**Concept Block Five: Forces and Motion**

1. In this section we will concentrate on the following standard and its components:

**5Se: The student will demonstrate an understanding of the nature of force and motion.**

 **5Se.1:** Illustrate the affects of force (including magnetism, gravity, and friction) on motion.

 **5Se.2:** Summarize the motion of an object in terms of position, direction, and speed.

 **5Se.3:** Explain how unbalanced forces affect the rate and direction of motion in objects.

 **5Se.4:** Explain ways to change the effect that friction has on the motion of objects (including changing the texture of the surfaces, changing the amount of surface area involved, and adding lubrication).

 **5Se.5:** Use a graph to illustrate the motion of an object.

 **5Se.6:** Explain how a change of force or a change in mass affects the motion

 of an object.

1. **These concepts correspond to the following sections in the Scott Foresman Textbook:**
2. xit
3. **These concepts are encountered in the following *Reading Street* stories and articles:**

**Concept Block Five Content Summary**

 **5Se.1: Illustrate the affects of force (including magnetism, gravity, and friction) on motion.**

* **Magnetism** is the attractive force between objects of opposite charge. Magnetism can both stop and create motion. A magnet stuck to a metal cabinet will stay in place and not fall as a non-magnetized object would. Electromagnets can be used to create motion in the form of an electric motor.
* **Gravity** is the force that causes objects to fall toward the center of the Earth. The force of gravity will cause a freefalling object to accelerate until it hits the ground (presuming it doesn’t have time to reach terminal velocity, which is another story).
* **Friction** opposes the movement of objects. Friction occurs at the point where opposing forces meet. The force of friction varies from surface to surface. If you brush your hand across a piece of paper some friction will be generated, but your hand will slide with ease. If you repeated this procedure with sandpaper the result would be quite different. Friction allows us to stand and walk. We count on the friction between shoes and sidewalks to keep us upright. Ice is very smooth and we generate very little friction when we walk on it. Walking on ice is a very delicate maneuver. Interestingly, we simply could not stand on a frictionless surface. Despite our attempts we would simple flail around, going nowhere.

 **5Se.2: Summarize the motion of an object in terms of position, direction, and speed.**

* **Motion** is a change in position. When an object has changed position motion has occurred.
* When objects move they move in a given **direction** (east, west, up, down, vertical, horizontal…). Speed in a given direction is **velocity**.
* **Speed** is a measure of the time it takes an object to cover a given distance (S=D/T). Speed is usually recorded in feet per second, or miles per hour for example.

 **5Se.3: Explain how unbalanced forces affect the rate and direction of motion in objects**.

* As you sit in your chair force is pushing you down. Thankfully, the earth below is pushing back balancing your forces nicely. You don’t sink into the floor, or fly into the air. Now if you tried to rest yourself on top of a pond, things would be different. You would push down on the pond, and the pond would push back on you, BUT your force would be greater. This imbalance of forces would result in your sinking and becoming quite wet. Balanced forces result in equilibrium, unbalanced forces create motion.
* How fast an object moves largely depends on the amount of force applied to it. The greater the force the greater the movement. In baseball, a light tap with a bat results in a bunt, while a heavy swing can produce a home run. If you give a child a light push on a swing they will swing gently, if you give them a hard push they will swing higher.
* Unbalanced forces also cause objects in motion to change direction. A ball thrown at a wall will bounce back, changing its trajectory. Cars involved in accidents frequently leave the road.

 **5Se.4: Explain ways to change the effect that friction has on the motion of objects(including changing the texture of the surfaces, changing the amount of surface area involved, and adding lubrication).**

* **Friction** occurs whenever opposing objects rub against each other. Friction can be increased or decreased a number of different ways. For example, rougher surfaces increase friction, smoother surfaces reduce it. Changing texture changes friction. So we can increase friction by applying abrasives to surfaces or roughing them up. The grip tape on a skateboard helps keep feet from slipping, as do adhesive strips in bath tubs. If we want to reduce friction we can smooth a surface out. Teflon on kitchen pans allows food to slide freely. The smooth surface of a playground slide allows children to slip along.
* One way to reduce friction is to **reduce the surface area** of the object we want to move around. This is the concept behind ice skates and skis. Reducing the contact area reduces friction. Most lamps have a base that is much larger than the rest of lamp body. This increases the surface area where the lamp meets the table and increases friction, helping the lamp stay upright.
* **Lubricants** reduce the friction between surfaces by making those surfaces slippery. Engine oil reduces wear on motor parts. Vegetable sprays keep food from sticking, and grease helps keep your bicycle wheels spinning freely.

**5Se.5: Use a graph to illustrate the motion of an object.**

* Graphs can be useful for organizing and displaying quantitative data (see 4Sa1). Line and bar graphs are typically used to display scientific measurements and observations. Though students will be familiar with graphing in math, they may need a bit of assistance in transferring that knowledge to science and data collection. Essential to this is an understanding of variables in relation to graphing.
* Variables- are things like objects, events, time periods, or temperatures that you want to measure. Whatever causes a change in an experiment is a variable. There are two types of variables; dependent, and independent.
* Independent Variables- are factors that are *not changed* by other variables. You can think of an independent variable as if it’s an independent person. It is stubborn and won’t change. In an experiment they are what or who you are testing, they represent the constant factor. For example, say I want to graph changes in average temperature over a set number of days. The temperature will vary, the days will not, so the days are my independent variable. Independent variables should always be charted on the horizontal (X) axis.
* Dependent Variables- are factors that *do* change or vary throughout an experiment. Just as what you wear depends on the weather, dependent variables are always changing because of something else (the dependent variable). In the above example, the temperature (dependent variable) changes over time (Independent variable). Dependent variables should be charted on the vertical (Y) axis. So the resulting graph would look like this:

Temperature Changes Over Time



 source: CIESE

* The same technique can be used to illustrate the motion of an object.

**Motion** reflects a change in the position of an object over time. How fast an object moves from one place to another is **speed**. Speed can be determined by dividing the distance an object traveled by the amount of time it took for the object to make the move (S=D/T).

* Speed related data can be displayed on a distance- time graph. In this case, time is our independent variable. Units of time are consistent, a second is a second, and a minute is a minute. They don’t change. So, we put time on our horizontal or “X” axis.
* How far we will go in time “depends”, so distance is our dependent variable. We will put it on our vertical or “Y” axis. We can now plot points showing the distance an object travels over time.
* A car traveling at a constant speed of 60km per hour will travel 300 kilometers in 5 hours. The graph tells the story:

 

 Time

 **5Se.6:** Explain how a change of force or a change in mass affects the motion

 of an object.

* **Inertia** is an important property of matter. The basic idea of inertia is that objects that are in motion want to stay in motion, while objects at rest want to remain at rest. In order to make a moving object stop, energy must be applied. The same is true for objects at rest. If you want them to move you have to make them move. In either case, an **opposing force** must be applied. How much force is required to stop or start movement depends on how much **mass** the object has, and how fast it’s moving (**velocity**).
* If someone throws a baseball to me, I can use my hands as an opposing force and stop its movement. The ball is light and is moving relatively slow so it’s easy to catch. But, if someone threw a 12 pound bowling ball at me it would be a different story. It may move at the same speed, but its heavy mass gives it much greater force. The amount of opposing force I could offer would likely be insufficient. Inversely, if someone threw a small chunk of lead to me I’d catch it easily, but if they fired that little chunk out of a gun at thousands of feet per second, my hand would barely slow it down as it passed.

**Suggested Resources:**

The following links are to sites that provide summaries, activities, and labs that can be used to support your teaching of this subject.

**5Se.1:** Illustrate the effects of force (including magnetism, gravity, and friction) on motion.

<http://www.physics4kids.com/files/motion_intro.html>

<http://archive.fossweb.com/modulesK-2/BalanceandMotion/index.html>

<http://science.k12flash.com/forceandmotion.html>

 **5Se.2:** Summarize the motion of an object in terms of position, direction, and speed.

<http://www.ducksters.com/science/laws_of_motion.php>

 <http://www.neok12.com/Laws-of-Motion.htm>

<http://scienceforkids.kidipede.com/physics/movement/>

 **5Se.3:** Explain how unbalanced forces affect the rate and direction of motion in objects.

<http://eschooltoday.com/science/forces/unbalanced-forces.html>

<http://eschooltoday.com/science/forces/balanced-forces.html>

<http://www.teachertube.com/viewVideo.php?video_id=58727>

 **5Se.4:** Explain ways to change the effect that friction has on the motion of objects (including changing the texture of the surfaces, changing the amount of surface area involved, and adding lubrication).

<http://www.ducksters.com/science/friction.php>

 <http://www.youtube.com/watch?v=C7NPD9W0kro&safe=active>

 <http://pbskids.org/sid/funwithfriction.html>

 **5Se.5:** Use a graph to illustrate the motion of an object.

 <http://www.youtube.com/watch?v=x2ve5yucNPQ&safe=active>

 **5Se.6:** Explain how a change of force or a change in mass affects the motion

 of an object.

<http://www.learningscience.org/psc2bmotionforces.htm>