

Name: _____

Date: _____

Lesson 10: Handout 3

Magnetic Levitation Trains

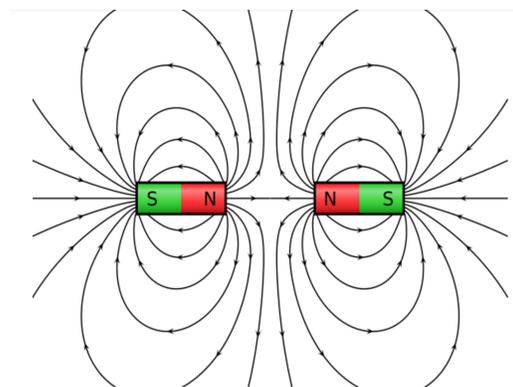
The fastest trains in the world. Have you ever taken a train ride? How fast do you think the train was going? Most trains in the United States have a maximum speed of about 100 miles per hour.

But there are types of trains in other parts of the world that travel much faster. One of these types of trains is called a Maglev Train. It has a maximum speed of 270 miles per hour! The Maglev Train between Shanghai Airport (China) and Shanghai City travels a 19 mile distance in 8 minutes. While Maglev Trains move very fast, they are also very smooth and quiet! What is it about these trains that makes it possible for them do this?

What is a Maglev? Maglev Trains get their name from magnetic levitation. Levitation means an object is suspended, floating, or hovering, without mechanical support. When magnets cause the object to do this it is called magnetic levitation. The Maglev Train has no wheels and doesn't touch any other material. It is suspended above the track and so the friction is extremely low. Once the Maglev Train starts moving, there is very little friction that would cause it to stop by pushing back on the train. However, the high speed does create a small amount of drag from air molecules that push back on the train as it runs into them.



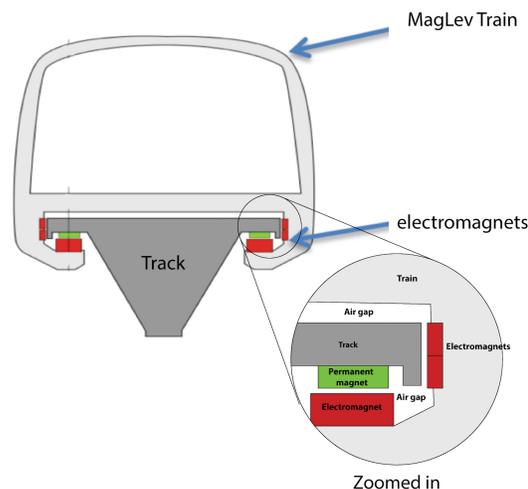
How does the Maglev Train levitate? We learned that magnets have magnetic fields that surround them. Two magnets can be placed with the same poles facing each other so they repel, or placed with opposite poles facing each other, so they attract. In both cases, magnetic fields allow the magnets to exert forces on each other without touching. Think of a magnetic field



as the space near a magnet where magnetic force can be detected. A diagram of the magnetic field shows us a map of the strength and direction of the forces you would detect if you put a test object near a magnet. The image above shows an illustration of the magnetic field. The Maglev Train has magnets on the bottom that are repelled by the magnetic field of the magnets attached to the rails below.

How does the Maglev Train move? The Maglev Train is guided forward by copper coils attached to steel rails. As the train moves forward, the current running through the copper coils on the rails in front of the train switches so that the copper coils have poles opposite to those of the magnets attached to the train. The attractive force will pull the train forward. After the train moves past the copper coils on the rails, the current running through the coils switches again so that the coils are the same poles as the magnets on the train. The repulsive force will continue to push the train forward, instead of pulling it back.

What is an electromagnet? The copper coils that propel the Maglev are called *electromagnets*. See the diagram below. An electromagnet is a magnet that relies on electricity to generate a magnetic field. A common way to make an electromagnet is to wrap copper wire into a coil. An electrical current must be running through the wire to generate the magnetic field.



Based on our investigations in class, how do you think they make electromagnets that are strong enough to levitate and propel something as big as a train?

Read more about Maglev Trains at: <https://en.wikipedia.org/wiki/Maglev>