Grade Level/Course: Grades 3-4/STEM Math and Science
Lesson/Unit Plan Name: Exploring Magnetism and Distance
Rationale/Lesson Abstract: Students will learn about magnetic energy through exploration about magnetism and its properties and will create model powered by magnets. Students will use the engineering design model to build their vehicles and measure the distance travelled.
Timeframe: 2-3 days

Common Core Standard(s):

3.MD Measurement and Data

Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.

3.MD.4 Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.

4.MD Know relative sizes of measurement units within one system of unit.

4.MD.4 Make a line plot to display a data set of measurements in fractions of a unit.

Next Generation Science Standards:

3-PS2 Motion and Stability: Forces and Interactions

3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.

4-PS3.C: Relationship Between Energy and Forces

4-PS3-3 When objects collide, the contact forces transfer energy so as to change the objects' motions. (4-PS3-3)

4-ETS1.A: Defining Engineering Problems

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria).

Instructional Resources/Materials:

1st Activity

For each group of 4 students:
Tray or paper plate
10 magnets (assorted kinds)
10-12 objects for magnetism exploration both magnetic and nonmagnetic such as: marbles, dominos, rubberbands, pennies, pencils, nails, screws, empty soda cans, aluminum foil, hinges, nuts

Note: some nonmagnetic metals would be helpful so that students do not assume all metals are magnetic or have strong magnetism.

2nd Activity

For each group of 4 students:
Several straws
string
Rubberbands
Tape
Elmer's Glue
Marbles
Lego wheels or even bottle caps (round to make something roll)
Cardboard or cardstock
Scissors
Rulers or tape measures
Pencils and paper

First Activity/Lesson:

Students will explore the properties of magnetism. Hopefully, they will have some prior knowledge about magnets. If not, teacher will introduce magnetism as a force of nature. Teacher will provide a meaningful definition of magnetism with vocabulary words that students can copy into their science notebooks. Teacher will explain that magnets have both a north and south pole. They both attract/pull and repel/push objects that are magnetic. In this lesson, students will have an opportunity to work in cooperative groups with an assortment of magnets to explore 1) which materials are magnetic; 2) are some materials more magnetic than others; 3) which magnets are stronger; 4) how do magnets attract and repel each other; and 5) are some magnets stronger than others.

For these science activities, it would be best if students could be placed in groups of 4. Teacher should review norms of working in small groups. Teacher should guide students through the exploration. Each table group will have a chart where students can

list the materials, make predictions as to their magnetism, test their materials and then record their final results. Table groups should be encouraged to look at materials around the room, list them on the sheet and test them also. Students should be encouraged to use the questions listed above to guide their discussions. In this section, students should determine not only which materials are magnetic but if any materials are more magnetic and if any of the magnets are stronger than others.

When students have sufficiently tested their materials and recorded the data, students should be told to see how magnets attract and repel each other. Again is the push and pull force stronger for some magnets and why?

When students have had ample opportunity to test their materials and record their results, the full class should come back together to share out their findings. One person from each group should report their findings. The teacher will record the table groups' findings on a line plot either on chart paper or document camera.

Activity two: The Design Challenge

Students will be presented with a design challenge. Again, students should be put in 4-person groups. The challenge is to build a lightweight model car or vehicle that will move the furthest distance using magnetic force. This means that throughout the design exercise, students will be not only making the vehicle but constantly testing and possibly revising their design.

Teacher should direct a short discussion about what the design process is. Use graphics provided on document camera.

1) **Ask** - what is the problem you want to solve or the product that you want to create. (In this case, students are engineers designing a vehicle that can be pulled or pushed (powered) the furthest by magnetic energy.

2) **Imagine** -- Brainstorm with others to get ideas and write them down.

3) **Make a Plan** -- now you should sketch designs for what you hope to build.

4) **Create** your vehicle and test it out!

5) **Regroup and Improve** - come back together talk about what you developed and try another design. Move the pieces around to make it move faster. Put the essentials of the design process on the whiteboard. Ask → Imagine → Plan → Create → Improve. A diagram to share with your students along with key questions follows.

Starting the Activity

Give each student group the same amount of materials to use to create their vehicle. Tell students that they must use only the materials they have at their table group. They

cannot borrow from or give materials to other groups. Give materials out and let students start their designs. Remind students that once they get their vehicles together they have to figure out how to power them using magnets. Then they have to measure how far the vehicle can go with one push or pull.

After an ample amount of planning, design and play time, bring students back together. Have each table group explain their design process. How far did their car move? How many magnets did they use? What was their best design and why?

Teacher should work with students to create a bar graph (template provided) to record the data for the vehicles – groups vs. distance travelled.

Individual exit slip: Write two things that you learned today about magnetism.

Assessment:
Teacher observations, group completion of charts, group presentations, and individual exit slips.

Exit Slip:

Name:_____ Date_____

Today I learned that magnetism is _____

_____.

Some examples of magnetic objects are _____

_____

_____.

Group Work:

Student Names: _____ Date: _____

Magnetism Chart

Objects	Prediction Yes or No	Was I correct?	If magnetic – strong or weak?
nail			
marble			
penny			
soda can			
rubberband			

ASK: What is the problem? How have others approached it? What are your constraints?

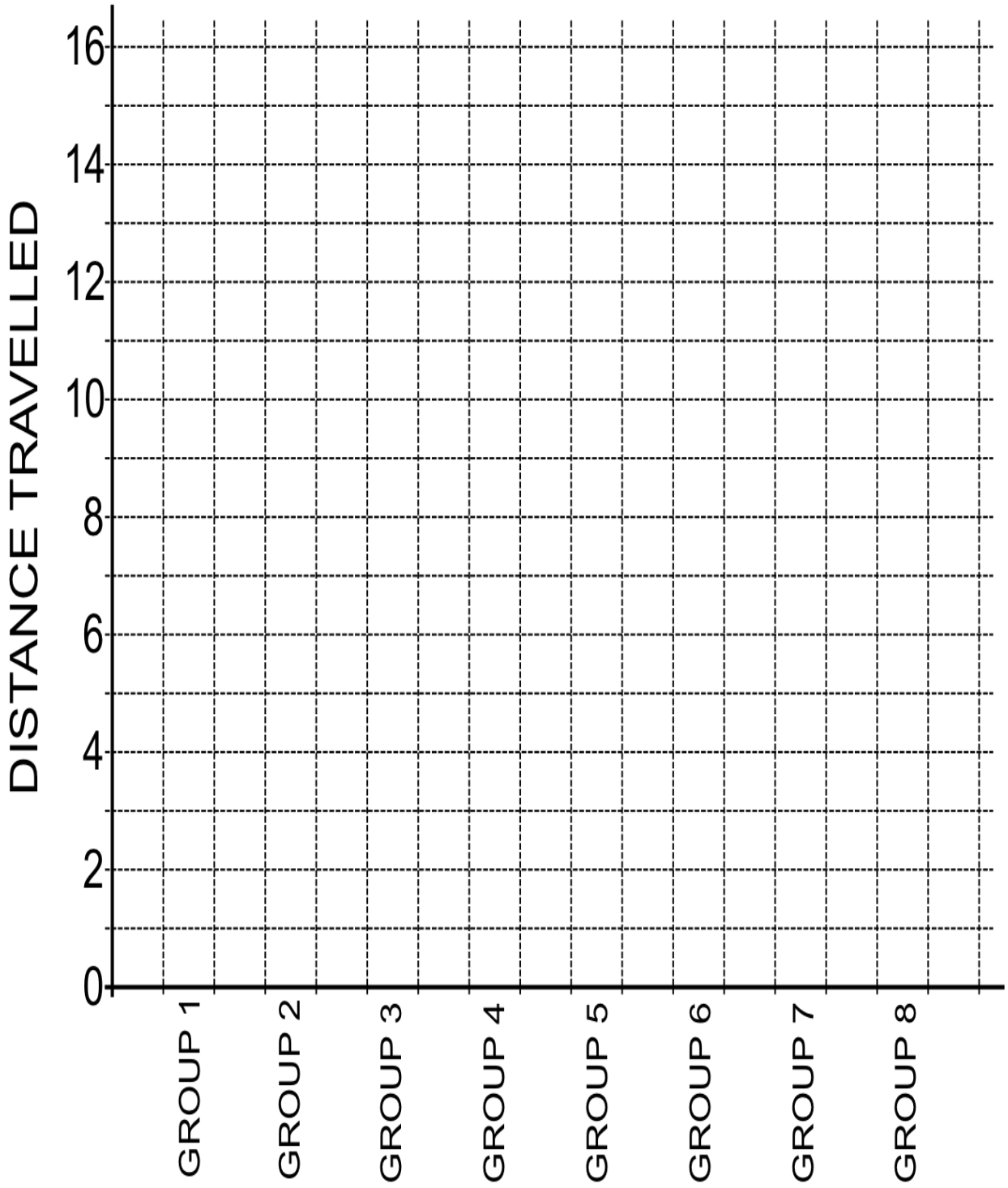
IMAGINE: What are some solutions? Brainstorm ideas. Choose the best one.

PLAN: Draw a diagram. Make lists of materials you will need.

CREATE: Follow your plan and create something. Test it out!

IMPROVE: What works? What doesn't? What could work better? Modify your designs to make it better. Test it out!

Engineering is Elementary http://www.eie.org/overview/engineering-design-process


DISTANCE TRAVELLED
16
14
12
10
8
6
4
2
0
GROUP 1
GROUP 2
GROUP 3
GROUP 4
GROUP 5
GROUP 6
GROUP 7
GROUP 8