Physical Science Comes Alive:
Energy Systems Grades K – 1 (Invent-a-Wheel)

Alignments to National Science, Math and English Language Arts Standards

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Key	National Science Standards A-E: Content Standard SI (Scientific Inquiry) PS (Physical Science) ST (Science and Technology)

Full Description of Standards

National Science Education Standards K-4 Standards Description
Scientific Inquiry
A: SI 1a ASK A QUESTION ABOUT OBJECTS, ORGANISMS, AND EVENTS IN THE ENVIRONMENT. This aspect of the standard emphasizes students asking questions that they can answer with scientific knowledge, combined with their own observations. Students should answer their questions by seeking information from reliable sources of scientific information and from their own observations and investigations. A: SI 1b PLAN AND CONDUCT A SIMPLE INVESTIGATION. In the earliest years, investigations are largely based on systematic observations. As students develop, they may design and conduct simple experiments to answer questions. The idea of a fair test is possible for many students to consider by fourth grade. A: SI 1c EMPLOY SIMPLE EQUIPMENT AND TOOLS TO GATHER DATA AND EXTEND THE SENSES. In early years, students develop simple skills, such as how to observe, measure, cut, connect, switch, turn on and off, pour, hold, tie, and hook. Beginning with simple instruments, students can use rulers to measure the length, height, and depth of objects and materials; thermometers to measure temperature; watches to measure time; beam balances and spring scales to measure weight and force; magnifiers to observe objects and organisms; and microscopes to observe the finer details of plants, animals, rocks, and other materials. Children also develop skills in the use of computers and calculators for conducting investigations. A: SI 1d USE DATA TO CONSTRUCT A REASONABLE EXPLANATION. This aspect of the standard emphasizes the students' thinking as they use data to formulate explanations. Even at the earliest grade levels, students should learn what constitutes evidence and judge the merits or strength of the data and information that will be used to make explanations. After students propose an explanation, they will appeal to the knowledge and evidence they obtained to support their explanations. Students should check their explanations against scientific knowledge, experiences, and observations of others. A: SI 1e COMMUNICATE INVESTIGATIONS AND EXPLANATIONS. Students should begin developing the abilities to communicate, critique, and analyze their work and the work of other students. This communication might be spoken or drawn as well as written.
Physical Science
B: PS 1a Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools, such as rulers, balances, and thermometers. B: PS 1b Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials. B: PS 2a The position of an object can be described by locating it relative to another object or the background. B: PS 2b An object's motion can be described by tracing and measuring its position over time. B: PS 2c The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.

National Science Education Standards K-4 Standards Description
Science and Technology
E: ST 1a IDENTIFY A SIMPLE PROBLEM. In problem identification, children should develop the ability to explain a problem in their own words and identify a specific task and solution related to the problem.   E: ST 1b PROPOSE A SOLUTION. Students should make proposals to build something or get something to work better; they should be able to describe and communicate their ideas. Students should recognize that designing a solution might have constraints, such as cost, materials, time, space, or safety.   E: ST 1c IMPLEMENTING PROPOSED SOLUTIONS. Children should develop abilities to work individually and collaboratively and to use suitable tools, techniques, and quantitative measurements when appropriate. Students should demonstrate the ability to balance simple constraints in problem solving.   E: ST 1d EVALUATE A PRODUCT OR DESIGN. Students should evaluate their own results or solutions to problems, as well as those of other children, by considering how well a product or design met the challenge to solve a problem. When possible, students should use measurements and include constraints and other criteria in their evaluations. They should modify designs based on the results of evaluations.   E: ST 1e COMMUNICATE A PROBLEM, DESIGN, AND SOLUTION. Student abilities should include oral, written, and pictorial communication of the design process and product. The communication might be show and tell, group discussions, short written reports, or pictures, depending on the students' abilities and the design project.
National Science Standards   A-E: Content Standard   SI (Scientific Inquiry)   PS (Physical Science)   ST (Science and Technology)

Lesson #	National Council of Teachers of Mathematics Principles & Standards for School Mathematics
	Pre-K–2
1. **How Can You Get It To Move?**	GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
2. **Playground**	GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
3. **Ramps and Sleds**	NO: 1a-b GT: 2a-c MT: 1a-d, 2a-d DP: 1a-c, 2a, 3a PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
4. **Surfaces and Friction**	NO: 1a-b GT: 2a-c MT: 1a-d, 2a-d DP: 1a-c, 2a, 3a PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
Key	NO (Number and Operations) RP (Reasoning and Proof) AB (Algebra) CM (Communication) GT (Geometry) CT (Connections) MT (Measurement) RT (Representation) DP (Data Analysis and Probability) 1-4 Skill PS (Problem Solving) a-e Expectations

Lesson #	National Council of Teachers of Mathematics Principles & Standards for School Mathematics
	Pre-K–2
5. **Sled Re-design**	AB: 4a-b GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
6. **Let's Roll**	AB: 4a-b GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
7. **Make a Car**	AB: 4a-b GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
8. **A Test Drive**	GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
9. **Car Facts**	GT: 1a-c
10. **Write a How-to-Book**	GT: 1a-c
Key	NO (Number and Operations) RP (Reasoning and Proof) AB (Algebra) CM (Communication) GT (Geometry) CT (Connections) MT (Measurement) RT (Representation) DP (Data Analysis and Probability) 1-4 Skill PS (Problem Solving) a-e Expectations

Lesson #	National Council of Teachers of Mathematics Principles & Standards for School Mathematics
	Pre-K–2
11. Improve Your Ride	AB: 4a-b GT: 2a-c PS: a-d RP: a-d CM: a-d CT: a-c RT: a-c
12. The Auto Show	
Key	NO (Number and Operations) RP (Reasoning and Proof) AB (Algebra) CM (Communication) GT (Geometry) CT (Connections) MT (Measurement) RT (Representation) DP (Data Analysis and Probability) 1-4 Skill PS (Problem Solving) a-e Expectations

Full Description of Standards

NCTM Principles & Standards for School Mathematics

Number and Operations Standard	
Skill	**Pre-K–2 Expectations:**
1. Understand numbers, ways of representing numbers, relationships among numbers, and number systems	a. Count with understanding and recognize "how many" in sets of objects; b. Use multiple models to develop initial understandings of place value and the base-ten number system; c. Develop understanding of the relative position and magnitude of whole numbers and of ordinal and cardinal numbers and their connections; d. Develop a sense of whole numbers and represent and use them in flexible ways, including relating, composing, and decomposing numbers; e. Connect number words and numerals to the quantities they represent, using various physical models and representations; f. Understand and represent commonly used fractions, such as 1/4, 1/3, and 1/2.

Algebra Standard	
4. Analyze change in various contexts	a. Describe qualitative change, such as a student's growing taller; b. Describe quantitative change, such as a student's growing two inches in one year.

Geometry Standard	
1. Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships	a. Recognize, name, build, draw, compare, and sort two- and three-dimensional shapes; b. Describe attributes and parts of two- and three-dimensional shapes; c. Investigate and predict the results of putting together and taking apart two- and three-dimensional shapes.
2. Specify locations and describe spatial relationships using coordinate geometry and other representational systems	a. Describe, name, and interpret relative positions in space and apply ideas about relative position; b. Describe, name, and interpret direction and distance in navigating space and apply ideas about direction and distance; c. Find and name locations with simple relationships such as "near to" and in coordinate systems such as maps.

Measurement Standard	
1. Understand measurable attributes of objects and the units, systems, and processes of measurement	a. Recognize the attributes of length, volume, weight, area, and time; b. Compare and order objects according to these attributes; c. Understand how to measure using nonstandard and standard units; d. Select an appropriate unit and tool for the attribute being measured.

Key	NO (Number and Operations) AB (Algebra) GT (Geometry) MT (Measurement) DP (Data Analysis and Probability) PS (Problem Solving)	RP (Reasoning and Proof) CM (Communication) CT (Connections) RT (Representation) 1-4 Skill a-e Expectations

NCTM Principles & Standards for School Mathematics
Measurement Standard Continued)

Skill	Pre-K–2 Expectations:
2. Apply appropriate techniques, tools, and formulas to determine measurements.	a. Measure with multiple copies of units of the same size, such as paper clips laid end to end; b. Use repetition of a single unit to measure something larger than the unit, for instance, measuring the length of a room with a single meterstick; c. Use tools to measure; d. Develop common referents for measures to make comparisons and estimates.

Data Analysis and Probability Standard

1.Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	a. Pose questions and gather data about themselves and their surroundings; b. Sort and classify objects according to their attributes and organize data about the objects; c. Represent data using concrete objects, pictures, and graphs.
2. Select and use appropriate statistical methods to analyze data	a. Describe parts of the data and the set of data as a whole to determine what the data show.
3. Develop and evaluate inferences and predictions that are based on data	a. Discuss events related to students' experiences as likely or unlikely.

Problem Solving
Instructional programs from pre-kindergarten through grade 12 should enable all students to—

a. Build new mathematical knowledge through problem solving
b. Solve problems that arise in mathematics and in other contexts
c. Apply and adapt a variety of appropriate strategies to solve problems
d. Monitor and reflect on the process of mathematical problem solving

Reasoning and Proof
Instructional programs from pre-kindergarten through grade 12 should enable all students to—

a. Recognize reasoning and proof as fundamental aspects of mathematics
b. Make and investigate mathematical conjectures
c. Develop and evaluate mathematical arguments and proofs
d. Select and use various types of reasoning and methods of proof

Key	NO (Number and Operations) AB (Algebra) GT (Geometry) MT (Measurement) DP (Data Analysis and Probability) PS (Problem Solving)	RP (Reasoning and Proof) CM (Communication) CT (Connections) RP (Representation) 1-4 Skill a-e Expectations

NCTM Principles & Standards for School Mathematics
Communication   **Instructional programs from pre-kindergarten through grade 12 should enable all students to—**
a. Organize and consolidate their mathematical thinking through communication   b. Communicate their mathematical thinking coherently and clearly to peers, teachers, and others   c. Analyze and evaluate the mathematical thinking and strategies of others;   d. Use the language of mathematics to express mathematical ideas precisely.
Connections   **Instructional programs from pre-kindergarten through grade 12 should enable all students to—**
a. Recognize and use connections among mathematical ideas   b. Understand how mathematical ideas interconnect and build on one another to produce a coherent whole   c. Recognize and apply mathematics in contexts outside of mathematics
Representation   **Instructional programs from pre-kindergarten through grade 12 should enable all students to—**
a. Create and use representations to organize, record, and communicate mathematical ideas   b. Select, apply, and translate among mathematical representations to solve problems   c. Use representations to model and interpret physical, social, and mathematical phenomena

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Lesson #	National Council of Teachers of English: Standards for the English Language Arts
1. **How Can You Get It To Move?**	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
2. **Playground**	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
3. **Ramps and Sleds**	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
4. **Surfaces and Friction**	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
5. **Sled Re-design**	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
6. **Let's Roll**	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12

Lesson #	National Council of Teachers of English: Standards for the English Language Arts
7. Make a Car	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
8. A Test Drive	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
9. Car Facts	Standard 4 Standard 5 Standard 6 Standard 8 Standard 11 Standard 12
10. Write a How-to-Book	Standard 4 Standard 5 Standard 6 Standard 8 Standard 11 Standard 12
11. Improve Your Ride	Standard 4 Standard 5 Standard 6 Standard 7 Standard 8 Standard 11 Standard 12
12. The Auto Show	

Full Description of Standards

National Council of Teachers of English: Standards for the English Language Arts
Standard 4
Students adjust their use of spoken, written, and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
Standard 5
Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
Standard 6
Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language, and genre to create, critique, and discuss print and nonprint texts.
Standard 7
Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
Standard 8
Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.
Standard 11
Students participate as knowledgeable, reflective, creative, and critical members of a variety of literacy communities.
Standard 12
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).