LESSON TITLE: How can I use a magnet to move an object?

PERFORMANCE EXPECTATION:

- 3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.*[Clarification Statement: Examples of problems could include constructing a latch to keep a door shut and creating a device to keep two moving objects from touching each other.]
- 3-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

STANDARDS ADDRESSED (See AR K-4 Science Standards) Prior to this Lesson:

Students should also already know about the effects of balanced and unbalanced forces on the motion of objects. They should also already know what magnets are and how they work. Will need to review some of the magnetic principles during the explore.

- PS2.B: Types of Interactions
  - 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)
- 3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- 3-PS2-3 Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

ENGAGEMENT

- Describe how the teacher will capture students' interest and **access the student's prior knowledge and misconceptions.**
- What kind of questions should the students ask themselves after the engagement?

The purpose: To capture students interest *and* elicit their understanding of and experiences with forces and magnets before heading into the first exploration.

- Engage students with questions to review their understanding about balanced and unbalanced forces and how they effect objects.
  - What does it take to make an object move? (unbalanced force)?
  - Can you give me an example of an unbalanced force causing an object to move?
  - What causes an object to Stop? (unbalanced force) Can you think of an example of a force causing an object to stop?
- Show this Fun with Magnets video.
  - Ask students what they think is going on.
  - What are those white fuzzy things?
  - Are they alive?
  - What is moving them? Where is the force coming from? Is it magic? etc…

EXPLORATION

- Describe what hands-on/minds-on activities students will be doing.
- List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration

Instructions to give students… Okay, I'm going to give you some supplies, and I want you to make some magic (or whatever it is) like you saw on the video. Your job is to see if you can make objects move and stop moving without actually touching them.

Suggested Materials: Fun with Magnets Kit, bar magnets with clearly marked north and south poles, disc magnets, cotton balls, blocks of wood toy car, scotch tape etc.

Teacher will walk around and see what students are doing… asking probing questions, offering suggestions if needed etc.

EXPLANATION

- Student explanations should precede introduction of terms or explanations by the teacher. What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?
- What concepts will the students be explaining? What format will the explanation take?
- List higher order thinking questions which teachers will use to solicit *student* explanations and help them to justify their explanations.
- How should vocabulary be addressed in this stage?

Randomly draw students' names to share what they observed during their exploration. Ask strategic questions that will elicit students explanations to describe magnetic forces (Orientation of the magnets, distance apart, shape of the objects being moved etc.). Possible questions follow (but the actual questioning should by dynamic and appropriate for the situation):

1. Were you able to start an object moving without touching it? What did you do? Did you notice anything specific about how two magnets interact?
2. Were you able to stop an object that was already moving? Explain what you did.
3. What were your challenges? What else did you lean about magnets?
4. If students don't say it, ask probing questions to get them to notice that magnetic forces are strong as long as the two objects are close together, but not so strong when they are far apart; that like poles repel, unlike poles repel etc.

Might want to show the You Tube video: Magnet Powered Car

Before leaving this part of the lesson, it should be clear that students understand the major magnetic concepts.

- Every magnet has a north and a south pole.
- Unlike poles attract
- Like poles repel.
- Magnetic interactions are forces that can be used to move /stop objects.
- The size of magnetic forces is dependent upon the distance the objects are apart….

ELABORATION

- Describe how students will develop a more sophisticated understanding of the concept. What activity, discussion, etc will the students engage in?
- What vocabulary will be introduced and how will it connect to students' observations?
- How is this knowledge applied in our daily lives?

Now that we know two magnets can interact and create an unbalanced force causing an object to move (or stop) without actually touching it, we need your help!

The company, Toys' for Peeps" wants your help to create a maze and help the white fuzzy snow peeps (Remember seeing them in the video at the beginning of class) find their way home.

Engineering Design Challenge:

1. You have to create a maze that is between **3-4 feet long** and has **at least two turns** in it.
2. Create a contraption to carry the snow peeps home without touching it.
3. Practice moving the vehicle through the maze until you can do it successfully.

Suggested Materials:

- roll of brown or white craft paper-to sketch your maze on it
- Cotton balls (lost snow peeps)/Styrofoam cubes
- 2- bar magnets
- disc magnets
- scotch tape
- markers

4. Write 3-5 rules on your maze so other people will how how to play and how to win (or keep score) at your game.
    a. Do you want it to be about speed and how long it takes to move 5 snow peeps through?
    b. Or do you want it to be a race between two different snow peeps?
    c. What happens if the peeps run out of the maze? What are the rule consequences (maybe a wolf or a bear is lurking in the shrubs and the sheep gets eaten).
5. Invite another team to play your game and keep score.
6. Is the game challenging enough or is it too hard.
7. Modify the game a bit to make is better.

Engineering Design Loop: In partners/small groups, students will follow the engineering design loop process to create and test their designs.

1. Understand the problem they are working to solve
2. Brainstorm how they could design their game - draw their idea; share solutions; select one to try.
3. Design and test the solution.
4. Evaluate results - did it work? Why/Why not? Do you need to adjust or modify?

EVALUATION

- How will students demonstrate that they have achieved the lesson objective?
- This should be embedded throughout the lesson as well as at the end of the lesson

- Other students should be able to play the game successfully.
- Students can critique their own game and suggest two ways to improve it and explain why.

SUGGESTED MATERIALS

- Random sizes and shapes of magnets
    - 2 bar magnets clearly labeled north and south
    - magnetic wand
    - Craft and Hobby Magnetic Tape
- Objects to use unbalanced magnetic force to start and stop

- Styrofoam/cotton balls
- block of wood
- ball (?)

- Maze Materials:
  - roll of craft paper
  - painter's tape
  - Magic markers