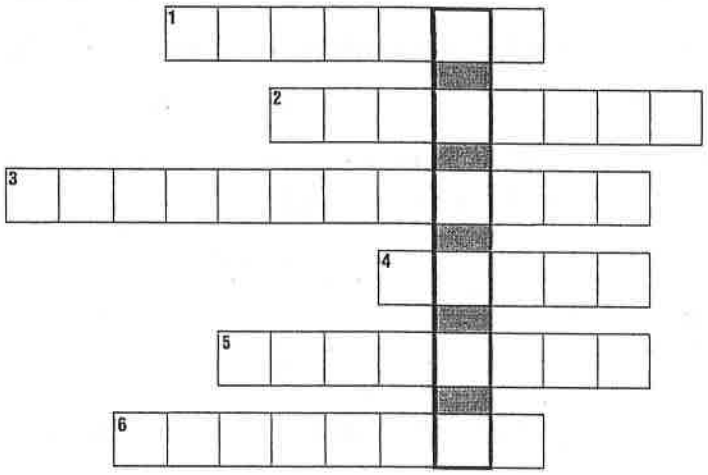
Name Date Class

Directed Reading for Content Mastery

Section 1 ▪ Motion
Section 2 ▪ Newton's First Law

Directions: *Write the term that matches each description in items 1 through 6 below on the spaces provided. Unscramble the boxed letters to spell the term that answers question 7.*



1. A measure of an object's tendency to remain at rest or continue at constant speed
2. How far something travels
3. How far something ends up from its starting place
4. A push or a pull
5. Forces that result in no change in an object's motion
6. The force that resists motion
7. An object will remain at rest or move in a straight line with constant speed unless it is acted upon by a force. This is the definition of Newton's first law of _____.

Directions: *Circle the term in parentheses that makes the statement correct.*

8. (Velocity, Speed) is an object's displacement divided by time.
9. (Displacement, Acceleration) is the change in an object's velocity divided by the amount of time required for the change to occur.
10. A (force, motion) is a push or a pull.
11. When scientists need to measure force, they use the (newton, degree).
12. The first law of motion is sometimes called the law of (inertia, force).

Name _____ Date _____ Class _____

Directed Reading for Content Mastery

Section 3 ▪ Newton's Second Law
Section 4 ▪ Newton's Third Law

Directions: *For each of the following, write the letter of the choice that best completes the sentence.*

_____ 1. When you exert a force on an object it exerts _____ force back on you.
a. a stronger **b.** the same

_____ 2. When volleyball players jump into the air, the primary force acting to make them land back on the ground is _____.
a. mass **b.** gravity

_____ 3. Forces always act in _____.
a. pairs **b.** singles

_____ 4. In a game of tug-o-war, the team that wins has exerted a greater _____ force.
a. unbalanced **b.** mass

_____ 5. When you are pushing on a large door, _____ friction keeps you from sliding backwards.
a. unbalanced **b.** static

_____ 6. _____ is determined by gravity.
a. weight **b.** mass

_____ 7. A component of inertia is _____.
a. mass **b.** friction

_____ 8. _____ friction causes a car tire to turn on the road.
a. Static **b.** Rolling

_____ 9. _____ friction keeps an object from moving when a force is applied.
a. Static **b.** Sliding

_____ 10. If the same force is applied to two different objects, the one with the _____ mass has a smaller acceleration.
a. larger **b.** smaller

Meeting Individual Needs

Name Date Class

SECTION 2 Enrichment

Crash-Test Dummies

More than one million people a year die in automobile crashes. Another 38 million are injured, with five million of those seriously or permanently hurt. While many people point to the lack of safety in cars, the real reason for the crashes is Newton's first law of motion. Remember that an object will remain at rest or continue moving in a straight line unless acted upon by a force. This universal law is also called the law of inertia.

Inertia

Inertia, the tendency of an object to remain at rest or continue moving with constant velocity, is dependent upon the mass of the object. This is exactly the kind of situation that exists when you are a passenger in a car. You are an object with inertia. When the car is hit, a force acts upon it. Depending on the size of the force and several other factors, you might or might not be hurt.

It's Only a Model

In an effort to make cars safer, automobile companies crash cars and study the effects of crashes on human bodies. Car makers want to build cars in which the crash force will not hurt the passengers or driver. It is not practical or legal to use real humans in these crashes, so a whole group of special human-like models called crash-test dummies have been created.

Studying Dummies

Crash-test dummies are basically human-like dolls that have sensors on them. In the laboratory, engineers and scientists stage and film car crashes. Then they look at the film and the dummies to determine the effects of the forces of inertia on the dummies. Most often they see evidence that the inertia of the dummy caused it to be damaged in the head and neck. These are the most dangerous places for a human to be hurt. By studying where the car is weakest and the most injury is caused to the dummy, engineers and scientists can build safer cars.

Building a Better Dummy

Every year the crash test dummies are replaced by increasingly human-like ones. They now slouch like a real human. They are more flexible like humans and they have more sensors on them to measure the effects and potential damage caused by the forces encountered in a crash. There are even child-sized dummies.

The hope is that the crash-test dummies will continue to provide additional life-saving information. Right now, you might owe some of your safety in an automobile to a crash-test dummy.

1. What is a crash-test dummy?

_____

2. What feature does a crash-test dummy have to help scientists measure forces and their effects?

_____

3. Why use crash-test dummies? _____

_____

4. In terms of forces and inertia, why do you think it is important to have different sizes of crash test dummies?

_____

_____

Meeting Individual Needs

Worksheet: Newton's 2nd and 3rd Laws

Name_____ **Date**_____ **Period**____

1. Explain using Newton's Second Law of Motion, why you can throw a golf ball further than a bowling ball, even though you throw both at the same angle and with the same amount of force.

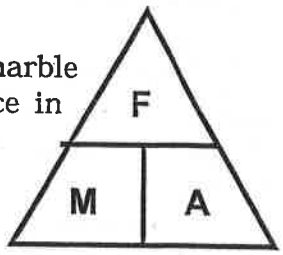
_____

_____

_____

2. Describe what a force is in physics._____

For questions 2 and 3 refer to the triangle formula to the right.



3. A steel marble with a mass of .020 kg is fired at an angle of 45° from the marble launcher. If the acceleration of the marble is 5.6 m/s^2 , what was the force in Newtons applied to the marble? Include the correct units!

_____

4. What mass will a pumpkin have if a force of 450 Newtons accelerates it to 110 m/s^2 ? Include the correct units!

_____

5. **Explain using Newton's Third Law of Motion**, what will happen when a person standing on a skateboard or rollerblades, throws a heavy concrete block as fast as they can to a person standing 10 feet in front of them.

_____

_____

_____

_____

6. **Explain using Newton's Third Law of Motion**, how starting blocks have helped lower times in sprinting events.

_____

_____

_____

_____

_____

Name Date Class

SECTION 3 Enrichment

Weight, Mass, and the Gold Rush

Gold has been precious to humans for thousands of years. A significant part of the history of the United States has to do with the discovery of gold. Many people grew rich from the huge amounts of gold discovered in California, Colorado, and Alaska. During the "gold rushes," people from all over the world hurried to these areas to try to make their fortunes. Many banks that exist today were founded on the huge income from gold miners.

Gold Weight

The banks that purchased gold from the miners were extremely careful about weighing the gold. Gold is, after all, a form of money. In fact, one banking company purchased extraordinary scales from a well known company called Howard and Davis in Boston, Massachusetts. These scales had jeweled movements that weighed so precisely that no one ever disputed them. A problem arose, however, when the gold was weighed in different places. Remember that Earth's mass produces the force of gravity. The closer an object is to the center of the Earth, the more it weighs. The farther it is from the center, the less it weighs.

Light Weights

When a bank in Denver, Colorado received a shipment of gold from San Francisco, California, it was always lighter than the paperwork said. And when a San Francisco bank received the gold from Colorado it was always heavy. The bank decided to send its scales along with its shipments, but the weights still varied.

How much does my gold weigh?

Only later was the problem understood. Because Denver was at a much higher altitude, the gold weighed less. The mass was still the same, but the weight was less. Eventually people realized that where the gold was weighed made a big difference in what the scales said. San Francisco was at sea level and Denver was at nearly 5,300 feet above sea level. This difference in altitude was enough to account for the difference in gold weight.

New Calculations

Now, mathematical calculations are used to make weights consistent. Newer scales and balances automatically correct for altitude and changes in the force of gravity. Should there be another gold rush, no longer would a miner at sea level make more money than a miner in the mountains for the same amount of gold.

Meeting Individual Needs

1. What force affected the weight of gold between San Francisco and Denver?

2. What initial solution did the bankers come up with to try to make sure the gold was weighed correctly? Did it solve the problem?

3. How was this problem eventually solved?

4. Although the weight of the gold changed from one place to another, what stayed the same?

5. Do you think this means that two people with the same mass will weigh different amounts depending on where they live?

Name Date Class

SECTION 4 Enrichment

Motion in the Ocean

Nature contains many examples of Newton's laws of motion in action. Some interesting animals that demonstrate Newton's third law can be found under the sea.

Newton Underwater

The cephalopods are the group of animals that include the octopus, squid, nautilus, and a variety of other marine mollusks. They have tentacles and a well developed nervous system. Most important to Newton, however, would have been their water siphon. These animals have a special organ from which they can shoot water at a very high rate, which they use to propel themselves through the water.

Using a Siphon to Move

The nautilus is one example of an animal with this remarkable feature. The nautilus is a mollusk that lives in a coiled shell. The shell has compartments and makes an attractive display when cut in half. Mollusks produce a tissue called a mantle. The nautilus uses this mantle to form a tube that is on the side of its head. The tube can be filled with water. When the animal wants to move, it shoots water from the siphon.

Equal Force Pairs

The nautilus's propulsion system is a good example of an action producing a reaction. As the water is quickly shot out of the siphon, the animal moves in the opposite direction. The water moves in one direction and the nautilus, in an equal and opposite reaction, moves in the other.

An Equal and Opposite Reaction

Squid also use this type of jet propulsion. Some squid have been measured by scientists as fast as 24 to 80 km/h. Cephalopods do not move only in one direction, but can move the siphon to any position necessary. However, it must always be pointed to the opposite of the direction in which they need to move. Whichever way the water spurts, the animal will go in the opposite direction. This type of motion is one of the reasons cephalopods are so hard to catch. They are very fast animals. So, while a squid, nautilus, or octopus has never heard of Sir Isaac Newton, they are good examples of his third law in action.

1. How does a cephalopod demonstrate Newton's third law?

2. If a cephalopod wanted to turn right, which way would it point its siphon? Explain your answer.

3. If you were in the middle of a lake in a boat without an oar, do you think it would help you to have a bucket? Why or why not?

Meeting Individual Needs