

# Lesson Plan Title: Newton's Laws of Motion

**Local School District:** Northwest Local School District

**Grade Level:** 9th Grade

**Teacher Name:** Beth E. Livingston

**Estimated Total Time:** 540 minutes

**Daily Time Allocation:** 90 minutes

**Number of Days:** 6

**Goal:** The best outcome will show that students will be able to do the following:

- Use Newton's Laws of Motion to explain how things move.
- Create a poster illustrating each law of motion.
- Present and explain their poster to classmates and teacher.

## National Standards:

**NCTM:** (National Council of Teachers of Mathematics)  
(<http://standards.nctm.org/document/chapter7/index.htm>)

**International Society for Teacher Educators (ISTE)**  
**Performance Indicators For Technology—Literate Students (NETS)**  
([http://cnets.iste.org/students/s\\_profile-912.html](http://cnets.iste.org/students/s_profile-912.html))

## Ohio Standards Connections:

**Physical Sciences (9–10) D:** Explain the movement of objects by applying Newton's three laws of motion.

## Grade Level Indicators:

**Physical Science, Forces and Motion 9-21:** Demonstrate that motion is a measurable quantity that depends on the observer's frame of reference and describe the object's motion in terms of position, velocity, acceleration, and time.

**Physical Science, Forces and Motion 9-2:** Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it.

**Physical Science, Forces and Motion 9-23:** Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object. ( $F_{\text{net}}=ma$ . Note that weight is the gravitational force on a mass.)

**Physical Science, Forces and Motion 9-24:** Demonstrate the ways in which frictional forces constrain the motion of objects (e.g., a car traveling around a curve, a block on an inclined plane, a person running, an airplane in flight).

**Mathematical/Scientific Processes:**

Activities to study Newton's Laws of Motion.

**Preassessment:**

- Journal Entry:
  - Who is Sir Isaac Newton?
  - What is he most known for?
  - Have you heard of the three laws of motion before?
  - What are the three laws of motion?

**Scoring Criteria**

Conduct a group discussion about the journal entries to find out how much they know before starting the unit on Newton's Laws. Have the students reassess the journal activity after completing the series of lessons on the laws of motion.

**Postassessment:**

- Verbal explanation of poster and rubric results
- Question Sheet

**Scoring Criteria:**

Rubric for poster on Newton's 3 Laws of Motion

**Materials and Resources Needed:**

*Products that need to be copied, collected, or created. Use box to indicate status.*

- CD with attached balloon and string for activity 1
- Various balls (beach ball, tennis, ping-pong, golf, softball, sponge, bowling)
- Spring scales
- 2 skateboards
- Video clips about Newton's Laws of Motion (The Video Encyclopedia of Physics Demonstrations)
- Demonstrations –flicker card, inertia dumbbell, dishes on cloth, Newton's cradle,
- Balloon
- Wooden block
- Styrofoam block
- Conceptual Physics*, Hewitt, 1989
- Poster board
- Colored pencils
- Markers

## Procedures:

### Session 1:

1. Teacher explains to the class that as a follow up to the activities that have been conducted on motion, speed, velocity, and acceleration, this lesson will help us to begin to understand why they occur.
2. Conduct the preassessment—Journal activity.
3. As a whole class, watch a video clip demonstrating each law of gravity.
4. Have students reiterate what each law is based on.
5. Using the computer with projector, type each sentence in a word processor.
6. Teacher demonstrates each of the laws.
7. Students identify which law is being applied.
  - a. Newton's 1st law—use computer disk with balloon attached.
8. Teacher questions:
  - a. Push the computer disk—friction stops it.
  - b. Inflate balloon and push puck. How does it move? Keeps moving until it runs out of air. It moves in a straight line.
  - c. Attach a string, inflate balloon, push—moves in a circular path until string is released, then in a straight line.
9. Activity 3: Newton's 2nd Law—Various Balls. Get different size balls and try to make them accelerate in a straight line at constant speed while your opponent tries to stop the balls:
  - a. What kind of forces are needed? Large or small? Large.
  - b. Which ball is easiest to accelerate? Hardest? Small mass is the easiest.
  - c. What if there is no force applied to the ball? No motion.
  - d. When 2 forces act on the ball at the same time, does it accelerate?  
Depends on size and direction of force applied.
10. Activity 8: Newton's 3rd Law—Connect two spring scales together and pull in opposite directions. Try to get different readings on the scales. It is impossible to get different readings. Demonstration—1 student on ground, 1 on skateboard. Skateboarder pushes off. The student on skateboard moves back as a result. Both push each other—both move backward. Both students on a different skateboard. One pushes off the other—both move backward. This shows ACTION-REACTION.
11. Create a poster illustrating each of Newton's Laws of Motion. Give a copy of the rubric before beginning the project.
12. Present poster to classmates and teacher.
13. Review and complete question sheet over Newton's Laws of Motion.

**Differentiated Instruction Strategies:** ([http://www.teach-nology.com/tutorials/teaching/differentiate/bottom\\_line/](http://www.teach-nology.com/tutorials/teaching/differentiate/bottom_line/))

*Describe changes that may be needed in depth, breadth and pace of the lesson to accommodate unique learner needs.*

- **Intervention:** Allow students to work in groups of 2 while working on poster.
- **Enrichment:** Have a Sports Broadcasting Audition. Provide the voice-over on a sports video and explain the physics of the action appearing on the screen. Each student or group will do a science commentary on a short (2–3 minute) sports video.

**Extension:**

*Describe how newly gained knowledge, understanding, or skill can be extended through context or application.*

Kepler’s Laws, Conservation of Momentum

**Key Vocabulary:**

- Motion: The result of unbalanced forces.
- Inertia: Resistance to change.
- Force: Push or pull.
- Mass: Amount of matter in an object or a measure of the inertia of an object.
- Acceleration: The rate velocity changes with time.
- Weight: Measure of gravitational attraction or force of gravity pulling one object toward the center of another object.
- Friction: Force that opposes motion between two surfaces.
- Gravity: The force that pulls on objects and causes acceleration if the objects are not balanced by an opposing force.
- Speed: Distance traveled per unit time.
- Velocity: Speed of an object, but in a specific direction.

**Technology Tips:**

- Overhead projector, VCR, TV, and videos.

**Teacher Reflections and Notes:**

Our district is using the *Active Physics* curriculum, published by It’s About Time. These activities came from Predictions, Chapter 2. The students enjoyed creating the posters. While the majority were excited about the assignment, a few were very reluctant to make an oral presentation before a group. This was an excellent opportunity to evaluate their actual understanding of the laws when they had to verbally explain the laws to their peers. I have not yet used the question sheet with the students. I will try this next year when I teach the unit over Newton ’s Laws of Motion.

**Table 1. Poster Demonstrating Newton’s Laws of Motion**

<b>Criteria</b>	<b>Points Possible for each law</b>	<b>1st Law</b>	<b>2nd Law</b>	<b>3rd Law</b>	
1. Law written in sentence form.	2				
2. Picture illustrating the law.	2				
3. Explanation of the picture.	2				
4. Demonstrates understanding of the law.	2				
5. Color is included in the poster.	1				
6. Sketch of preliminary work.	1				
7. Creativity.	1				
<i>Score for each law</i>	XXXXXX				<b>TOTAL SCORE</b>
					/33

**COMMENTS:**

NAME: \_\_\_\_\_

Block: \_\_\_\_\_

### Question Sheet: Newton's Laws of Motion

#### **Part A: Multiple Choice**

\_\_\_\_\_ 1. When you bump into someone and you both fall back, this law of motion is illustrated.

- a. First law                      b. Second law                      c. Third law

\_\_\_\_\_ 2. Which of the following laws states that every object maintains constant velocity unless acted upon by an unbalanced force?

- a. First law                      b. Second law                      c. Third law

\_\_\_\_\_ 3. This law of motion is illustrated by the amount of force that must be applied on a car's brakes to make it stop.

- a. First law                      b. Second law                      c. Third law

\_\_\_\_\_ 4. The blast off of the space shuttle from Earth is an example of which law?

- a. First law                      b. Second law                      c. Third law

\_\_\_\_\_ 5. Assume the following vehicles are all moving at the same speed. It would harder to change the velocity of which vehicle?

- a. Bicycle                      b. Car                      c. Motorcycle                      d. Semi-trailer truck

#### **Part B: Short Answer**

A car sits motionless on a hill. What forces are acting on the car? Are the forces balanced or unbalanced?

#### **Part C: Extended Response**

A space station worker found herself floating free 100 meters from the space station because her safety line became unhooked. Attached to her space suit were her unhooked safety line, her tool belt and tools, and her oxygen tank. How could she get back to the space station without calling someone for help? In answering, explain the physics of your proposed method. Be sure to include all of Newton's Laws of Motion in your answer.

NAME: KEY  
Block :

*Question Sheet: Newton's Laws of Motion*

**Part A: Multiple Choice**

- c 1. When you bump into someone and you both fall back, this law of motion is illustrated.  
a. First law                      b. Second law                      c. Third law
- a 2. Which of the following laws states that every object maintains constant velocity unless acted upon by an unbalanced force?  
a. First law                      b. Second law                      c. Third law
- b 3. This law of motion is illustrated by the amount of force that must be applied on a car's brakes to make it stop.  
a. First law                      b. Second law                      c. Third law
- c 4. The blast off of the space shuttle from Earth is an example of which law?  
a. First law                      b. Second law                      c. Third law
- d 5. Assume the following vehicles are all moving at the same speed. It would harder to change the velocity of which vehicle?  
a. Bicycle                      b. Car                      c. Motorcycle                      d. Semi-trailer truck

**Part B: Short Answer**

*A car sits motionless on a hill. What forces are acting on the car? Are the forces balanced or unbalanced?*

Gravity and friction act on the car. Gravity tends to pull the car down the hill, while friction on the hand brake prevents the car from rolling down the hill. Because the car is at rest, no net force is acting on the car, so the forces are balanced.

**Part C: Extended Response**

A space station worker found herself floating free 100 meters from the space station because her safety line became unhooked. Attached to her space suit were her unhooked safety line, her tool belt and tools, and her oxygen tank. How could she get back to the space station without calling someone for help? In answering, explain the physics of your proposed method. Be sure to include all of Newton's Laws of Motion in your answer.

She can get back to the station by throwing something away from the station. When she does, the object thrown will apply an equal force in the opposite direction, accelerating her toward the station (3rd law of motion). She will accelerate toward the station during the throw (2nd law of motion) and will continue to travel toward the station at a constant velocity until acted upon by another force (1<sup>st</sup> law of motion).

**Scoring Criteria**

- 4—Correct response and includes all three laws of motion correctly.  
3—Correct response and includes 2 laws of motion correctly.  
2—Correct response and includes 1 law of motion correctly.  
1—Correct response, but does not include any of Newton's Laws of Motion  
0—Incorrect response.