Smithsonian | SCIENCE *for Makerspaces*

# MAGNET MOTION

PHYSICAL SCIENCE

## LESSON GUIDE

Magnet Motion is tied to our Smithsonian Science for Makerspaces, and this lesson plan booklet is geared for and written to guide teachers and students in using this education tool provided by the Smithsonian Science Education Center.

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Produced by Ryan Seymour

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# MAGNET MOTION

| | Student Objectives | Disciplinary Core Ideas | Science and Engineering Practices | Crosscutting Concepts |
|---|---|---|---|---|
| **Observe It!**<br>**Make It!**<br>**Design It!**<br>**Test It!**<br><br>**Class periods:** 1-2<br><br>**Preparation time:**<br>40 minutes<br><br>**Vocabulary:**<br>attract<br>force<br>magnet<br>repel<br>transportation | Use patterns in data to reveal relationships between magnetic force and motion.<br><br>Design a transportation model that uses magnets to move an object using non-contact forces. | Each force acts on one particular object and has both strength and direction. (3-PS2-1)<br><br>Electric and magnetic forces between a pair of objects do not require that the objects be in contact (3-PS2-3) | Developing and Using Models<br><br>Organize simple data sets that suggest relationships<br><br>Analyzing and Interpreting Data | Patterns<br><br>Cause and Effect<br><br>Interdependence of Science, Engineering and Technology |

# MAGNET MOTION

## Introduction

The Smithsonian Science for Makerspaces: Magnet Motion lesson plan explores how magnetic forces can act on objects without them being in contact. Using computational thinking and pattern recognition, students will use information from data tables to construct a model representation of a transportation track.

**Vocabulary Words:** attract, force, magnet, repel, transportation

## Observe It

Teacher will share the following passage with students

There are many ways to travel to new and different places. Moving from one place to another is called transportation. What are all the types of transportation you can use to get to school?

Did you know some people use magnets to go from one place to another? Inventors long ago worked on ways to use magnets for transportation. Magnets are special because they can move other magnets without touching them. Magnets have a force that can attract and repel other magnets. Attract means to bring close and repel means to push away. How do you think magnets can help with transportation in your community?

Image Caption: zyxeos30/iStock/Getty Images Plus

Now people can travel on a very fast train that uses magnets to move. This train is called a maglev train and it can move hundreds of people almost as fast as an airplane! The maglev train and train tracks both have magnets that use electricity to make them stronger and weaker. Some magnets in the train tracks attract the train to move forward, while other magnets repel the train from behind. This is how the train moves very fast. For this project we will also move an object from one place to another using magnetic forces, similar to a maglev train.

**Discussion Questions:**

1. How can magnets move other magnets?

2. Do magnets need to touch each other to move?

3. Would you like to travel on a maglev train? Why or why not?

## SMITHSONIAN CONNECTIONS:

The Smithsonian National Museum of American History features exhibitions that focus on historical innovations and relvolutionary inventions. https://americanhistory.si.edu/topics/innovation

## Make It

**Teacher will:**

1. Separate the class into groups of three or four students.

2. Print one copy of the Magnet Motion: Directions worksheet and the Transportation Challenge Track worksheet for each group of students.

3. Print one copy of the Magnet Motion: Design It! worksheet, the Transportation Creation Track worksheet, and the Magnet Motion: Test It! worksheet for each individual student.

4. Provide each student group with the following materials:
   3 Rectangular magnets: 1 inch by 3/4 inch
   Scissors
   Tape
   1 Marker or crayon

**Student groups will:**

1. Read the Directions worksheet found in their worksheet packet.

## Design It

1. With the class, the teacher will read and review the steps found on the Directions worksheet.

2. Students will set up the magnets and the Transportation Challenge Track worksheet as described in the Directions.

3. Students will place the train station magnet on the 1 square of the Transportation Challenge Track. Students within their groups will take turns repelling the train magnet until it reaches the train station. To do this, one student will use the unlabeled magnet to push the train magnet from behind.

4. On the Design It! worksheet, each individual student will record the direction of the train magnet's motion and the number of squares it moved. The number of squares moved should include the train station square the train magnet ended up on, but not the square the train magnet started on.

5. Student groups will pick up and move the train station magnet to the 2 square, then turn the train magnet so it faces the train station magnet. They will use the unlabeled magnet to push (repel) the train toward the 2 square train station. Again, individual students will record on the Design It! worksheet the direction of the train magnet's motion and the number of squares it moved.

6. Student groups will move the train station magnet to the 3 square and repeat the exercise. Individual students will complete their Design It! worksheet.

**Discussion Questions:**

Bring the class together and facilitate a discussion about the information gathered on the Design It! worksheet.

1. What three directions did the train move to get from start to finish?

2. How many squares did your train travel to get from start to finish?

Tell students they will now each design their own train transportation track using the Transportation Creation Track worksheet. Students choose where to write in a start block (they can use the letter S to save space) and five station blocks with numbers 1 though 5. They can use only straight lines to move their trains from one location to another. No diagonal or curvy lines are allowed. Students can use the check list on the Design It! worksheet Part 2 for directions.

## Test It

1. After each individual student has completed their track design, have them work through the Test It! worksheet. Similar to the Design It! worksheet, students will fill out the steps needed to complete their custom-made transportation track.

2. When everyone is finished, students groups will create two piles of papers. In the first pile are all of the group's Transportation Creation Track worksheets. In the second pile are all the Test It! worksheets. Tell students groups to shuffle the two piles.

3. Tell student groups to switch classroom locations with another group.

4. At their new location, student groups will review the two piles of worksheets and try to match the step-by-step instructions found on each Test It! worksheet with its corresponding Transportation Creation Track worksheet.

5. After student groups have made their initial matches, give them time to use the magnets to test each track individually to see if their predictions were correct.

6. Facilitate a discussion with the class about matching directional data tables to the Transportation Creation Track models. Use the following discussion questions.

**Discussion Questions**

1. How was each magnet was used in this model. How did they work with each other?

2. Could you change the strength of the magnetic forces on the train? What if you brought the magnet in your hand too close to the train? What if it was too far away?

3. What information would make it easier to match the tracks with the instructions?

## Additional Resources:

*See next page*

# Magnet Motion: Directions

## 1

- Cut out pictures of train and train station. Tape train picture ontop of a magnet.

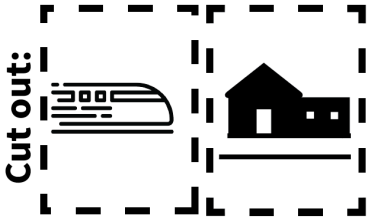
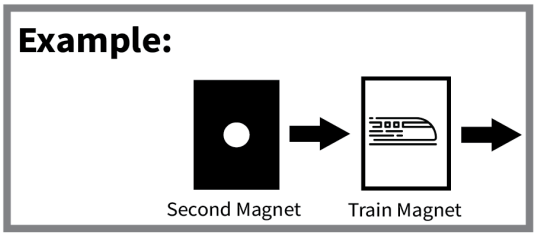


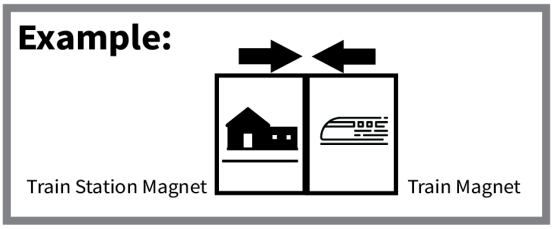

Image Credit: Rahmat Hidayat/Noun Project

- Use a second magnet to repel (push) the train magnet.




## 2

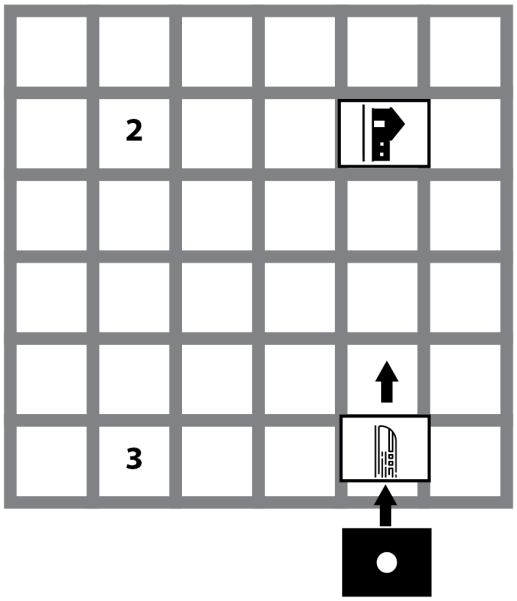
- Tape train station picture ontop of a third magnet.




- Use the train station to attract the train magnet.

## 3

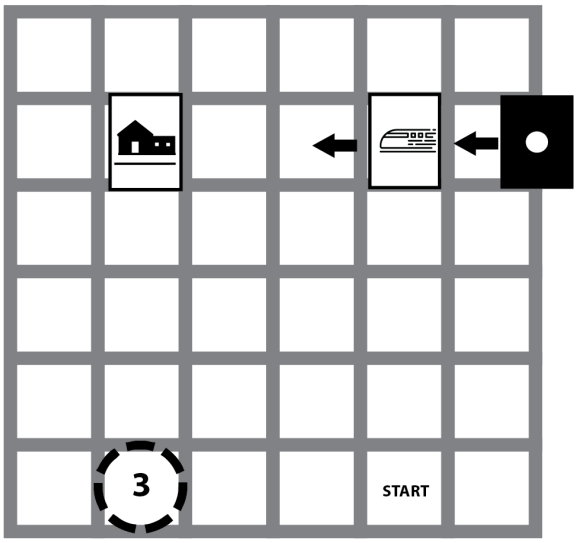
- Place train station magnet on #1.



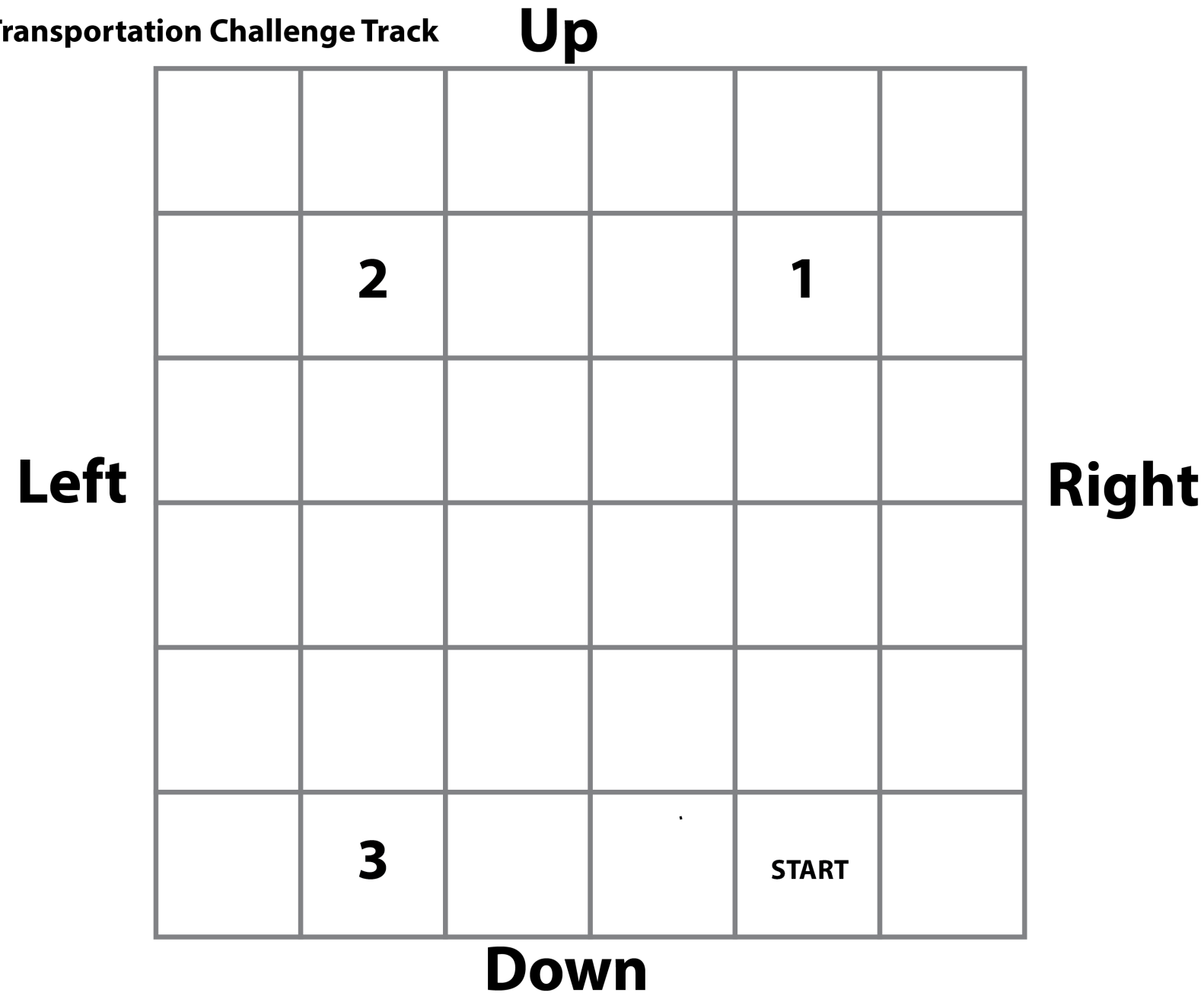

- Repel the train until it reaches the train station magnet.

# 4

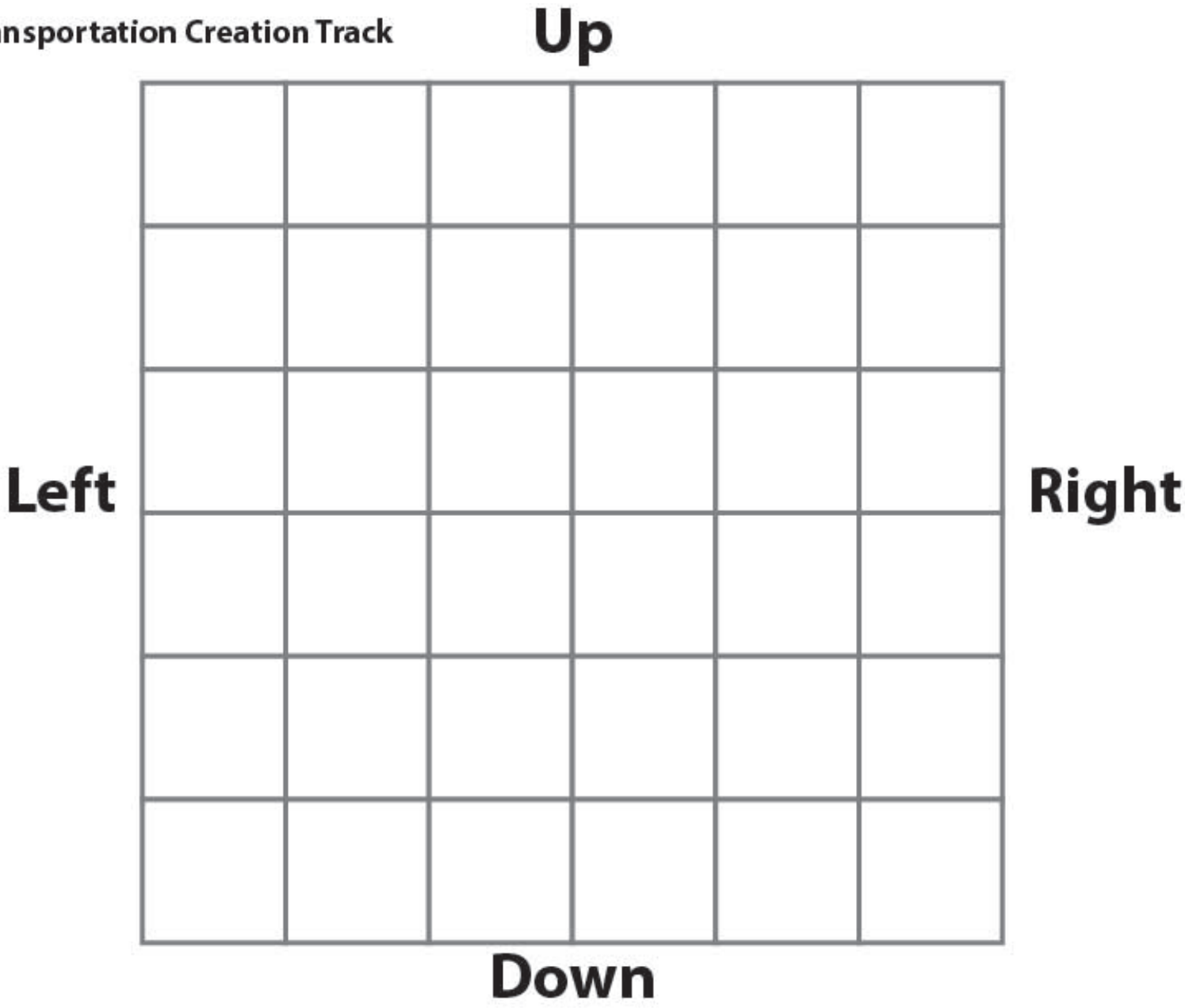
- Place train station magnet on #2.
- Repel the train until it reaches the train station magnet.
- Do this again until you reach #3.



**Transportation Challenge Track**



**Transportation Creation Track**



# STUDENT WORKSHEETS

## MAGNET MOTION

# Magnet Motion: Design It!

**Name**_____

**Part 1**

**Write the steps to finish the track**

| Stations | Direction | Number of Squares |
|---|---|---|
| Start | | |
| 1 Station | | |
| 2 Station | | |
| 3 Station | | |

**Part 2**

**Design your own track**
**Use the Transportation Creation Track worksheet.**

**Directions:**

- **Place a Start block.**
- **Place five station blocks with numbers 1-5.**
- **Trains can only move in straight lines from one station to another.**

# Magnet Motion: Test It!

**Name**_____

**Part 1**

**Write the steps to solve your track**

| Stations | Direction | Number of Squares |
|---|---|---|
| Start | | |
| 1 Station | | |
| 2 Station | | |
| 3 Station | | |
| 4 Station | | |
| 5 Station | | |

**Part 2**

**Have another student group match the Transportation Challenge Track with the steps here.**

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