Key: Yellow highlight = required component

Blank Activity Template (←put your title here!)

Subject Area(s) Physics

Associated Unit Electricity and Magnetism

Associated Lesson Magnetism

Activity Title Magnetic Levitation

Header

Image 1

Image file: ___?

ADA Description: Picture of the transrapid 09 at the emsland test facility in germany

Source/Rights: Copyright © http://upload.wikimedia.org/wikipedia/commons/thumb/0/0f/Transrapid-emsland.jpg/800px-Transrapid-emsland.jpg

Caption: Picture illustrating maglev train

Grade Level 11 (10-11)

Activity Dependency

Time Required 45 minutes

Group Size 2

Expendable Cost per Group US $ 5

Summary

In this activity, students will get hands-on experience on magnetic levitation. They will construct a model Maglev train using simple tools and materials. They will emphasize their knowledge on concepts such as attraction, repulsion and levitation.

Engineering Connection

Magnetism plays a major role electrical engineering analysis and design processes. Electrical engineers extensively use concepts from magnetism to design motors and generators. They also use magnetism in designing communication systems. Biomedical engineers use magnetism to design imaging systems such as MRIs (Magnetic Resonance Imaging) and fMRIs (Functional Magnetic Resonance Imaging) to study the brain's anatomy and function. Mechanical engineers use magnetism to design propulsion systems that use magnetic levitation to propel vehicles, for instance, Maglev trains

Engineering Category = Engineering design process

Keywords

Magnetism, Force, Negative pole, Positive pole, Attraction, Repulsion, Levitation

Educational Standards (List 2-4)

State STEM Standard (required)

Texas: Science [2010] Subchapter C. High School, Physics, Science concepts. The student knows the nature of forces in the physical world. The student is expected to: identify examples of electric and magnetic forces in everyday life

ITEEA Standard (required)

International Technology and Engineering Educators Association: Technology [2000], Design, Standard 9. Students will develop an understanding of engineering design.

NGSS Standard (strongly recommended)

CCSS Standard (strongly recommended)

Pre-Requisite Knowledge

Learning Objectives

After this activity, students should be able to:

- Describe how Maglev train works
- Understand attraction and repulsion concepts via experimentation
- How to place magnets in order to create a repellant force

Materials List

Each group needs:

- Duct tape
- Scissors
- A cardboard box
- a cereal box, or similar material such as paperboard
- 26 permanent magnets (each about 1 inch long)
- Rubber bands

Introduction / Motivation

Engineering Maglev trains comes from the simple idea of repulsion and attraction of magnets i.e., North poles repel North poles and South poles repel South poles. The motivation behind levitating comes from the fact that they can travel faster due to lower friction between the train and the train rails. Furthermore, Maglev trains move more smoothly and more quietly than regular trains and they only use electric power for their propulsion system.

Vocabulary / Definitions

Word	Definition

Procedure

Background

Before the Activity

-

With the Students

1. Cut out a base for your track from your cardboard box. It should measure about 4 inches wide by 12 inches long.
2. Next, place your permanent magnets North-side or South-side down on to the sticky side of a strip of duct tape, lining them up like a track. You'll make 2 tracks—each should have 12 magnets.
3. Flip over the taped magnet tracks and adhere them to the cardboard base.
4. Make the guide walls. Cut out two 4 inches wide by 12 inches long pieces of cardboard. Fix the guide walls to the base.
5. Cut out a square that measures 3⅞ inches wide by 3 inches long from the cereal box. Make sure the train fits in between the guide walls and can float freely.
6. Fix 4 permanent magnets to the bottom of the train using the duct tape. Make sure that the magnets are facing the proper direction so that the train is repelled by the magnets that make up the track. See Figure 2, for a schematic build.
7. Finally, use the rubber band to propel your train.
8. Add some mass (maybe a pen or a pencil) to your train and see if it can still levitate

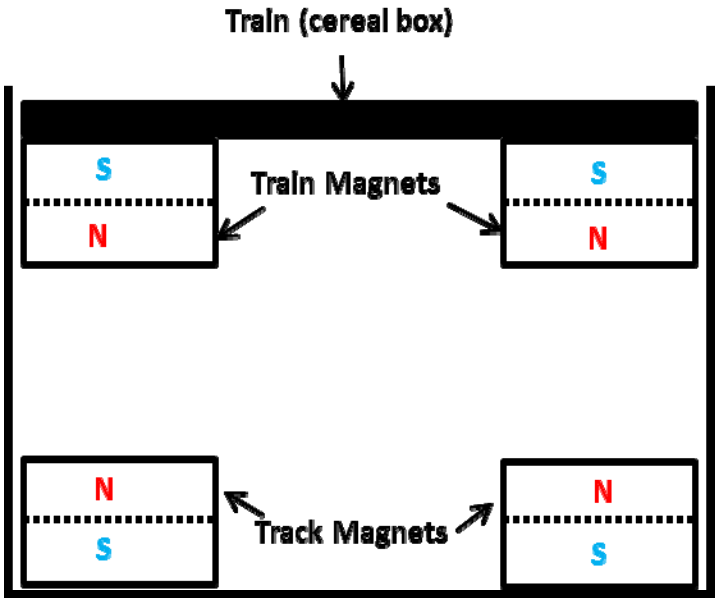

Image Insert Image # or Figure # here (use Figure # if referenced in text)

Figure 2
Image file: ___?
ADA Description: Schematic of Maglev Train
Source/Rights: Copyright © ___?
Caption: Illustrating the architecture of the maglev train

Attachments

Safety Issues

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Troubleshooting Tips

Investigating Questions

Assessment

Activity Embedded Assessment
Descriptive Title: Write up
Ask the students to write a short paragraph while answering the following questions:

1. How and why do maglev trains levitate?
2. How much weight can your maglev train carry? and what is the breakdown point?
3. List two or more magnetic levitation applications in engineering.

Activity Extensions

Activity Scaling

- For lower grades, ___?

- For higher grades, ___?

Additional Multimedia Support

References

http://www.sciencebuddies.org/science-fair-projects/project_ideas/Phys_p067.shtml#summary

http://www.ehow.com/how_7240938_build-magnetic-levitation-experiment.html

http://www.go-explore-trans.org/wp-content/uploads/Instructions-for-Build-your-own-maglev-train.pdf

Other

Redirect URL

Contributors

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Classroom Testing Information

This lesson was conducted in 12/03/2013 with Pre-AP Physics students Westfield high-school, Spring, TX