NGSS Science Standards Covered: MS-PS2-2, MS-PS2-4, MS-PS2-5, MS-PS2.A1.SEP, MS-PS2.B1.SEP, MS-PS2.B2.SEP, MS-PS2.C1.SEP, MS-PS2.E1.SEP, MS-PS2.A2.DCI, MS-PS2.B1.DCI, MS-PS2.B2.DCI, MS-PS2.B3.DCI, MS-PS2.A1.CC, MS-PS2.B2.CC, MS-PS1.F1.CC
ELA/Literacy Standards Covered: RI.6.1, RI.6.2, RI.6.3, RI.6.4, RI.6.7, RI.6.10, RI.7.1, RI.7.2, RI.7.3, RI.7.4, RI.7.10, RI.8.2, RI.8.3, RI.8.7, RI.8.10, W.6.1, W.6.2, W.6.4, W.6.5, W.6.6, W.6.7, W.6.8, W.6.9, W.7.1, W.7.2, W.7.4, W.7.5, W.7.6, W.7.7, W.7.8, W.7.9, W.8.1, W.8.2, W.8.4, W.8.5, W.8.6, W.8.7, W.8.8, W.8.9, L.6.1, L.6.2, L.6.3, L.6.4, L.6.6, L.7.1, 7.2, L.7.3, L.7.4, L.7.6, L.8.1, L.8.2, L.8.3, L.8.4, L.8.6, SL.6.1, SL.6.5, SL.7.1, SL.7.5, SL.8.1, SL.8.5, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7, RST.6-8.8, RST.6-8.10, WHST.6-8.1, WHST.6-8.2, WHST.6-8.4, WHST.6-8.5, WHST.6-8.8, WHST.6-8.9

Literature Links

"The Handy Physics Answer Book" by P. Erik Gunderson
"Conceptual Physics" by Paul G. Hewitt
"Can You Feel the Force?" by Richard Hammond
"Eyewitness: Force & Motion" by Peter Lafferty

Display the following objective in your classroom:
This week we will learn about forces and their properties.

Focus Question:
What is the difference between contact and non-contact forces?

Words to Know & Building Academic Vocabulary (BAV)

applied force	inertia	orbit
electricity	magnetism	parabolic arc
force	mass	physicist
friction	matter	weightlessness
gravity	newton (N)	

Page 1 Cover Story
Forces at Work in the Universe
Next Generation Science Standards Covered: MS-PS2.A1.SEP
ELA/Literacy Standards Covered: RI.6.1, RI.6.2, RI.6.3, RI.6.4, RI.6.10, RI.7.1, RI.7.2, RI.7.3, RI.7.4, RI.7.10, RI.8.2, RI.8.3, RI.8.10, L.6.1, L.6.2, L.6.3, L.6.4, L.6.6, L.7.1, 7.2, L.7.3, L.7.4, L.7.6, L.8.1, L.8.2, L.8.3, L.8.4, L.8.6, SL.6.1, SL.7.1, SL.8.1, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7, RST.6-8.8, RST.6-8.10

Lesson Suggestions: Whole Group or Independent Reading

- Jumpstart students with questions about force and motion that may be review for some and introduction for others. For example: Why do objects stay where they are? What causes objects to fall? (Text to World Connection)
- Record ideas about force and motion on a class brainstorming chart before moving on. After reading each article of the issue, come back to the chart to elaborate and/or make corrections to the understanding about force and motion. (Text to World Connection)

- Allow students to cold read independently or in pairs before coming back together to check for understanding and marking the chart. (Text to World Connection)

Teacher Questions, (Answers) and Cognitive Complexity Level/Relevance Level
- What do physicists study? (Physicists study motion, energy, momentum and forces on matter throughout the universe.) MODERATE/2-3
- How have discoveries by physicists changed our world? (Physicists have made discoveries that ultimately led to technological improvements. Engineers have used their discoveries to design new products.) MODERATE/2-3
- Do you think an understanding of physics would make a baseball player better? (Answers will vary. Accept any answers about students' favorite sports that are thoughtful.) MODERATE/3-4

Differentiated Instruction
- In addition to information and review for the whole group, offer students who may benefit from differentiation an opportunity to demonstrate ideas that are brought forward about movement and forces. Look for a basic understanding of the terms push and pull. (Text to World Connection)

Pages 2 and 3 Main Lesson
Gravity, Force and Magnetism
Next Generation Science Standards Covered: MS-PS2.A1.SEP, MS-PS2.A2.DCI, MS-PS2.B1.DCI, MS-PS2.B2.DCI
ELA/Literacy Standards Covered: RI.6.1, RI.6.2, RI.6.4, RI.6.10, RI.7.1, RI.7.2, RI.7.4, RI.7.10, RI.8.2, RI.8.10, L.6.1, L.6.2, L.6.3, L.6.4, L.6.6, L.7.1, 7.2, L.7.3, L.7.4, L.7.6, L.8.1, L.8.2, L.8.3, L.8.4, L.8.6, SL.6.1, SL.7.1, SL.8.1, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7, RST.6-8.8, RST.6-8.10

Lesson Suggestions:
- This lesson focuses primarily on an understanding of the forces of gravity and magnetism. Begin with simple demonstrations and/or explanations of those terms as we understand them in the classroom. The lesson will expand these explanations to reach a broader understanding of these forces (especially gravity) in the universe. (Text to World Connections)
- Gauge student confidence in vocabulary before allowing them to read independently or in small groups.
- After reading, return to the chart created at the beginning of the issue to add ideas of magnetism and gravity if they were not already there, and add the terms to the student notebook/glossary.
- Review the notion with all students that a force is essentially a push or a pull.

Teacher Questions, (Answers) and Cognitive Complexity Level/Relevance Level
- How are contact and non-contact forces different? (Contact forces require two forces touching. Non-contact forces occur over a field or a distance and do not require any contact.) LOW/2
- What are the variables that affect the strength of gravity? (Strength of gravity is affected by the mass of the objects and the distance between them. Greater masses have stronger gravity, but the strength of a force is weaker as the distance between objects grows.) MODERATE/2-3
- How are magnetism and electricity connected? (Magnetism can be used to generate electricity. An electric current through a wire wrapped around a metal rod can produce magnetism.) MODERATE/3

Differentiated Instruction
- Unpack this article in small groups and in small chunks for students who benefit from differentiation. Begin with a review of the definition of force as a push or a pull. (Text to World Connection)
- Stop to demonstrate concepts as you work your way through sections of the lesson. (Text to World and Self Connection)
- Using templates as needed, assist students in adding vocabulary to their glossaries. Encourage them to give examples in their definitions.

Page 2 Science, Tools
Free-body Diagrams
Next Generation Science Standards Covered: MS-PS2.A1.SEP, MS-PS2.B1.CC
ELA/Literacy Standards Covered: RI.6.1, RI.6.2, RI.6.3, RI.6.4, RI.6.10, RI.7.1, RI.7.2, RI.7.3, RI.7.4, RI.7.10, RI.8.2, RI.8.3, RI.8.10, L.6.1, L.6.2, L.6.3, L.6.4, L.6.6, L.7.1, 7.2, L.7.3, L.7.4, L.7.6, L.8.1, L.8.2, L.8.3, L.8.4, L.8.6, SL.6.1, SL.7.1, SL.8.1, RST.6-8.1, RST.6-8.3, RST.6-8.4, RST.6-8.7, RST.6-8.8, RST.6-8.10

Lesson Suggestions:
- This brief article is an introduction to use free-body diagrams in the science classroom and laboratory. One idea that may be new to students—or easily overlooked—is the concept that the table holding the book is also a force. (Text to World Connection)
- After reading through the article with students, check for understanding by having students complete two or more diagrams together.
- Add these new diagrams to the glossary under an entry for free-body diagram.

Teacher Questions, (Answers) and Cognitive Complexity Level/Relevance Level
- How can free-body diagrams be used? (Free-body diagrams can be used by scientists to show the size and direction of forces acting on an object.) LOW/2-3
- What happens when forces acting on an object are equal in strength but come from opposite directions? (The forces are balanced and there is no change in motion.) MODERATE/2-3

Differentiated Instruction:
- Students who benefit from differentiation will benefit from models of free-body diagrams, as well as from more specific labeling of the diagrams. For example, where one force is labeled gravity and the opposing force is labeled normal, it will help students add the name of the normal force, such as table, floor, hand, etc. (Text to World Connection)

Page 3 In the Lab
Friction
Next Generation Science Standards Covered: MS-PS2-2, MS-PS2-5, MS-PS2.A1.SEP, MS-PS2.B1.SEP, MS-PS2.B2.SEP, MS-PS2.C1.SEP, MS-PS2.E1.SEP, MS-PS2.A1.CC, MS-PS2.B1.CC

ELA/Literacy Standards Covered: RI.6.4, RI.7.4, SL.6.1, SL.7.1, SL.8.1, RST.6-8.3, RST.6-8.4, RST.6-8.5, MS-PS1.A2.DCI, MS-PS1.B1.DCI

Materials Needed:
- a piece of wood at least 6” by 6”
- a spring scale
- a nail

- eight pencils
- eight marbles
- sandpaper
- a hammer
- string

Lesson Suggestions:
- This investigation is packed with vocabulary and concepts about force. Begin by reading through the investigation and facilitating a discussion about friction. Demonstrate as necessary and as discussed in the investigation. (Text to World Connection)
- Next, review the measurement unit, newton. Practice converting grams to newtons with students and check for understanding. Add friction and newton unit of measurement to the glossary. (Text to World Connection)
- Before proceeding, review safety standards for the classroom, as well as the specific uses and purposes of tools necessary. Students may be eager to demonstrate unnecessary amounts of strength using the hammer. Walk through the steps of the directions to make sure they understand that driving a nail into an object requires varied amounts of force, depending on the purpose of the nail. (Text to World Connection)
- Encourage students to practice pulling before recording data. Ask them why it's a good idea to practice (to ensure they are pulling as uniformly as possible each time). If time allows, encourage students to test as many surfaces as possible. Consider expanding the table to include extra trials and different surfaces.

Teacher Questions, (Answers) and Cognitive Complexity Level/Relevance Level
- What is the purpose of expanding the investigation to include more trials over each surface? (More trials will ensure the accuracy of the results.) MODERATE/3
- What would you do if 4/5 of the trials produced similar results? (It would be safe to assume that the one trial that was different was an anomaly, and we reason that the other four were accurate.) MODERATE/3

Differentiated Instruction:
- Break the investigation down and begin by demonstrating and explaining friction in many ways over the course of daily life—brakes, shoes on surfaces, rubbing hands together, tools used to help cross over ice safely, etc. (Text to World Connection)
- Consider constructing the scale in advance, depending on available time and needs of students.
- Assist students in expanding the data table to include extra trials, perhaps providing them with a pre-printed template.

Pages 4 Mini-Lab
Magic Coins and Inertia

Science Standards Covered: MS-PS2-2, MS-PS2-5, MS-PS2.A1.SEP, MS-PS2.B1.SEP, MS-PS2.B2.SEP, MS-PS2.C1.SEP, MS-PS2.E1.SEP, MS-PS2.A1.CC, MS-PS2.B1.CC
ELA/Literacy Standards Covered: RI.6.4, RI.7.4, SL.6.1, SL.7.1, SL.8.1, RST.6-8.3, RST.6-8.4, RST.6-8.5, MS-PS1.A2.DCI, MS-PS1.B1.DCI

Materials Needed:
- 7 or 8 coins of the same denomination (pennies, nickels or quarters)
- butter knife, craft stick or tongue depressor

Lesson Suggestions:
- This investigation on inertia may be done as a quick demonstration, but it's also easily managed in small groups. Note: Depending on school policy and availability of knives, you may want to substitute large paper clips for the butter knife. Plastic knives are typically too thick to achieve desired results. Tongue depressors or craft sticks are also an option. (Text to World Connection)
- Ask students to make predictions about what might happen when they run the knife under the stack. Faster? Slower?

Teacher Questions, (Answers) and Cognitive Complexity Level/Relevance Level
- What keeps the stack of coins in place when you move the knife slowly? (inertia) LOW/2
- What happens when you move the knife more slowly? Why? (The coins probably fell over because there was too much friction.) MODERATE/3

Differentiated Instruction:
- Review the concept of inertia—the resistance of an object to a change in motion.
- Go back to the previous articles and investigations about friction and help students make the connection to this demonstration. (Text to Text Connection)

Writing and Technology
Let's Write:
- In this week's STEM article, we learned about the Microgravity University run by the National Aeronautics and Space Administration. Take a moment to review the article, and think about what kinds of student qualities you might need in order to apply and be accepted into one of the outreach programs run by MGU students.
- Draft a letter to an MGU student introducing yourself, explaining why you would like to join an outreach program there and how you would be an asset to their program. Make sure you offer solid, persuasive reasons they should accept you.
- Share with your family and teachers.

ELA/Literacy Standards Covered: W.6.1, W.6.2, W.6.4, W.6.5, W.6.7, W.6.8, W.6.9, W.7.1, W.7.2, W.7.4, W.7.5, W.7.7, W.7.8, W.7.9, W.8.1, W.8.2, W.8.4, W.8.5, W.8.7, W.8.8, W.8.9, L.6.1, L.6.2, L.6.3, L.7.1, L.7.2, L.7.3, L.8.1, L.8.2, L.8.3, SL.6.1, SL.7.1, SL.8.1, WHST.6-8.4, WHST.6-8.5, WHST.6-8.8, WHST.6-8.9

Digital Developments: The teacher may use this as a student product assessment and/or replacement for weekly assessment. MODERATE to HIGH/3 and 4

Web 2.0 Publishing Technology Suggestion(s):
- In last week's Web 2.0 Publishing suggestion we experimented with time-elapsed videography. This week the Mini-Lab on Page 4 offers an investigation of inertia and friction using coins that you can film in slow motion. Download or ask your building technology resource teacher to provide access to a video camera with slow-motion replay capability, or try downloading a free application such as SloPro. Capture the "slight of hand" as you slide that bottom coin out, including the tumble that results from friction! Present it to classmates and family.

ELA/Literacy Standards Covered: RI.6.7, RI.7.7, RI.8.7, W.6.6, W.7.6, W.8.6, SL.6.5, SL.7.5, SL.8.5

Web Surfers
http://www.cosmos4kids.com/files/universe_gravity.html
http://www.experiland.com/html_browse/ph_forces_motion_1.htm
https://phet.colorado.edu/en/simulations/category/new