Balls and Tracks School Program

Description of Program:
This program allows students to apply the "scientific method" in observing the behavior of golf balls on tracks. Students will be asked to make observations and predictions while briefly exploring the exhibit. Following the exploration, there will be a discussion about some of the forces at work in the exhibit, and how these forces affect the design of the tracks. Students will then put this knowledge to use by working in groups to design their own unique raceways tracks.
Teachers: Please divide your class into groups of three or four and assign each group a chaperone before your visit.

Goals
There are several goals to this program. First, students will practice the important science techniques of observing and predicting. Students will also learn words for several physical concepts, including *gravity* and *friction*. These concepts and practices are brought to life in a very hands-on experience, in which students will see these forces in action. This will require them to use their problem-solving skills and think creatively. In addition to all the science knowledge and skill they will learn, students will also improve their teamwork abilities as the groups work together to overcome the challenges of their raceways project.

Meeting the Learning Standards
The concepts of the Raceways school programs are aligned with the following Massachusetts learning standards:

Grades K-2: Physical Science *Position and Motion of Objects*
- standard 3 "Describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, and slow."
- standard 5: "Demonstrate that the way to change the motion of an object is to apply a force (give it a push or a pull). The greater the force, the greater the change in the motion of the object."

Grades 3-5 Physical Science *Forms of Energy*
standard 5 "Give examples of how energy can be transferred from one form to another."

Grades 3-5 Technology *Materials and Tools*
standard 1.1 "Identify materials used to accomplish a design task based on a specific property, i.e., weight, strength, hardness, and flexibility."

Grades 6-8 Physical Science *Position and Motion of Objects*
Standard 11: "Explain and give examples of how the motion of an object can be described by its position, direction of motion, and speed."

Vocabulary

prediction: an educated guess about what will happen
gravity: the force that pulls things down to the earth
friction: a resistance to motion
momentum: the force of an object in motion; heavier faster-moving objects have greater momentum.

Pre-Visit Activities

1. Make predictions about long-term things like the weather, short-term things like what will happen if you eat something bad and immediate things, like what will happen if you drop a heavy object. Make predictions about your Museum visit. Write them down for discussion later on.
2. Explore *momentum*: Go out to a playground and play on the swings. Is it harder to push an adult or a child? Is it harder to stop an adult or a child? How do you suddenly stop yourself from swinging? How long does it take to slow down if you stop pumping your legs?
3. Explore *friction*: Go down the slide. Now go again but with your feet flat on the surface of the slide. Go one more time with your fit lifted up. Which was fastest? slowest?
4. Ask the class if they have ever been on a roller coaster. What's it like? Why can it take all those twists and turns without anyone falling out?
5. Build team building skill with a game of Tangle. Have students stand in a circle. Everyone puts their right hand to the center and grabs someone else's hand (not someone next to them). Repeat for the left hand. Now, untangle—without letting go.

Post-Visit Activities

1. When you get back to school (or even on the bus) continue the discussion of challenges encountered, and solutions students tried, in building their tracks at the Museum today.
2. Discuss the predictions your class made about the Museum visit. Were any of them accurate? How did they differ from what actually happened?
3. Design your own Raceways tracks. You can use pipe insulation cut lengthwise, or use strips of oaktag taped together. Try using different items on the track—golf balls, ball bearings, matchbox cars, etc.
4. See if you can design a track that will time 5 seconds. That is, the ball has to start at the top and, exactly 5 seconds later, end in a cup.

Resources:

Books

Lafferty, Peter. *Eyewitness: Force and Motion.* DK Children, 1997.
Driver, Rosalyn & Guesne, Edith & Tiberghien, Andree (ed.), *Children's Ideas in Science*. Open University Press, 1985.
Macauley, David, *The New Way Things Work*, Houghton Mifflin Company, 1998.
Osborne, Roger & Freyberg, Peter, *Learning in Science*, Heinimann Education, 1985.
Zubrowski, Bernie. *Raceways: Having Fun with Balls and Tracks*. William Morrow and Company, 1985.

On-line

Amusement Park Physics *http://www.learner.org/exhibits/parkphysics/*
Funderstanding Roller Coaster *http://www.funderstanding.com/k12/coaster/*