Topic: Center of Mass

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Genre: Center of Mass **Unit: Forces and Motion on Earth**
Grade Level: 8th **Duration:** double period

Essential Question
(Domain 1: Planning and Preparation-Component 1c: Designing Coherent Instruction)

- Through the use of their robots, students will be able to identify the center of mass by applying problem solving strategies to real-world applications.

Background Knowledge

Background Summary: By the end of this lesson students will be able to identify the center of mass using the robot in a variety of scenarios. Students will manipulate the brick to various locations and hypothesize what they think will happen when traveling up a hill. Students will record, illustrate, and explain their results.

Lesson Objective:

- Students will analyze and interpret data to provide evidence for phenomena.
- Students will analyze and interpret data to determine similarities and differences in findings.
- Students will analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Standards
(Domain 1: Planning and Preparation- Component 1a:Demonstrating Knowledge of Content and Pedagogy)

- MS-ETS1-4- reinforces the use of a model to test and modify a tool to achieve an optimal design.
- MS-ETS1-3- supports the use of multiple models to determine the **best characteristics** of each model to produce a viable solutions.

Vocabulary (Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)	**Prep Work/Materials (Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Instruction Engaging Students in Learning)**	**Cross Curricular Connection (Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)**
Center of gravity Mass Friction Angles Geometry Brick Incline Decline Proportional relationship Descends Ascends Ratios Rates Proportionality Slope Sir Isaac Newton	Laptops Worksheet Lego Mindstorm kit Ruler/tape measure Notebook Calculator Pencil Video- Brain Pop: Gravity	• Math • Technolog • English/Language Arts • Science

- Visual: videos-Brain Pop: Gravity
- Auditory: Lecture and Class Discussions
- Verbal: Worksheets
- Kinesthetic: robot activities, active participation
- Students will be working in small groups 3-4 per group

Procedure **(Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)**	**Student Engagement (Teacher Assessment)**
• Teacher and students will discuss brain pop video – gravity • Teacher introduces the scenario in worksheet form. A large company keeps losing money because the trucks that ship their products keep crashing when on an incline . You are hired to investigate and develop a solution to lower the number of accidents. Using your robot to act as the vehicle, sketch ways to prevent the vehicle from crashing. Think about the positions of your brick in your investigation. Illustrate below. • Students share some solutions to their investigation.. • Discuss Center of Gravity and why the vehicle keeps crashing. • Students break up into groups to begin testing their predictions. • Teacher will circulate and ask students about their robots and the placement design of their bricks. Students will turn their paper over and begin to test their robots and the different mass placements. **Teacher Directions:** **(In groups of 3-4)** 1. Place the load (EV3 brick) in different positions (3) to test your predictions about center of mass (MS-ETS1-3) as the robots go up hills at a specific angle. Do this for each position with a mass placed on the robot. 2.Students will measure the distance on the incline and illustrate what happens when the brick (mass) is placed at the appropriate location noted on the student worksheet. **<u>Reflection</u>** 3. Students will collaborate as a whole class on their findings and revisit the truck delivery scenario. 4. The teacher will ask probing questions to elicit students responses: a)Which model was the most unstable? Why? b)Which model was the most stable? Why? 5. Students will explain that there is more mass in the front the more easily the truck will drive on an incline. Therefore the model with the brick above the front wheels is the most stable.	• **Opportunities for students to initiate higher-order questions & extend/enrich the discussion.** • **Open-ended questions with multiple correct answers.** • **Fully aligned with instructional outcomes.** • **Permits student choice.** • **Appropriately paced to allow time needed to intellectually engage with and reflect upon learning.** • **Students serve as resources for one another.** • **Student centered group work**
-Students will be monitored as they conduct their experiment and record their findings. -Students will complete an exit slip:two groups will answer question 1 and two groups will answer question 2. 1. Why do you think the robot moved differently with different mass configurations? Explain. 2. What is the best method for your truck to use to make all of the deliveries without crashing? Explain.	• Integrated into instruction. • Students contribute to assessment criteria. • Students self-assess & are aware of characteristics of high-quality work. • Specific & timely feedback.

	• Set child-friendly goals with students.

Additional Resources

Homework

http://www.7bscience.com/uploads/4/7/3/3/473362/mass_and_weight_worksheet.pdf - page1
http://lambertscience.weebly.com/uploads/5/8/8/9/5889937/mass_and_weight_worksheet.pdf - page 2
To be assigned together - due next class period