

Big Idea: Speed and Motion (Energy and Motion)

Quarter 1

Inquiry Questions

Science:

- How do forces affect speed and direction?
 - What is the relationship between speed, distance and time?
 - What problems exist in motion and transportation? How might they be solved?
 - How do lift, drag, friction and gravity affect motion?
 - How are energy and speed related? (Les. 1 pages 4-17)
 - What happens when objects collide? (Les. 2 pages 18-31)

Technology:

- What problems exist in motion and transportation? How might they be solved?
- How might models be used in the design process?

Engineering:

- What improvements can be made to transportation in order to better the design and motion of the vehicle?

Mathematics:

- How do rates of speed compare with different forces and objects?

Social Studies:

- How has Indiana’s industries changed over time?
 - What significant movements have impacted life in Indiana?
 - How has speed and motion allowed Indiana to compete globally?

Content Grade Level Standards

Area

Science 4.PS.1 Investigate transportation systems and devices that operate on or in land, water, air and space and recognize the forces (lift, drag, friction, thrust and gravity) that affect their motion.
 4.PS.2 Investigate the relationship of the speed of an object to the energy of that object (contact force, noncontact force, gravity, energy transfer, conservation of energy, potential energy, kinetic energy, energy, speed, velocity, inertia, and acceleration).
 4.PS.3 Investigate how changes in speed or direction are caused by forces: the greater the force exerted on an object, the greater the change (pulley, lever, wedge, wheel and axle, inclined plane, and screw).

Note: Supplement for 4.PS.3 in Science Handbook Grade 4/5 pages 288-295 and A Closer Look on pages 512-523.
Note: Words in parenthesis are module vocabulary and academic standard vocabulary.

Technology & Engineering

STL 9. C The engineering design process involves defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results

STL 9. D When designing an object, it is important to be creative and consider all ideas.

STL 9.E Models are used to communicate and test design ideas and processes.

Mathematics

4.OA.2 Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.

4.OA.3 Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

4.NBT.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using $>$, $=$, and $<$ symbols to record the results of comparisons.

4.NBT.3 Use place value understanding to round multi-digit whole numbers to any place.

4. NBT.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm.

4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

4.NBT.6 Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

4.NF.1 Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.

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4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.

4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems.

Social Studies

- 4.1.12 Describe the transformation of Indiana through immigration and through developments of agriculture, industry and transportation.
- 4.1.13 Identify and describe important events and movements that changed life in Indiana from the mid-twentieth century to the present.
- 4.1.14 Research Indiana's modern growth emphasizing manufacturing, new technologies, transportation and global connections

ELA

Reading: Informational Text

CCSS.ELA-Literacy.RI.4.1 Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.

CCSS.ELA-Literacy.RI.4.2 Determine the main idea of a text and explain how it is supported by key details; summarize the text.

CCSS.ELA-Literacy.RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

CCSS.ELA-Literacy.RI.4.4 Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a *grade 4 topic or subject area*.

CCSS.ELA-Literacy.RI.4.5 Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.

CCSS.ELA-Literacy.RI.4.6 Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in focus and the information provided.

CCSS.ELA-Literacy.RI.4.7 Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

CCSS.ELA-Literacy.RI.4.8 Explain how an author uses reasons and evidence to support particular points in a text.

CCSS.ELA-Literacy.RI.4.9 Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

CCSS.ELA-Literacy.RI.4.10 By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 4–5 text complexity band proficiently, with scaffolding as needed at the high end of the range.

WRITING

CCSS.ELA-Literacy.W.4.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

- W.4.2a Introduce a topic clearly and group related information in paragraphs and sections; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.
- W.4.2b Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.
- W.4.2c Link ideas within categories of information using words and phrases (e.g., *another, for example, also, because*).
- W.4.2d Use precise language and domain-specific vocabulary to inform about or explain the topic.
- W.4.2e Provide a concluding statement or section related to the information or explanation presented.

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CCSS.ELA-Literacy.W.4.7 Conduct short research projects that build knowledge through investigation of different aspects of a topic.

CCSS.ELA-Literacy.W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

CCSS.ELA-Literacy.W.4.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

CCSS.ELA-Literacy.W.4.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences

SPEAKING AND LISTENING

SLA 4.1 Engage effectively in a range of collaborative discussions. With diverse partners on grade 4 topics and texts, building on others ideas and expressing their own clearly.

SLA 4.4 Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or things; speak clearly at an understandable pace.

SLA 4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or things.

SLA 4.3 Use knowledge of language and its conventions when writing, speaking, reading, or listening.

SLA 4.6 Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal precise actions, emotions, or states of being and that are basic to a particular topic.

Science Process Standards

Standards for Mathematical Practice

Science Process Standards

Nature of Science

- Make predictions and formulate testable questions
- Design a fair test.
- Plan and carry out investigations—often over a period of several lessons—as a class, in small groups or independently.
- Perform investigations using appropriate tools and technologies that will extend the senses.
- Use measurement skills and apply appropriate units when collecting data.
- Test predictions with multiple trials.
- Keep accurate records in a notebook during investigations and communicate findings to others using graphs, charts, maps and models through oral and written reports.
- Identify simple patterns in data and propose explanations to account for the patterns.
- Compare the results of an investigation with the prediction.

Design Process

- Identify a need or problem to be solved.
- Brainstorm potential solutions.
- Document the design throughout the entire design process.
- Select a solution to the need or problem.
- Select the most appropriate materials to develop a solution that will meet the need.
- Create the solution through a prototype.
- Test and evaluate how well the solution meets the goal.
- Evaluate and test the design using measurement.
- Present evidence by using mathematical representations (e.g. graphs, data tables)
- Communicate the solution (including evidence using mathematical representations (graphs, data tables), drawings or prototypes).
- Communicate how to improve the solution.

Mathematical Practices

- MP.1. Make sense of problems and persevere in solving them.
- MP.2. Reason abstractly and quantitatively.
- MP.3 Construct viable arguments and critique the reasoning of others.
- MP.4. Model with mathematics.
- MP.5. Use appropriate tools strategically.
- MP.6. Attend to precision.
- MP.7 Look for and make use of structure.
- MP.8 Look for and express regularity in repeated reasoning.

Vocabulary

Force, motion, engineer, friction, lift, drag, design, evaluate

Resources

<http://www.need.org/needpdf/Energy%20Math%20Challenge.pdf>
<http://www.partselect.com/JustForFun/Electric-Math-Numbers-Behind-Appliances.aspx>
<http://www.eia.gov/kids/energy.cfm?page=6>

Guiding Questions – Plan of Work

Common Misconceptions

What misconceptions might students have with these ideas?

- Speed is only generated by pushing the gas pedal in a car.
- Not seeing the relationship between the weight of an object and its speed.
- Not knowing the relationships between rate, friction and speed.

Profiles of Practice

- Design a bridge. Give students paper and tape, with the task of designing and creating a bridge that needs to hold a notebook.
- Students can build soda straw rockets
- Use matchbox cars, hot wheels with ramps
- K’Nex kits
- Paper airplane designs for lift, drag, thrust
- Connect to sports (baseball, kickball)

Assessment

Type of Assessment	Example
<input type="checkbox"/> Observation	Observing students working and building
<input type="checkbox"/> Oral Questioning	Question students to check for understanding
<input type="checkbox"/> Exit Slip	
<input type="checkbox"/> Journal	Science note booking, journal experiences and learning. Document designs
<input type="checkbox"/> Graphic Organizers	
<input type="checkbox"/> Self-Assessment	
<input type="checkbox"/> Writing Prompt	Students write for 60 seconds using the main vocabulary from the unit
<input type="checkbox"/> Presentation	
<input type="checkbox"/> Electronic media	
<input type="checkbox"/> Think Pair Share	

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<input type="checkbox"/> Whiteboards	
<input type="checkbox"/> Experiment/projects	Collection and explanation of the data from the experiments
<input type="checkbox"/> Quiz	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	