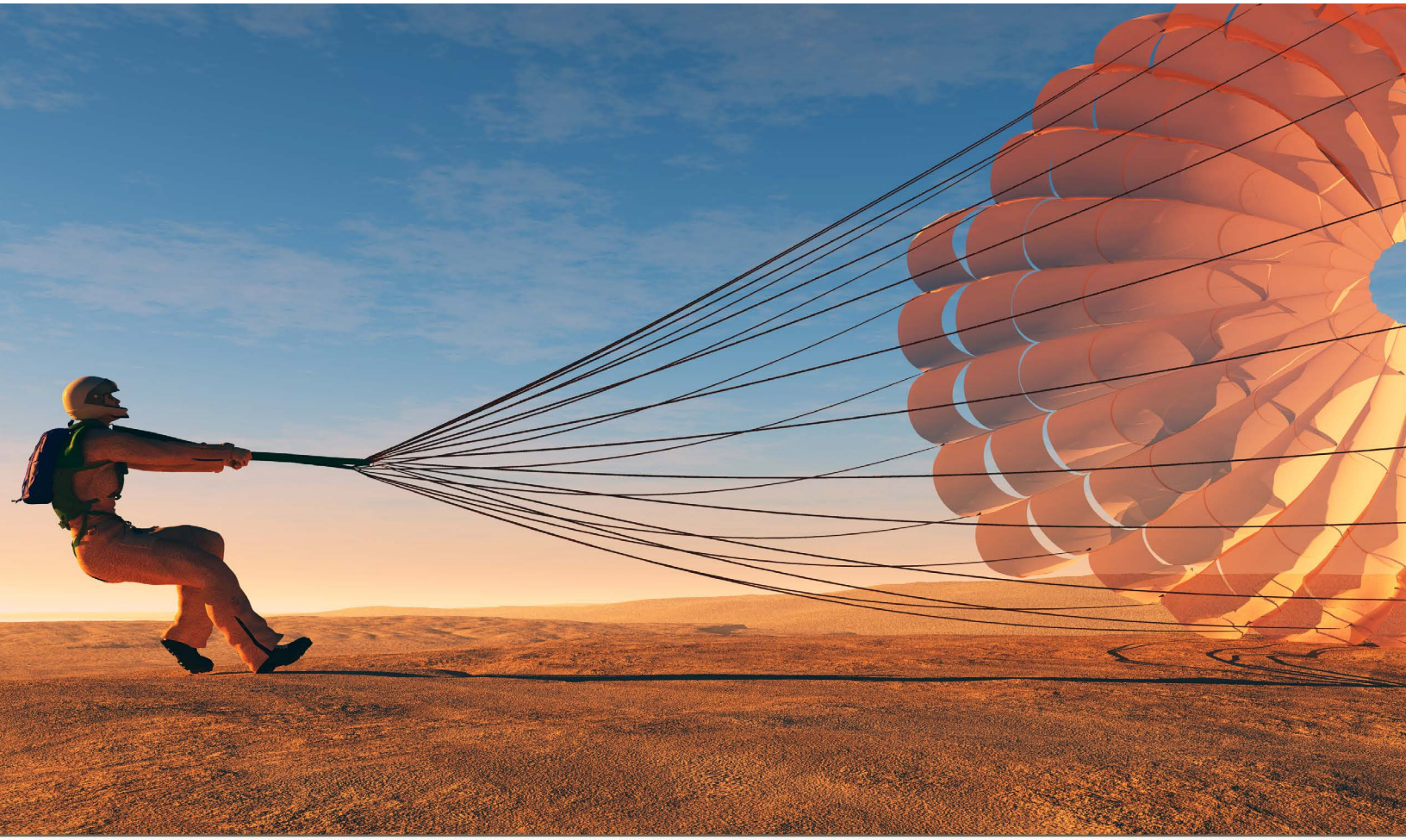
MeTEOR Learning Modules

STEM MEA (Model Eliciting Activity)

Designing a Parachute



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Parachute Building

Reflective Planning

Description/Summary of Lesson:
In this activity students will work in groups to create a parachute for Jack. They will modify their parachute in order to produce the safest landing possible. Kids will have a great time creating and demonstrating their designs, while learning about wind resistance, surface area, friction and gravity.

Essential Questions:
- What is gravity?
- How do we "see" gravity?
- How does surface area impact the effectiveness of a parachute?

Suggested Grade Level: Grades 1-5

Approximate Time: Two days (40 minute class periods)

Teacher's Role: Demonstrator and Facilitator

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

Success Standards:
- Students can explore the Law of Gravity by investigating how objects are pulled toward the ground unless something holds them up.
- Students can raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.
- Students can explain that empirical evidence is information, such as observations or measurements, which is used to help validate explanations of natural phenomena.
- 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 recognize the importance of communication among scientists.
- Students can recognize that scientists question, discuss and check each other's evidence and explanations.
- 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 keep records as appropriate, such as pictorial, written or simple charts and graphs, of investigations conducted.
- 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:

- Gravity
- Friction
- Surface Area
- Wind Speed
- Parachute
- Control

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)

- The book *Jack and the Beanstalk* (for teacher)
- Small Action Figure (Jack)
- Tissue Paper
- Newspaper
- Plastic Grocery Bags
- Canvas
- Coffee Filters
- Pipe Cleaners
- String
- Dental Floss
- Rubber Bands
- Timer
- Glue
- Scissors
- Tape

Summary of Tasks/Experiences

Spark Activity: (for younger students) Jack and the Beanstalk

- Read *Jack and the Beanstalk* or show the following 5:20 video: https://www.youtube.com/watch?v=_VCpAYajmvo.
    - Note: this video does NOT show Jack falling. Explain that in other versions Jack actually tried to escape so quickly that he fell from the beanstalk.
- Discuss the purpose and mechanics of a parachute.
- Share with students that they are going to make a parachute.

Spark Activity: (for older students) Parachute Exhibition

- Have students watch this 1:58 video that shows 88 women breaking the record for the largest parachute exhibition: https://www.youtube.com/watch?v=fMswcVNyXls.
- Afterwards, discuss the speed of the "free fall" and then the purpose of the parachute.
- Hypothesize how the parachute works. Are parachutes different or all the same?

Lesson Descriptions:

Introduction: Day 1

The teacher will:

- introduce the concept of the "control group." (What would happen if Jack jumped from the top of the beanstalk (or a plane) without any parachute?)
- take the students to the launch point and demonstrate. (Jack would fall straight down.)
- discuss the concept of gravity and wind resistance. (Time Jack's fall for the first trial.)
- introduce the activity, provide the materials and establish the time frame (about 20 minutes).
- explain that in order for the students to be successful, their parachute must stay in the air longer than the control group.

Construction

The students will:

- choose up to five items from the supplies provided.
- design and create a parachute.
- test and time, logging the data in their Flight Time chart.

Teacher facilitates class asking guiding questions as students work in groups:

- Why did you choose these materials?
- What is your time prediction?
- After a few attempts, can you improve on your design?

Practice Time

The students will:

- test their parachutes a minimum of three times and log the time in the Flight Time chart.

Day 2

The students will:

- repeat Day 1 making modifications to their parachutes.
- complete the Exit Slip questions:
    - How did your parachute do?
    - If you could change something or perform more trials, what would you change about your design and why?
    - How were gravity, wind resistance, friction and surface area involved in this activity?

Student Engagement

Social/Emotional Engagement: Students will use social, interaction skills for completing projects with peers.

Physical Engagement: Students will design, create and engage the parachute while working in small groups.

Cognitive Engagement: Students will work together using concepts including control groups, surface area, wind resistance and elapsed time.

Evidence of Learning

Checks for Understanding/Expected Outcomes:

- Students will build their parachutes.
- Students will articulate how surface area impacted their success/failure.
- Students' elapsed time will be greater than the control.
- Students should record data on Data Collection/Reflection sheet.
- Students will be evaluated using the included Rubric.

Teacher Notes

- Through this STEM activity, students should be exposed to the engineering process of design, build and modify.
- Larger surface area of the parachute should produce longer flight time.

- Data Collection/Reflection sheet should reflect understanding of the design/build/modify process.
- Students should have created a parachute that surpassed the control's time.

Designing a Parachute
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

Design a Parachute
Data Collection/Reflection

Flight Time

Attempt	How many seconds was it before Jack hit the ground?
Control	
1	
2	
3	

Sketch a diagram of your parachute.

What materials did you use?

Did you modify your parachute after the first attempt? How?

What changes did you expect with these modifications? Did they work?

What did you learn about the STEM process of design, build and modify?

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