Lesson 2.9: Physical Science – Newton's Laws of Motion

Weekly Focus: Reading Comprehension
Weekly Skill: Main idea

Lesson Summary: This week students will continue the study in the areas of forces and motions with an emphasis on Newton's Laws of Motion. Students will read passages with information on the three laws; then, they will answer comprehension questions about the passages.

Materials Needed:

- Main Idea Reading **Unit 2.9 Handout 1** (6-Way Paragraphs, Middle Level, "Newton's Laws of Motion," pages 128-129)
- Comprehension Reading: **Unit 2.9 Handout 2**
- Extra Work/Homework: **Unit 2.9 Handout 3**

Objectives: Students will be able to…

- Demonstrate an understanding of Newton's Laws of Motion
- Answer comprehension questions about Newton's Laws of Motion

College and Career Readiness Standards: RI, RST, WHST, SL

ACES Skills Addressed: EC, LS, ALS, CT, SM, N

Notes: Please review and be familiar with classroom routine notes for: reading for fluency strategies (**Routine 2**), Using 6-way Paragraphs Readings **(Routine 3),** summarizing techniques (**Routine 4**), and self- management skills (**Routine 1)**. The notes will help with making a smooth transition to each activity.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be a short answer portion (suggested 10 minutes) where students may have to summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

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The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.

Activities:

Warm-Up: K-W-L Chart	**Time: 5 - 10 minutes**

- As students enter the class, have the following written on the board or overhead **"Sir Isaac Newton discovered three laws of motion. What do you know about Newton's Laws of Motion?"** Have students create a **"KWL"** chart on a piece of notebook paper (below). This helps to activate students' prior knowledge by asking them what they already **K**now (column 1); students (collaborating as a classroom unit or within small groups) set goals specifying what they **W**ant to learn (column 2); and, after reading, students discuss what they have **L**earned (column 3).
- Students apply higher-order thinking strategies which help them construct meaning from what they read and help them monitor their progress toward their goals.

KWL Chart:

K - What (else) do I KNOW?	**W - What do I WANT to know?**	**L - What did I LEARN?**

Activity 1: Forces & Motion (Unit 2.9 Handout 1)	**Time: 40- 45 minutes**

1) Distribute **Unit 2.9 Handout 1** to students.
2) Explain to students that the purpose of the 6-way Paragraphs reading passage is to master the essential skills needed to organize, understand, and apply information found in nonfiction texts.
3) Ask students to review the title and count the number of paragraphs in the reading passage. Ask students how they know where a paragraph begins. Explain that it is important to know how to find a paragraph quickly as some test questions may ask students to refer to a certain paragraph. If you have an overhead, point to it and/or label the indents.
4) Explain to students they should read all of the paragraphs silently in order to answer the questions that follow. To help students find the main idea of the reading passage, remind them to think "*What are all of the paragraphs about?*" and "*What is the point that the author is trying to make?*" while reading.
5) Explain to students that they will decide which of the statements that follow the reading passage is the **m**ain idea, **b**road idea, or **n**arrow idea. Use the explanations in Using 6-way Paragraphs Readings **(Routine 3)**.
6) Brainstorm reading strategies as a class. Be sure to point out that when reading for comprehension, there are many strategies to use: read the title to predict what the reading is about; while reading, remember to ask "What is this all about?" While students are reading, circulate and discuss any questions with students.
7) Review answers as a whole class. Ask students to point out the evidence (proof) from the reading that led them to the answer. If there is extra time or to challenge students, they can write a 3 – 5

sentence summary of all of the material presented, use **Routine 4 Summarizing Techniques**.
8) Remind students that they need to have a good foundational knowledge of Newton's Laws of Motion in order to answer some questions that may be on the GED 2014 test. They can also fill in the **L** (what have I learned) portion of the K-W-L chart.
9) If there is extra time, have students read the passage in pairs to promote reading fluency. Students who finish early should try to paraphrase the main idea of the passage for extra practice.

Break: 10 minutes

Activity 2: Reading Comprehension (Unit 2.9 Handout 2)	**Time: 40 – 50 minutes**

1) Distribute **Unit 2.9 Handout 2** to students.
2) Explain to students that the purpose of the reading passages is to reinforce and apply some of the information they just learned about Newton's Laws of Motion.
3) Ask students to review the title and count the number of paragraphs in the reading passage. Ask students how they know where a paragraph begins. Explain that it is important to know how to find a paragraph quickly as some test questions may ask students to refer to a certain paragraph. If you have an overhead, point to it and/or label the indents.
4) Explain to students they should read all of the paragraphs silently in order to answer the questions that follow. To help students find the main idea of the reading passage, remind them to think *"What are all the paragraphs about?"* and *"What is the point that the author is trying to make?"* while reading.
5) If you choose to have students work individually: while students are reading, circulate and discuss with students that when reading for comprehension, there are many strategies to use: read the title to predict what the reading is about; while reading remember to ask "What is this all about?"
Otherwise, you can complete this article in small groups or as a class.
6) Review answers as a whole class. Ask students to point out the evidence (proof) from the reading that led them to the answer. If there is extra time or to challenge students, they can write a 3 – 5 sentence summary of all of the material presented, use **Routine 4 Summarizing Techniques.**
7) Remind students that they need to have a good foundational knowledge of Newton's Laws of Motion in order to answer some questions that may be on the GED 2014 test.
8) If there is extra time, have students read passage in pairs to promote reading fluency. Students who finish early should try to write a 3-4 sentence summary of the passage for extra practice.

Wrap-Up: Summarize	**Time: 5 minutes**

Have students turn to a partner (or write in their journals) about what they have learned today about Newton's Laws of Motion. They may want to discuss some of the areas that they would like to do further study on in the future. Their summary may include any wonderings they have about the subject. Ask them to tell a partner what Newton's Laws of Motion are in two to three sentences.
Note: Use Routine 4.

Extra Work/Homework: (Unit 2.9 Handout 3)	**Time: 15 minutes outside of class**

Students can read and answer questions from the **Unit 2.9 Handout 3** "Newton's Laws of Motion." This is an excellent opportunity for students to review today's material in an independent manner.

Differentiated Instruction/ELL Accommodation Suggestions	Activity
If some student groups finish early, they can turn their paper over and summarize the reading passage.	**Activity 2 Handout 2**
There may be a lot of new vocabulary and ideas for some students; be prepared to assist by circulating while they are reading.	**Activity 1 & 2**

Online Resources:

Online Quiz of Newton's Laws of Motion

If students are able to have access to the Internet, there are some online quizzes for them to check on their knowledge of Newton's Laws of Motion. The online component may help with digital literacy skills needed for GED 2014.

http://www.softschools.com/quizzes/science/newtons_laws/quiz384.html

http://www.proprofs.com/quiz-school/story.php?title=laws-motion-quiz

American Physical Society - http://www.aps.org/studentsandeducators/index.cfm

Suggested Teacher Readings:

- GED Testing Service – GED Science Item Sample (to get an idea of what the test *may* be like)

  http://www.gedtestingservice.com/itemsamplerscience/

- Assessment Guide for Educators: A guide to the 2014 assessment content from GED Testing Service:

  http://www.riaepdc.org/Documents/ALALBAASSESSMENT%20GUIDE%20CHAPTER%203.pdf

- Minnesota is getting ready for the 2014 GED test! – website with updated information on the professional development in Minnesota regarding the 2014 GED.

  http://abe.mpls.k12.mn.us/ged_2014_2

- The 2014 GED Classroom: **ATLAS** (ABE Teaching and Learning Advancement System)

  http://atlasabe.org/resources/ged/science

Unit 2.9 Handout 1 ANSWER KEY

1. a. N (narrow)
   b. B (broad)
   c. M (main)
2. a
3. b
4. b
5. a
6. c

Unit 2.9 Handout 2 – (5 pages total)

Sir Isaac Newton and LeBron James

The English physicist and mathematician Sir Isaac Newton discovered three basic laws of motion. The First Law says that objects at rest and objects in motion will remain at rest or in motion, unless they are acted upon by an "unbalanced force." The Second Law says that when a force acts on a mass, acceleration is produced. The greater an object's mass is, the more force is needed to accelerate it.

But it's Newton's Third Law of Motion that everyone remembers. "For every action," the famous law reads, "there is an equal and opposite reaction." A simpler way of saying this might be: "When you push an object, it pushes back." For every force, in other words, there is a reaction force equal in size.

There are many ways to describe how the Third Law of Motion works in the world of sports. One of the more interesting examples is the way that LeBron James dunks a basketball. In order for LeBron James to score a slam-dunk, he must exert a certain amount of force against the surface of the basketball court. LeBron James is a big man. He is 6 feet, 8 inches tall. He weighs 245 pounds. When he is standing upright, with his arms raised above his head, his reach extends to 8 feet and 10 ¼ inches.

The rim of the basketball hoop is exactly 10 feet high. For LeBron James to slam the ball, he must propel himself high enough that he can force the basketball, which is approximately 9.39 inches in diameter, into the hoop. This requires that he reach well above the height of the rim, which he does fairly often. In photographs and slow-motion replays of LeBron James dunking the basketball, his elbow is often equal to the height of the rim!

LeBron James may be tall, strong and fast. He may be extremely mobile and flexible. But it is no easy feat to dunk a basketball, especially when you weigh 245 pounds. His vertical leap— that is, the maximum height he can reach when he jumps—is around 44 inches. The average vertical leap in the National Basketball Association, or NBA, is about 27 inches. That means that LeBron James, despite his large size, can jump more than 10 inches higher than most players in the NBA! This is a serious benefit in basketball, a game of inches in which how high someone can jump often means the difference between scoring and missing the shot.

Why can LeBron James jump higher than other basketball players? The answer has to do with Newton's Third Law of Motion. When LeBron James jumps, he is driving force into the court. That force is created by the energy stored inside his muscles. And how high he jumps depends not just on how much energy he forces into the surface of the court, but also on how well he does it.

When LeBron James jumps, he is not unlike a rocket launching off the ground. The rocket uses its engines to push down on the surface of the Earth. This is the "action" that Newton mentions in his Third Law. The "reaction" comes when the ground pushes the rocket upwards using an equal amount of force.

It may seem strange to think of the ground exerting force on an object, especially a basketball player or a rocket ship. But this is what Sir Isaac Newton understood way back in 1687, when he published his most famous book, *Mathematical Principles of Natural Philosophy*.

Newton would have been fascinated by LeBron James's jumping ability. But he would also have understood that it is not simply the strength of James's legs that enables him to jump so high. The stability of his body, located in his core and his torso, also contributes to the energy that he forces into the ground. The energy and strength of LeBron James's entire body is what enables him to reach such fantastic heights.

Watching LeBron James dunk on television often causes people to think he is denying the forces of gravity, which seeks to pull us and other objects to the ground. In reality, no one can deny such forces. LeBron James just happens to be so strong and agile that, when he jumps into the air, he appears to be denying the force of gravity. He seems almost capable of flying.

Naturally, smaller basketball players require less force to dunk a basketball. Since they are lighter, they don't have to combat the same gravitational pull. On the other hand, the fact that they are lighter means they do not have as much mass to store energy. The more muscles you have, the more energy you can force into the ground, and the higher you can go.

This is why professional basketball players appear to have no fat on their bodies at all. Fat does not store energy as effectively as muscle, but it still contributes to one's body weight. Fat on a basketball player is equal to wearing lead weights around their hips during a game. Obviously, this would hinder a player's performance, especially his ability to dunk.

Physicists have spent time thinking about the physics of dunking. To remain in the air for one second, they say, one would have to have a vertical leap of 4 feet, which is higher than pretty much any basketball player of all time. One exception is Michael Jordan, who is believed to have the highest vertical leap—48 inches, or 4 feet—of any professional basketball player. Michael Jordan was just 6 feet, 6 inches tall—average for an NBA player—but his vertical leap placed his head about 6 inches above the rim.

That the best basketball player in history also has the highest vertical leap is no coincidence. Michael Jordan's body was strong, stable and proportioned in such a way that the force he pushed

onto the ground placed him above the rest. He was one of the best overall athletes in the game, and his slam-dunking ability was an indication of his prowess.

Still, Michael Jordan often tucked his legs beneath him when he jumped, to make it seem as if he was flying through the air. Even athletes with 48-inch vertical leaps, in other words, wish they could jump even higher.

Comprehension Questions – Choose the best answer for each question or statement.

1. What is Sir Isaac Newton's Third Law of Motion?

A. Objects at rest and objects in motion will remain at rest or in motion, unless they are acted upon by an unbalanced force.

B. For every action there is an equal and opposite reaction.

C. When a force acts on a mass, acceleration is produced.

D. When a force acts on a mass, the mass increases.

2. What does the author describe in the passage?

A. Sir Isaac Newton's most famous book, Mathematical Principles of Natural Philosophy

B. how LeBron James developed his basketball dunking skills

C. how Sir Isaac Newton came up with the three basic laws of motion

D. how the way that LeBron James dunks a basketball illustrates Newton's Third Law of Motion

3. Read the following sentences from the passage: *"When LeBron James jumps, he is not unlike a rocket launching off the ground. The rocket uses its engines to push down on the surface of the Earth. This is the 'action' that Newton mentions in his Third Law."*

Based on this information, LeBron James jumping and the rocket using its engine to push down on the surface of the Earth are examples of which part of Newton's Third Law?

A. both the action and the equal and opposite reaction

B. the equal and opposite reaction of an action

C. the action which causes an equal and opposite reaction

D. neither the action nor the equal and opposite reaction force?

4. The force created when the court pushes LeBron James upwards is equal to which force?

A. the force LeBron James used to dunk the ball

B. the force LeBron James drives into the court when he jumps

C. the force LeBron James uses to throw the ball

D. the force LeBron James drives into the court when he lands after jumping

5. What is the main idea of this passage?

A. LeBron James and Michael Jordan are two of the best players in the history of professional basketball.

B. Basketball players must have high vertical leaps in order to dunk basketballs.

C. Newton's Third Law of Motion is related to the First and Second Laws of Motion.

D. Newton's Third Law of Motion can be examined using the examples of basketball players jumping and rockets launching.

6. Read the following paragraph from the passage: "*LeBron James is a big man. He is 6 feet, 8 inches tall. He weighs 245 pounds. When he is standing upright, with his arms raised above his head, his reach extends to 8 feet and10 1/4 inches.*"

How can the tone of the author best be described in this paragraph?

A. humorous

B. angry

C. disinterested

D. factual

7. Choose the answer that best completes the sentence below.

_____ LeBron James has an impressive vertical leap of 44 inches, Michael Jordan holds the record with a vertical leap of 48 inches.

A. In contrast

B. For example

C. Although

D. Initially

8. Describe how a rocket launches off the ground by using information from the passage.

9. When LeBron James jumps, he is driving force into the court. How is this force created?

10. How does the example of LeBron James jumping to dunk a basketball illustrate Newton's Third Law of Motion? Use information from the passage to support your answer.

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Unit 2.9 Handout 2 – (5 pages total)

Sir Isaac Newton and LeBron James

TEACHER ANSWER KEY

1. B
2. D
3. C
4. B
5. D
6. D
7. C
8. **Answers may vary, suggested answer:**

The rocket uses its engines to push down on the surface of the Earth. Then the ground pushes the rocket upwards using an equal amount of force.

9. **Answers may vary, suggested answer:**

This force is created by the energy stored inside his muscles

10. **Answers may vary, suggested answer:**

When LeBron James jumps to dunk a basketball, he is using energy to drive force into the court. This force is the "action" that Newton mentioned in his third Law. The "reaction" comes from the group pushing LeBron James upwards with an opposite and equal amount of force.

Unit 2.9 Handout 3

Name: _____

Nonfiction Text Features

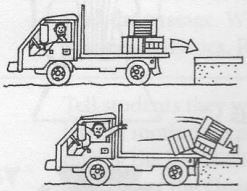
WEEK 30 DAY 2

READ THE PASSAGE Pay attention to how the writer has organized the information.

Newton's Laws of Motion

Have you ever heard of Newton's Laws of Motion? These three laws, or principles, explain how things move.

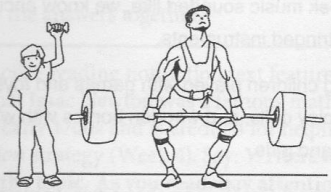
Law 1: An object at rest stays at rest. A moving object keeps moving. Objects continue doing what they're doing unless a stronger force acts on them.



Here, the stronger force is the wall. It stops the truck but not the boxes, so they keep moving backward.

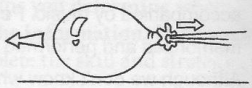
Law 2: It takes more force to move a heavy object than to move a lighter object. Newton came up with a scientific formula to explain this:

Force = Mass x Acceleration.



Large weights with a lot of mass require more force to lift than smaller, lighter weights do.

Law 3: For every force, there is an equal reaction in the opposite direction.



Air from an untied balloon rushes out in one direction. As the air escapes, it pushes the balloon in the opposite direction.

SKILL PRACTICE Read each question. Fill in the bubble next to the correct answer.

1. The drawing for Law 1 shows that the _____.
   - Ⓐ boxes are a stronger force than the truck
   - Ⓑ truck stays at rest, but the boxes do not
   - Ⓒ wall acts on the truck but not the boxes
   - Ⓓ wall and truck keep moving, but the boxes stay at rest

2. How do the captions help you understand the drawings?
   - Ⓐ They label parts of the drawings.
   - Ⓑ They tell why the law could be wrong.
   - Ⓒ They provide the scientific explanation of Newton's laws.
   - Ⓓ They explain what is happening in the drawing.

3. Which is *not* a way that the drawings help you understand Newton's Laws of Motion?
   - Ⓐ They give an example of each law in action.
   - Ⓑ They help you see how the laws work.
   - Ⓒ They provide the scientific formula for each of Newton's laws.
   - Ⓓ They provide real-life examples of the laws at work.

4. The drawings and caption for Law 2 are designed to help you understand that _____.
   - Ⓐ adults are stronger than children
   - Ⓑ more force is required to move an object that has greater mass
   - Ⓒ the larger an object's size, the greater its mass
   - Ⓓ objects move more quickly when pulled by a string or chain

STRATEGY PRACTICE Explain how the columns used to organize the text helped you understand the information.

_____

_____

Unit 2.9 Handout 3

TEACHER ANSWER KEY

1. C
2. D
3. C
4. B

Answers may vary: Suggested answer: *The columns help to separate and organize the laws of motion into the three types determined by Sir Isaac Newton.*