

# 3rd/4th Grade Science Unit: Forces and Motion

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TE 804 Spring 2007

## **Part I: Learning Goals Documentation**

**Unit Title:** Forces and Motion

**Grade Level:** 3<sup>rd</sup>

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### **The Main Idea(s)/Importance for Students:**

Throughout this unit students will be exposed to the concepts of forces and motion. There are a few main ideas that will be addressed and each of these main ideas is crucial for students at this grade level to understand.

The first main idea is that students will investigate the movement of example toys and forces involved in that movement. It is important for students to understand this concept because at this age, students have many misconceptions as to how something moves (forces involved). Many students can explain the movement of an object, but cannot tell you how it was able to move.

The next main idea that students will be exposed to is that students will explore the forces of pushes, pulls, gravity, and friction. Pushes, pulls, gravity, and friction all have an effect on the movement of any given object. Many students can understand and already have knowledge about pushes and pulls, however many students know the concept of gravity and friction but cannot use those terms to explain the forces being exerted on an object that allows it to move in such ways.

Another key main idea that is important for students to know in this unit is that students will explore the movement caused by the forces listed above: speed up, slow down, fast, slow, right, left, and direction (north, south, east, west). The difference in the force exerted will affect the motion and movement of any sort of object. It is important

for students to know the forces that cause motion, but also those effects from those forces. These are the key movements than an object may take.

The last and final main idea that students will need to know is that simple machines can affect the movement of an object by adding to or taking away from the forces on that object (change effort). Simple machines help to change the motion and movement of an object. Simple machines help to change the force that is exerted on an object. It is important for students to know specifically the forces and the motions of objects, however they also must know the importance of how a variable can cause and effect as well, such as a simple machine.

**Central Problem/Question:**

- What makes a toy car able to stay in one place (no motion) and what allows a toy car to move about (have motion)?

**Example Response:**

A toy car will stay in one place because there is no force exerted on it. There is enough friction between the cars wheels and the surface it is placed on to keep it in one place. There is also gravity acting upon the car to keep it on that surface. For a toy car to take motion there must be a forced exerted on it. There must be a push or pull (force) to the object to get it moving. With such a force being exerted on the toy car it then can have motion like speed up, slow down, and travel in a certain direction. The difference in forces exerted on the object will determine the type of movement the object will have (more force, faster movement and vice versa). When an object is in motion, there is also less friction which allows that object to have movement. There are also different factors that affect the force and motion an object will have. The mass of the object and the use

of a simple machine will affect the forces exerted on the object in turn affecting the movement of the object

**EPE Chart for Forces and Motion**

<b>Experiences</b>	<b>Patterns*</b>	<b>Explanations*</b>
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<ul style="list-style-type: none"> <li>• Demonstrates and observes the movement of a swing. (IV.3.e.1)</li> <li>• Demonstrates and observes the movement of a cotton ball by the use of a straw and their mouth. (IV.3.e.1)</li> <li>• Observes and records a demonstration of a milk carton cars as a pull is exerted (speed up, slow down, friction) (IV.3.e.1, IV.3.e.2)</li> <li>• Observes and records a demonstration of how an increasing inclined plan affects the forces and motions of a milk carton car. (IV.3.e.1, IV.3.e.2, IV.3.e.4)</li> <li>• Observes and records the affects of different materials on the movement of a block of wood attached to washers. (IV.3.e.1, IV.3.e.2, IV.3.e.4)</li> <li>• Views a video that demonstrates all forces and motion concepts experienced thus far. (IV.3.e.1, IV.3.e.2, IV.3.e.4)</li> <li>• Designs, builds, and constructs a working roller coaster that has at least one hill, turn, and loop. (IV.3.e.1, IV.3.e.2, IV.3.e.4)</li> </ul>	<ul style="list-style-type: none"> <li>• Whether there is a push or pull, it affects the motion of an object that either helps it to slow down, speed up, or change direction. (IV.3.e.1, IV.3.e.2)</li> <li>• The more friction the less movement of an object. (IV.3.e.2)</li> <li>• The mass of an object may slow down or speed up and object. (IV.3.e.1, IV.3.e.2)</li> <li>• The use of a simple machine may help to speed up or slow down and object. (IV.3.e.1, IV.3.e.2, IV.3.e.4)</li> <li>• All objects used in our demonstrations remain on the ground when moving (a force is exerted). (IV.3.e.1, IV.3.e.2)</li> </ul>	<ul style="list-style-type: none"> <li>• Friction, pushes, pulls, and gravity are all forces that affect the movement of an object. (IV.3.e.2)</li> <li>• When certain forces are exerted on an object (push, pull, gravity, friction) the movement of that object will speed up, slow down, move left, move right, stay in the same place, move north, south, east, and west. (IV.3.e.1)</li> <li>• Simple machines (inclines planes, screws, levers, pulleys, wheels, axles, and wedges) affect the motion of an object (certain forces are exerted). (IV.3.e.4)</li> <li>• There is gravity exerted on all objects on earth. (IV.3.e.2)</li> </ul>
		

\* Document each statement with the code for national standards benchmarks or other source.

**Scientific Practices**

<b>Michigan Curriculum Framework benchmarks</b>	<b>Example specific practices</b>
<i>Using Scientific Knowledge</i>	
<ul style="list-style-type: none"> <li>• Describe or compare motions of objects in terms of speed and direction (IV.3.e.1)</li> <li>• Explain how forces (pushes/pulls) are needed to speed up, slow down, stop, or change direction of a moving object (IV.3.e.2)</li> <li>• Identify and use simple machines and describe how they change effort.</li> </ul>	<ul style="list-style-type: none"> <li>• Demonstrates, observes, and records movement of swing, cotton balls, milk carton cars, and marble in terms of motion and speed depending on the forces exerted on those objects.</li> <li>• Explain what forces were needed to speed up, slow down, stop, or change direction of a swing, cotton ball, milk carton cars and marble.</li> <li>• Observe and record observations from the milk carton cars demonstrations in which the cars will speed up and/or slow down.</li> <li>• Use simple machines (inclined plane, wedge) to show how they affect the motion of an object and the different forces applied to that object.</li> </ul>
<i>Constructing Scientific Knowledge</i>	
<ul style="list-style-type: none"> <li>• Generate questions about the world based on observation. (I.1.e.1)</li> <li>• Develop solutions to problems through reasoning, observations, and investigations. (I.1.e.2)</li> <li>• Use simple measurement devices to determine the force, speed, and/or change in speed of objects (I.1.e.4)</li> <li>• Develop strategies and skills for information gathering and problem solving. (I.1.e.5)</li> <li>• Construct charts and graphs and prepare summaries of observations. (I.1.e.6)</li> </ul>	<p>Generate questions related to the forces applied on an object and the motion that is exerted.</p> <ul style="list-style-type: none"> <li>• Observe demonstrations that demonstrate forces and motions in action.</li> <li>• Develop solutions and reasoning through the observation of hands-on demonstrations provided by the teacher.</li> <li>• Use washers to determine how much pull is needed to move a milk carton car and a block of wood to speed up and change the direction of those objects.</li> <li>• Observe and record the data that they observed during demonstrations using tables and charts to organize their observations.</li> <li>• Obtain data about the forces and motions being demonstrated through the use of swings, cotton balls, and milk carton cars.</li> <li>• Represent data on the forces and motions of a object (milk carton car, marble) by drawing and labeling their sketches.</li> </ul>
<i>Reflecting on Scientific Knowledge</i>	
<ul style="list-style-type: none"> <li>• Develop an awareness of the need for evidence in</li> </ul>	<ul style="list-style-type: none"> <li>• Explain how we know there are forces on objects</li> </ul>

making decisions scientifically. (II.1.e.1)	that either prevent or aid in their movement. <ul style="list-style-type: none"><li>• Give justifications as to why the demonstrations went the way they did.</li></ul>
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## **Part II: Pre-Assessment**

### **Reviewing Available Research Information about Common Student Ideas:**

Many students have misconceptions about the topic of forces and motion. Most students can explain a fair amount of the actions that are taking place, but fail to be able to apply that to the concept of forces and motion. Here are some of the misconceptions that students have when dealing with forces and motion:

- If an object is at rest, there are no forces acting on that object.
- Force is a property of an object. An object has force until it runs out of force and stops moving.
- Friction always hinders motion. Thus, you want to eliminate all friction.

These misconceptions are all ones that I intend to encounter. Students come to each lesson with prior knowledge of the subject, that doesn't always mean that they have all the pieces put together. Here is the source that provided these misconceptions about forces and motion:

- <http://amasci.com/miscon/opphys.html>

### **Identifying or Developing Assessment Tasks:**

Here is a brief overview of each assessment that students will be expected to complete and show their understandings of the concepts learned throughout the unit.

1. In Part 1 of this assessment task, students will demonstrate how they can apply a force to a playground swing (push, pull, speed up, slow down, or change direction). In part 2, students will use a straw and cotton ball to exert the same forces as in the swing activity to investigate forces and motion. Students will be expected to participate in the activity as well as voice and record their findings.

2. In the next assessment task, students will have to demonstrate proper actions when recording information about a teacher-lead demonstration. The first demonstration will involve the use of a milk carton car, paper clip, string, and washers. The teacher will demonstrate how many washers it will take to move the milk carton car. Students will think about what they saw and voice as well as record their findings on a student sheet. Students will also be able to sketch out their findings. In the second in class demonstration, students will observe how an inclined plane (ramp) affects the forces and motion of the milk carton car. Students will again be responsible for recording and voicing their ideas and findings on their student sheet. Students will also be able to put what they learned to use by applying that knowledge to that of another scenario.
3. The next assessment task allows students to explore the idea of friction. Students will be able to investigate how a block of wood moves when the surface beneath it changes. Students will explore and write their findings on their student sheet. They will also talk to their group members and report back to the class.
4. Students will be responsible for viewing a United Streaming video. Students will combine all the information learned previously as well as new information learned through the video. Students will respond in a journal format.

5. The last culminating assessment task involved the building and constructing of a rollercoaster. Students will have to put together all of the knowledge learned about forces and motion to sketch out a drawing that they think will work as well as construct that rollercoaster (that has at least a turn, hill, and loop). Students will have to work well as a team as well as observe their rollercoaster and change aspects that do not work.

