

Magnetic Fields 7.1.3 e2

Time: 45-75 minutes	Anchor Phenomena: See phenomenon video showing iron filings.
Big Idea: There are forces between objects that can affect them, even if they are not touching.	
CCCs Cause and Effect Patterns	Practices Develop and use a model to describe phenomena.

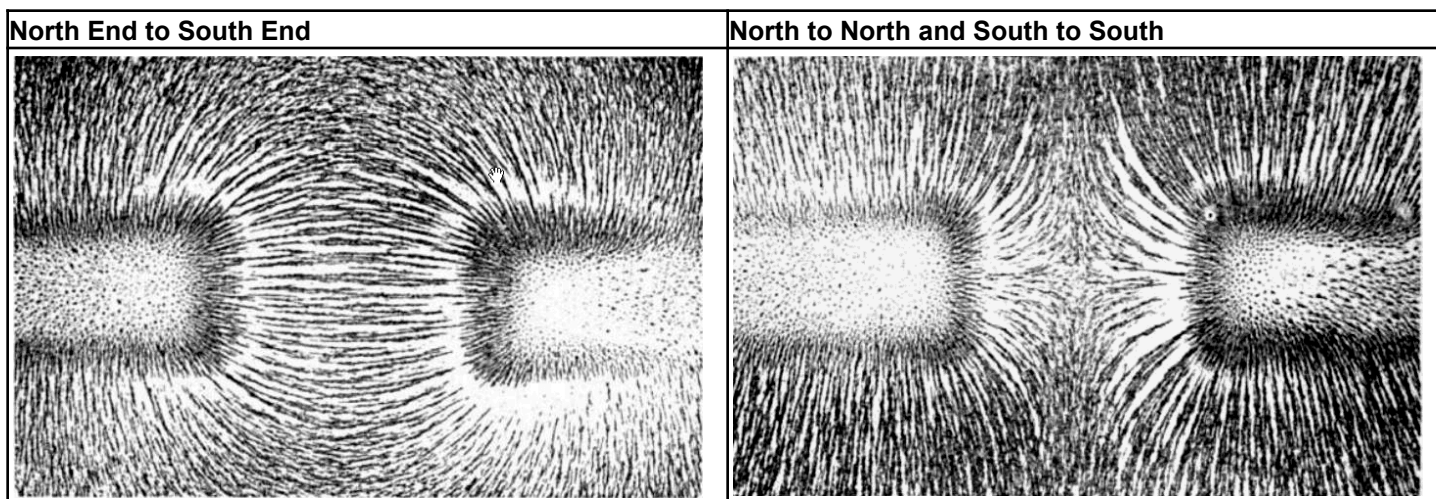
EPISODE SNAPSHOT: Students make **models** of magnetic fields with bar magnets and iron filings or compass diagramming and computer simulations.

GATHERING

Give small groups of students two bar magnets and ask them to try putting the two ends of the magnets together and to observe what happens. Make sure they try both ends. Have them record their observations and have some students share their observations with the class. Explain that today they will learn why opposite ends of the magnets are attracted to each other and why the same ends of the magnets repel each other.

Teacher Note: This YouTube video will help you set up and run the experiment with the magnets and iron filings: “Teacher Workshop: Make a Magnetic Field” <https://www.youtube.com/watch?v=j8XNHIV6Qxg>. For a less messy option, several science supply catalogs have iron filings trapped in a plastic bubble or transparent acrylic trays that suspend the iron filings in a fluid. Depending on the thickness of these containers, students will see less of the three dimensional field, but they will still see the patterns shown below. If this method is shown, students will probably need to tap the table to move the filings into place. **NOTE:** Coarse iron filings are a lot less messy and give shapes without becoming too powdery and obscuring the patterns. Fine iron filings tend to turn plastic sleeves black, making it difficult to discern the patterns.

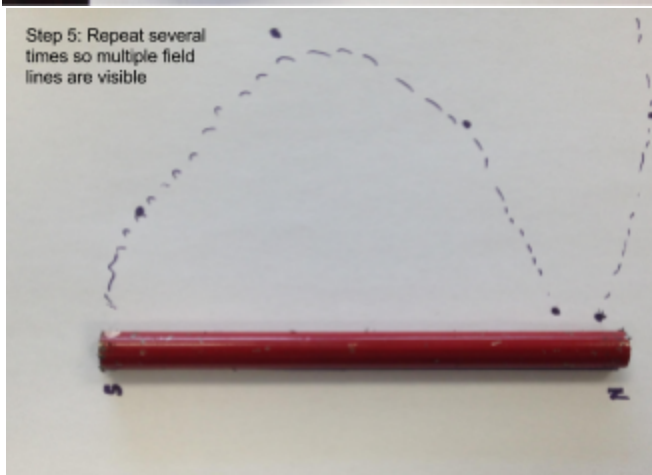
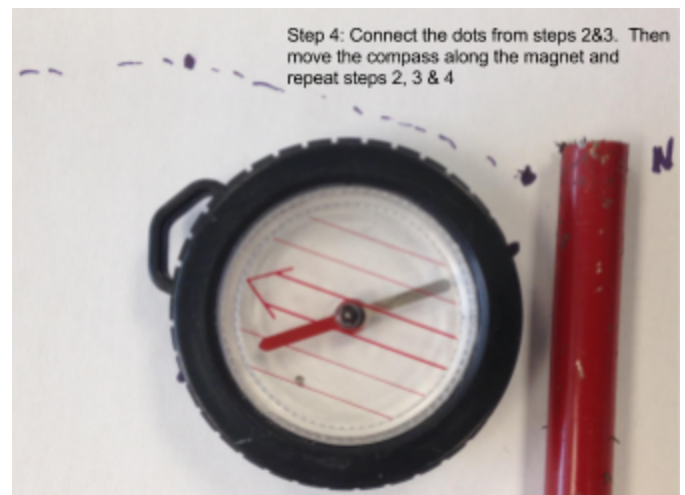
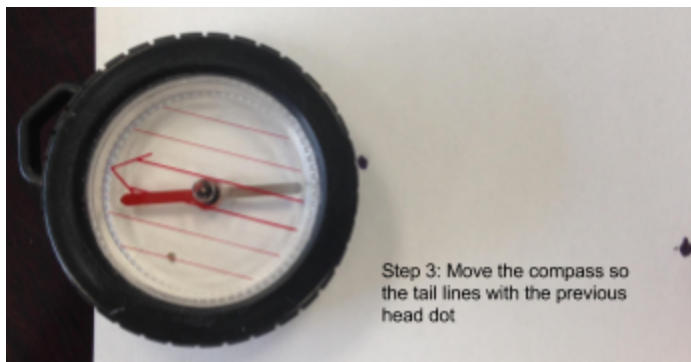
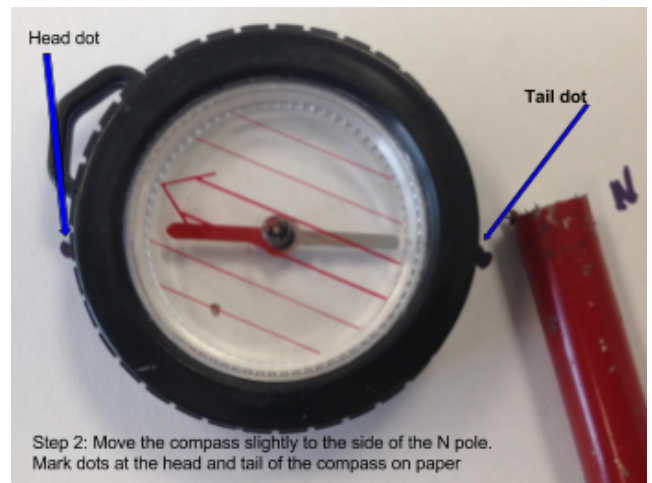
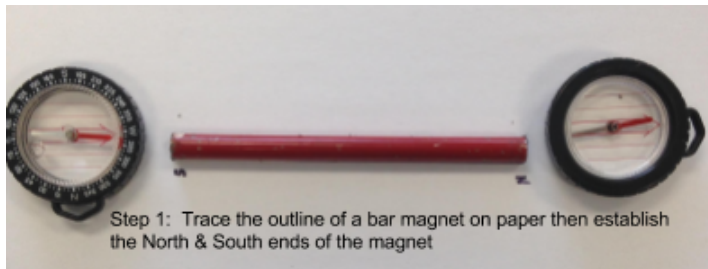
Have the students follow the directions on their student sheets, making model of the magnetic fields between the north end of one magnet and the south end of another, between both south ends, and between both north ends. The students should **make a model** or drawing of the magnetic fields that they see on their student sheets. They should see results similar to the images below.



Alternative Activity if Iron Filings are not available

Mapping Magnetic Field Lines Around a Bar Magnet: Students can feel the force caused by magnetic fields but they can't see the field. A very simple and clean way for students to **model** magnetic field lines for observation is by use of a magnet, compass, paper and pencil.

Step by step instructions are below:



The above technique can be used with like poles of 2 magnets facing each other or opposite poles facing one another.

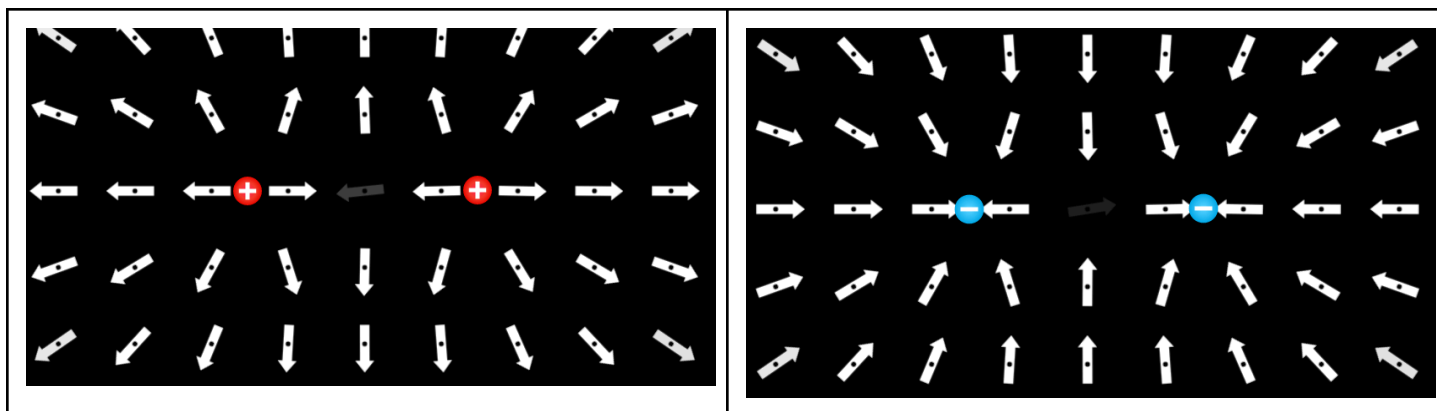
REASONING

Now the students need to figure out and explain what causes the magnetic field lines to appear as they do. Direct the students to go to the PhET [“Charges and Fields”](#) simulation, or you could demonstrate this for all of the students with a projector. Explain to the students that electric fields and magnetic fields are very similar to each other. The positive sphere on the simulation is like north on a magnet and the negative sphere is like south. Place a positive sphere onto the black area of the simulation. **Make a model** or drawing of the force arrows around the sphere. Remove the positive sphere by dragging it back to the box and repeat with the negative sphere. The students should record what they observed--that the force arrows always pointed away from the positive or north and the force arrows pointed in toward the negative or south.

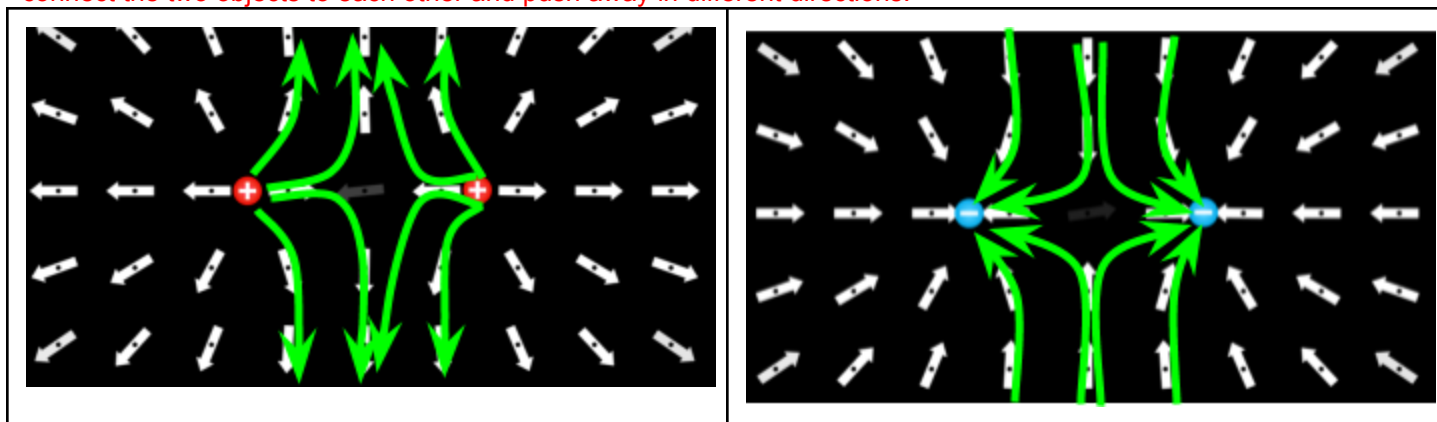
Have some students share their observations and then ask them how their observations from the simulation could explain the patterns they saw in the iron filings. Then, before you take any answers, explain to the students that the patterns they saw in the filings earlier follow the force arrows they saw in the simulation. Guide the students to see that when they placed a north and a south end near each other, the lines in the iron filings seemed to connect because magnetic force always goes away from the north end of a magnet and towards the south end. When they placed two north ends together or two south ends together, the iron filings never connected the two magnets because the forces are always going out and away from each other in the north ends or coming in on the south ends. If they are having a difficult time reaching these

conclusions, model what is happening for them on the simulation. Place a positive and a negative on the screen and have them watch what happens and then a positive and a positive or a negative and a negative.

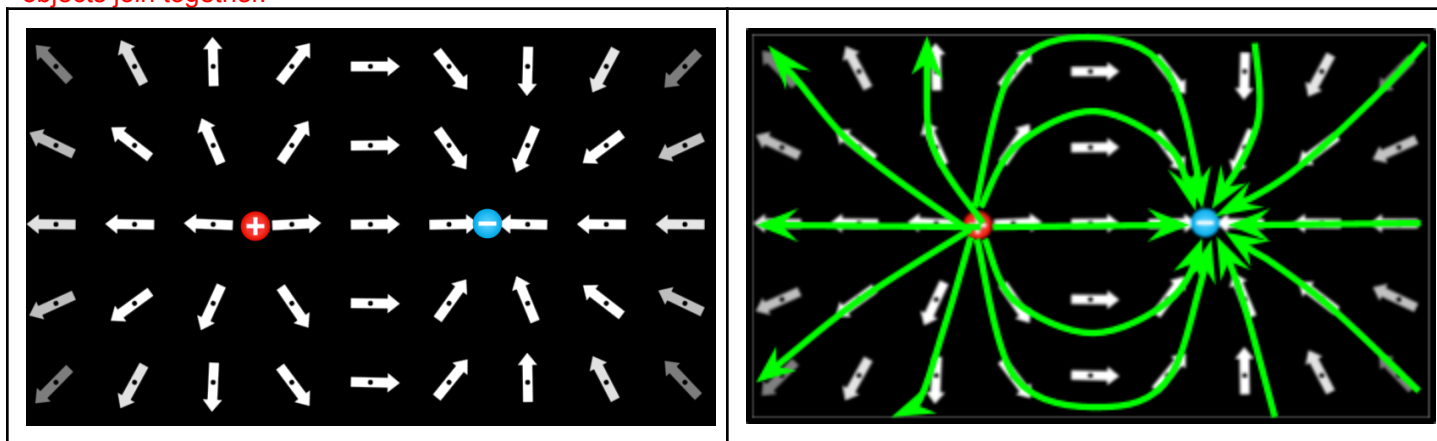
Teacher Note: At first glance, students may be confused by what they see on the screen when you put a positive and a positive or a negative and a negative on the screen. Below are screenshots of what they will see.



Especially with the positive and positive, the students may think that the arrows in between the two positives that point toward the other positive would attract the other positive. Trace the arrows for them, filling in the magnetic field lines for them (examples are below) so that they see these forces repel, not attract. They repel because the force lines never connect the two objects to each other and push away in different directions.



The positive and negative should look something like the images below. They attract because the force lines from the two objects join together.



COMMUNICATING

After the class discussion, students should summarize what they have learned that day. Magnets have forces around them that can affect other objects, even when they do not touch. The magnetic force causes objects to be attracted to each other when their charges or poles are opposite (north to south) because the force lines between the two objects join

together. The magnetic force causes objects to be repelled from each other when the charges or poles are alike (north to north or south to south) because the force lines go in opposite directions and push the objects apart.

Teacher note: Another resource that can be used is the [Magnetism gizmo](#) found on [explorelearning.com](#) if you have a paid subscription. You can also try a free trial to access the gizmos for 30 days.

Assessment: The assessment for this assignment is the summary. A proficient student should be able to explain that magnets have a force that affects other objects, even though they do not touch. The magnetic force causes opposite ends of the magnet to be attracted to each other because the force lines connect and pull the two magnets together. The magnetic force causes the same ends to be repelled from each other because the force lines move away from each other and never connect.

Materials, resources, handouts, etc:

- Two bar magnets for each group, preferably magnets that have the north and south ends of the magnet clearly marked.
- Iron filings
- Clear plastic plate or lid, Paper, plastic, or glass to pour the iron filings onto to see the magnetic fields
- PhET “Charges and Fields” simulation: https://phet.colorado.edu/sims/html/charges-and-fields/latest/charges-and-fields_en.html
- [“Magnetic Fields” student sheet](#)

