County Implementation Award Program (CIAP) Math and Science Lesson

Unit Title:
Force & Motion: Magnets

Lesson Title:
Making Magic the Rube Goldberg Way

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Grade Level:
Third Grade

Time Frame:
Two 45-minute class periods (students will need time to plan, build, assess, and revise before submitting)

Targeted Standard(s):
3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.
W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1), (3-PS2-2)
SL.3.3 Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. (3-PS2-3)
MP.2 Reason abstractly and quantitatively. (3-PS2-1)
MP.5 Use appropriate tools strategically. (3-PS2-1)
MP.8 Look for and express regularity in repeated reasoning

Short Description of Targeted Phenomenon: Share with students the following video:
https://www.youtube.com/watch?v=QQ9gs-5lRKc&feature=youtu.be

Through experimentation, students will use magnetic force to create a Rube Goldberg machine to complete a task. They will understand what causes magnets to be attracted or repelled by other magnets. They will be able to explain to others that positive-negative poles attract and how like poles repel each other. They will learn and be able to explain that items with metal attract items and how using magnetic forces they can manipulate objects to make them move. They will be able to explain how magnets can manipulate objects by their magnetic force. They will be able to explain how they were able to use this knowledge to design and build a machine to complete a task.

Three Dimensions of NGSS

Science & Engineering Practice/s (SEP):
Ask questions that can be investigated based on patterns such as cause and effect relationships. (3-PS2-3)
Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

Plan and investigate collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)
Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)

Crosscutting Concept/s (CCC):
Patterns of change can be used to make predictions. (3-PS2-2)
Cause and effect relationships are routinely identified, tested, and used to explain change. (3-PS2-3)

Disciplinary Core Idea/s (DCI):
PS2.A: Forces and Motion
Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)
The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)
Objects in contact exert forces on each other. (3-PS2-1)
Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other. (3-PS2-3), (3-PS2-4)

Language Supports:
slide deck or anchor chart with visual vocabulary (magnet, attract, repel, force, distance, magnetism, pole, positive and negative)

Materials Needed:
teacher device with access to the internet for opening, show this marble and magnet video (additional video of marble run); sets of magnets (see list in "other teaching resources" section of lesson plan) for students to use in pairs or triads; a variety of materials and items (pieces of cardboard, scissors, small blocks, dominos, etc.) for students to use in their creation; planning sheet; written summaries

Objective(s): Students will be able to:

1. Construct a latch to keep a door shut or a device to keep two moving objects from touching each other.
2. Explain to others how magnets attract and repel each other and how they interact with objects not in contact with each other.
3. Articulate their findings in a written summary (reflection part of the planning sheet, blog post, or notebook)

How Math and Science concepts/skills/practices were integrated in this lesson:

This lesson is designed to address third grade NGSS science standards. Math is integrated into the lesson as students measure the size and placement of pieces of their Rube Goldberg machines, measure distance traveled, and create data tables to demonstrate each trial of their machines, Students will reason abstractly and quantitatively as they determine which items are needed to create their machines, how magnetic poles attract and repel each other, and how they cause items to move due to their magnetic pull. Students will use data tables to collect and display data that they collect throughout the lesson. Students will use the data in their data tables to look for and explain any patterns that they may find in relation to the size or placement of key elements of their designs.

Possible Challenges /Misconceptions:
Students playing rather than recording findings
Students not working in collaborative groups
(If using colored magnets) thinking that magnets attract/repel based on colors rather than on magnetic poles
Students playing rather than designing their device

Formative Assessment:
Teacher observation as students conduct experiments, group interactions; final creation; class discussion

Lesson Opening

Activate prior knowledge and student interest- teacher presents an interesting situation, phenomenon, or dilemma that helps students connect to the content

Teacher Actions	**Student Actions**
Show a variety of images or videos of Rube Goldberg Machines, simple machines, magnets Record things students share	View images discuss what they notice about the images what do they wonder about the images Share out some of the notes/wonders as part of class discussions

Lesson Introduction

Getting students ready - teacher introduces the task and makes sure students understand *what* they are trying to accomplish, but not *how* they are to do it

Teacher Actions	**Student Actions**
Provide students with enough magnets to create a machine (the number will depend on how elaborate you want students to get and how many magnets are at your disposal) and access to a variety of other materials (cardboard, dominos, scissors, other classroom materials). Provide a time limit for experimentation	Create a list of guiding questions about how to create a device that meets the parameters of the assignment. Students work in collaborative groups to design a working Rube Goldberg machine.

Explain that students need to create a machine to keep two items apart or a way to lock a door (they create). (The more elaborate the device the better.) Provide recording sheet or access to a doc for students to record their trial and errors	
Body of Lesson Students working on content - teacher observes students, monitors their progress, and provides clarification as necessary	
Teacher Actions Circulate room, observing groups, ask questions of students to check for understanding (Why did you design ___ like ___?; What is your goal with ___?; How will ___ work?; What would happen if ___?; Do you have a plan for ___?), assist as needed, ask open-ended questions to ensure students are working through issues and working together.	**Student Actions** Students work in collaborative groups to create and revise a working Rube Goldberg machine that meets the parameters of the assignment.
Lesson Closure Wrapping Up - students complete a gallery walk to observe other students' designs; teacher facilitates group discussion, helps students share their work/progress, helps students make connections, and ensures that big ideas are brought forward	
Teacher Actions Students share their devices Have students create a movie or write a summary of the steps they took to create their devices (How many times did they have to revise their plan? What worked and didn't work? Why?) What was the easiest/most difficult part of this assignment?	**Student Actions** Share student created devices Generate questions about other groups' designs. Students share ideas and participate in collaborative conversations about their creative and design process.
Summative Assessment: Student created devices - do they meet the criteria of the assignment? Student planning and data sheets	
Other Teaching Resources: Possible magnets for the lesson: set of 20 marble magnets for $6.99 classroom magnet kit level 1 $79.99 classroom magnet kit level 2 $79.99	

3mm ⅛ inch magnetic ball/beads set of 50 $10.99 5mm ⅕ inch magnetic ball/beads set of 50 $12.99
Lab Safety: Make sure students understand magnets are **not toys** and should **not** be put in their mouths or elsewhere. There could be **serious damage** done to their bodies if they are ingested.
Extensions (if any):