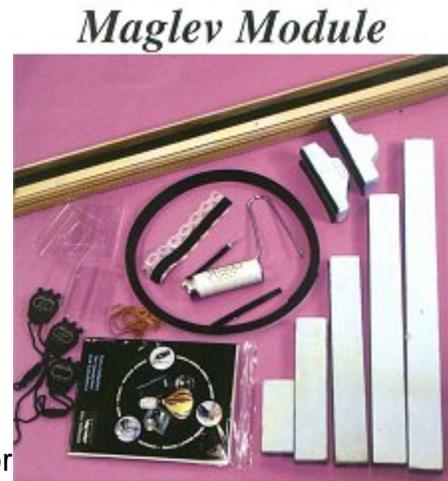


Magnetic Levitation

The Maglev module covers basic kinematic concepts by investigating Newton's First and Second Laws of Motion, as taught in an intermediate school general science course or a high school physics course.

The understanding of these two concepts is fundamental to the topics of highway safety and design. Specific relationships to the National Science Education Standards (NSES) relating to these topics are outlined in the activities chart.

Maglev Module will supply hands-on experience for 1 group of 3 or 4 students .



	Estimated Classroom Time	Module Contents
Pre-Lab	10 prep, 15 minutes class time	Manual
Activity 1	20 minutes prep, 20 minutes class time	8' Maglev Track
Activity 2	15 minutes reading, 10 minutes lab prep, 30 minutes to learn software, class time: 20 minutes for data collection, 15 minutes to graph, 15 minutes to use software	Track Stands Vertical Markers Car Markers Magnetic Tape Stop Watches Plastic Cutters D-Cell Batteries Foam Blocks Xacto Knives Model Cars
Activity 3	10 minutes reading, 10 minutes lab prep, 20 minutes class time	Maglev Car w/ Magnet Graphical Analysis Software
Activity 4	20 minutes reading, 10 minutes lab prep if graphing by hand, 30 minutes to learn to use software if software is needed	
Activity 5	10 minutes prep, class time: 20 minutes for introduction, 50 minutes to build, 30 minutes to race	

All students should do the short pre-lab activity, "**Newton's Apple: How Accurate is Your Measurement?**" where the student identifies the human factors that can lead to measurement errors.

Then, two activities illustrate Newton's first law of motion from which a teacher should select one based on grade level. **Running the Gauntlet** demonstrates Newton's first law of motion using the Maglev track as students measure the time it takes the car to pass designated points along its path, and calculate its velocity.

Graphing the Gauntlet provides students opportunities to develop important graphing skills as they verify Newton's first law of motion by relating the concept of line slope to a real concept like velocity.

Two activities in the second section illustrate Newton's second law of motion, from which a teacher should select one based on grade level. **Caution: 6% Grade Ahead!** uses an inclined Maglev track to demonstrate Newton's second law as students collect data on acceleration rates between intervals.

Graphing the Grade provides students with opportunities to graph data collected from the inclined Maglev track as they verify Newton's second law of motion via the interpretation of their graphs.

The final activity, **Float Like a Butterfly, Sting Like a Bee**, is a design competition suitable for all grades. Students are first introduced to the design process and then apply key lessons from the previous five activities, in addition to given information on aerodynamics, and their own experiments, to build the best Maglev car.

For all activities, possible answers to questions and troubleshooting tips are included in the teacher's section of the manual. Student handouts, enhancements to the activities, educational standards, and a section for volunteers are available in the appendix.

****NOTE: Class visits by NDDOT TRAC volunteers are available for this module. These visits include a presentation on NDDOT's use of Impulse and Momentum principals used for designing safety barriers and video on crash testing safety equipment. Also a presentation on engineering is given.***