



## Inquiry Approaches

### Initial Inquiry

What is a magnet?

A magnet is a material that produces a magnetic field. Magnets have a north and a south pole.

Where does one encounter magnets in daily life?

Magnets are used in computers, speakers, cellphones, headphones and other technologies.

How does a conventional train move?

The train converts chemical or electrical energy into kinetic energy that causes the train to move.

### Experimental Procedure Inquiry

When you push the train, why does it keep going around the track for such a long time?

Since the train is levitating, there is minimal friction acting on the train. The applied force (of the push) is only counterbalanced by air resistance, which is very small compared to the force of friction between a solid surface and a non-levitating train.

Can you explain why the train follows the track?

The train moves in the direction that minimizes changes in magnetic flux. The magnetic field is uniform in the x-direction (the direction of the track) but changes considerably in the y-direction (the width of the track), so the train moves along the x-direction.

Why is the train levitated by the magnetic track? What property of the train prevents the magnetic field from passing through it?

The train contains a superconductor, which is impermeable to magnetic fields. Additionally, the superconductor produces its own magnetic field, which repels the magnetic field from the track. The force of gravity pushes down on the train and the train levitates at the point where the forces of gravity and magnetic repulsion are equal in magnitude but opposite in direction.

### In-Depth Inquiry

Is it possible to have a magnet with only one pole?

No. A magnet always has two poles and when a magnet is broken into smaller pieces, each smaller piece will have two poles.