

<p>Grade, Subject/Course: Energy, Power, & Transportation (10-12)</p>	
<p>Unit: Transportation: Model Rocketry</p>	<p><input checked="" type="checkbox"/> Essential <input type="checkbox"/> Important <input type="checkbox"/> Compact</p>
<p>Big Idea: The design challenge is constructing an aerodynamically sound model rocket to the specifications and safely recover it.</p>	
<p>STEELS/Tech and Engineering Strand: 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.B Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal. 3.5.9-12.E Evaluate how technology and engineering advancements alter human health and capabilities. 3.5.9-12.H Evaluate ways that technology and engineering can impact individuals, society, and the environment. 3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality. 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process. 3.5.9-12.JJ Identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes. 3.5.9-12.MM Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system</p>	<p>Pacing: 3 weeks</p>
<p>Essential Questions: UEQ: How does Newton’s Law of Motion explain how rockets are launched into space? LEQ: How do balanced and unbalanced forces relate to Newton's First Law of Motion?</p>	<p>Understandings: Students will know that...</p> <ul style="list-style-type: none"> ● Newton’s Laws of Motion govern the forces and loads acting on a model rocket during flight. ● Aerodynamics affects the stability of model rockets. ● Various construction materials, tools, and techniques are used to build model rockets safely.

<p>LEQ: How does Newton's Second Law of Motion relate to force, mass, and acceleration? LEQ: What is Newton's Third Law of Motion and how does it relate to momentum? LEQ: How much force is a Newton? LEQ: How does aerodynamics and static margin affect the stability of a model rocket? LEQ: What are the various construction materials, tools, and techniques used to build model rockets safely? LEQ: How are math and science concepts used to construct and fly a model rocket? LEQ: How does meteorology influence the flight of a model rocket? LEQ: What are the NAR rules and code regulations that must be followed to build and fly model rockets safely? LEQ: What is the procedure for safely launching and recovering a model rocket?</p>	<ul style="list-style-type: none"> ● Math and science concepts are used to construct and fly a model rocket. ● Meteorology influences the flight of a model rocket. ● The parts of a model rocket have distinct functions. ● NAR rules and code regulations must be followed to safely build and fly model rockets.
<p><u>Knowledge:</u> Newton's Laws of Motion Forces Acting On An Object Mass & Weight Acceleration Action & Reaction Model Rocketry</p>	<p><u>Do/Skills:</u> Students will be able to...</p> <ul style="list-style-type: none"> ● Describe motion, describe the changes motion causes, and identify the characteristics of objects in motion. ● Investigate the relationship between mass, acceleration, and force as described in Newton's second law of motion. ● Investigate the relationship between equal and opposite forces exerted by interacting objects as described in Newton's third law of motion. ● Explore everyday forces and weights in terms of newtons. ● Identify the parts of a payload model rocket and explain their functions. ● Build an aerodynamically sound model rocket to the specifications of the design that withstands the stresses of mid-power flights. ● Safely launch a model rocket and recover it.
<p><u>Vocabulary:</u> Inertia, Force, Motion, Mass, Weight, Acceleration, Momentum, Newton, Action, Reaction, Body Tube, Nose Cone, Launch Lug, Engine Mount, Engine Hook, Shock Cord Mount, Parachute, Fins, Apogee</p>	<p><u>Core Resources:</u> Schoolology LMS</p>

<p><u>Common Assessment(s):</u></p> <ol style="list-style-type: none"> 1. Newton’s First Law of Motion: Glass/Coin Experiment 1 2. Newton’s Second Law of Motion: Newton Car Experiment 2 3. Newton’s Third Law of Motion: Dual-Range Force Sensors Experiment 3 4. How Much Force Is A Newton? Experiment 4 5. Model Rocket Safety Code Review 6. Model Rocket Project 	<p><u>Supplemental Resources:</u></p>
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<p><u>Grade, Subject/Course:</u> Energy, Power, & Transportation (10-12)</p>	
<p><u>Unit:</u> Energy: Solar Sprint Car</p>	<p><input checked="" type="checkbox"/> Essential <input type="checkbox"/> Important <input type="checkbox"/> Compact</p>
<p><u>Big Idea:</u> The design challenge is to construct a solar sprint car capable of producing the fastest speed over a given length of track.</p>	
<p><u>STEELS/Tech and Engineering Strand:</u> 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.B Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal. 3.5.9-12.E Evaluate how technology and engineering advancements alter human health and capabilities. 3.5.9-12.H Evaluate ways that technology and engineering can impact individuals, society, and the environment. 3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality. 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process. 3.5.9-12.JJ Identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the</p>	<p><u>Pacing:</u> 4 weeks</p>

<p>development and use of tools, materials, and processes. 3.5.9-12.MM Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system</p>	
<p>Essential Questions: UEQ: How can we use the power of the sun as an alternative energy source in transportation? LEQ: How do photovoltaic cells convert sunlight into electricity? LEQ: How do changes in light conditions and angles affect the power output of a photovoltaic system? LEQ: How is the amount of solar energy available at any location in the United States at a given time of year determined? LEQ: What are the different types of gears and how do gears work? LEQ: How are gear ratios calculated to determine the relationship between rotational speed and torque? LEQ: What is the best strength-to-weight ratio for a variety of materials used as a chassis for a solar sprint car? LEQ: What are the various construction materials, tools, and techniques used to build the fastest solar sprint car?</p>	<p>Understandings: Students will know that...</p> <ul style="list-style-type: none"> ● Photovoltaic cells convert sunlight into electricity. ● Changes in light conditions and angles affect the power output of a photovoltaic system. ● Gear ratios express the relationship between rotational speed and torque. ● Various materials have different strength-to-weight ratios. ● Specific tools and techniques are used to construct the fastest solar sprint car.
<p>Knowledge: Problem & Design Brief Research & Gathering Information</p> <ul style="list-style-type: none"> ● Forms of Energy ● Renewable & Nonrenewable Energy Resources ● Laws of Energy Conservation ● Photovoltaic Cells ● Solar Angles & Tracking Systems ● Gears & Gear Ratios ● Chassis Strength To Weight Ratio <p>Developing Ideas & Solutions Choosing The Best Solution Construction Drawings Building Prototypes Testing & Data Collection Evaluation & Analysis</p>	<p>Do/Skills: Students will be able to...</p> <ul style="list-style-type: none"> ● Evaluate the solar energy available at any location in the United States at a given time of year. ● Investigate how changes in light conditions and angles affect the power output of a photovoltaic system. ● Determine the relationship between rotational speed and torque based on calculated gear ratios. ● Determine the best strength-to-weight ratio of a variety of materials to be used as a chassis for the solar sprint car. ● Design and determine the most efficient photovoltaic solar angle while maintaining good aerodynamics for producing the fastest solar sprint car. ● Design and calculate the best gear ratio of speed and torque in a geartrain for producing the fastest solar sprint car. ● Construct a solar sprint car capable of producing the fastest speed over a given track length.
<p>Vocabulary: Photovoltaic Cell, Latitude, Longitude, Azimuth, Angle of Incidence, Chassis, Pinion Gear, Spur Gear, Gear Ratio, Geartrain,</p>	<p>Core Resources: Schoology LMS</p>

<p><u>Common Assessment(s):</u></p> <ol style="list-style-type: none"> 1. Solar Power: Determining the Amount of Solar Energy We Can Capture 2. Solar Powered Photovoltaic System Lab 3. Speed vs. Torque Lab 4. Solar Sprint Car Chassis Lab 5. Gear Ratio Quiz 6. Solar Sprint Car Project 	<p><u>Supplemental Resources:</u></p>
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<p><u>Grade, Subject/Course:</u> Energy, Power, & Transportation (10-12)</p>	
<p><u>Unit:</u> Power: Catapult</p>	<p><input checked="" type="checkbox"/> Essential <input type="checkbox"/> Important <input type="checkbox"/> Compact</p>
<p><u>Big Idea:</u> The design challenge is to construct a mechanical launching system using mechanical advantage that can deliver a small projectile predictably and repeatedly over a specified range of distances.</p>	
<p><u>STEELS/Tech and Engineering Strand:</u> 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.B Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal. 3.5.9-12.E Evaluate how technology and engineering advancements alter human health and capabilities. 3.5.9-12.H Evaluate ways that technology and engineering can impact individuals, society, and the environment. 3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality. 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process.</p>	<p><u>Pacing:</u> 5 weeks</p>

<p>3.5.9-12.JJ Identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.</p> <p>3.5.9-12.MM Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system</p>	
<p>Essential Questions:</p> <p>UEQ: How are simple machines used to gain mechanical advantage to make work easier?</p> <p>LEQ: What is work, energy, and power?</p> <p>LEQ: How is human horsepower measured and calculated?</p> <p>LEQ: What is an inclined plane and how are inclined planes used to gain a mechanical advantage?</p> <p>LEQ: What is a wedge and how are wedges used to gain a mechanical advantage?</p> <p>LEQ: What is a screw and how are screws used to gain a mechanical advantage?</p> <p>LEQ: What is a lever and how are levers used to gain mechanical force or speed advantage?</p> <p>LEQ: What is a wheel and axle and how are wheels and axles used to gain mechanical force or speed advantage?</p> <p>LEQ: What is a pulley and how are pulleys used to gain a mechanical advantage?</p> <p>LEQ: What is the difference between ideal mechanical advantage (IMA) and actual mechanical advantage (AMA)?</p> <p>LEQ: Which glues or adhesives have the best holding strength for wood?</p>	<p>Understandings: Students will know that...</p> <ul style="list-style-type: none"> • The concepts of work, energy, and power can be determined by looking at real-world examples. • Efficiency describes how well energy is converted from one form into another. • The mechanical advantage of incline planes, wedges, and screws makes work easier by applying a force over a greater distance. • The mechanical advantage of levers, wheels & axles, and pulleys makes work easier by increasing force or speed. • Glues and adhesives vary based on holding strength for different materials.
<p>Knowledge:</p> <p>Problem & Design Brief</p> <p>Research & Gathering Information</p> <ul style="list-style-type: none"> • Work, Energy, & Power • Force & Distance • Mass vs. Weight • Speed vs. Velocity • Horsepower • Simple Machines • Mechanical Advantage • Efficiency <p>Developing Ideas & Solutions</p> <p>Choosing The Best Solution</p> <p>Construction Drawings</p> <p>Building Prototypes</p>	<p>Do/Skills: Students will be able to...</p> <ul style="list-style-type: none"> • Define how work is done, the different forms of energy (kinetic and potential), and how energy is converted or transferred from one form to another. • Measure and calculate human horsepower when climbing a flight of stairs. • Calculate the mechanical advantage of simple machines. • Conduct material testing on a variety of adhesives and structural bracing applications to determine the best strength. • Design and build a mechanical launching system using mechanical advantage that can deliver a small projectile predictably and repeatedly over a specified range of distances.

Testing & Data Collection Evaluation & Analysis	
<u>Vocabulary:</u> Work, Energy, Power, Potential Energy, Kinetic Energy, Mass, Weight, Speed, Velocity, Horsepower, Watts, Joules, Inclined Plane, Wedge, Screw, Lever, Pulley, Wheel & Axle, Mechanical Advantage, Trade-off, Efficiency	<u>Core Resources:</u> Schoology LMS
<u>Common Assessment(s):</u> 1. Calculating Human Horsepower 2. Inclined Plane Lab 3. Wedge Lab 4. Screw Lab 5. Lever Lab 6. Wheel & Axle Lab 7. Pulley Lab 8. Catapult Project	<u>Supplemental Resources:</u>

<u>Grade, Subject/Course:</u> Energy, Power, & Transportation (10-12)	
<u>Unit:</u> Electricity & Electronics	<u> X </u> Essential <u> </u> Important <u> </u> Compact
<u>Big Idea:</u> The principles of electricity and electronics enable the creation and operation of the diverse technologies that shape modern life.	
<u>STEELS/Tech and Engineering Strand:</u> 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.B Critically assess and evaluate a technology that minimizes resource use and resulting waste to achieve a goal. 3.5.9-12.E Evaluate how technology and engineering advancements alter human health and capabilities. 3.5.9-12.H Evaluate ways that technology and engineering can impact individuals, society, and the environment. 3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for	<u>Pacing:</u> 6 weeks

a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality.

3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process.

3.5.9-12.JJ Identify and explain how the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials, and processes.

3.5.9-12.MM Troubleshoot and improve a flawed system embedded within a larger technological, social, or environmental system

Essential Questions:

UEQ: How do the principles of electricity and electronics enable the creation and operation of modern devices, and how can we apply these principles to solve real-world problems?

LEQ: How can you ensure safety when working with electricity to prevent electric shock and other hazards?

LEQ: How does electron theory explain the flow of electric current through different materials, and what role do conductors, insulators, and semiconductors play in this process?

LEQ: How does the ability to read and interpret electrical circuit schematic diagrams help in understanding and troubleshooting electrical systems??

LEQ: What tools and techniques are used to accurately measure voltage, current, and resistance in an electrical circuit?

LEQ: What is the relationship between voltage, current, and resistance in a circuit?

LEQ: How are voltage, current, and resistance interrelated in an electrical circuit, and how can this relationship be used to solve circuit problems?

LEQ: How can Ohm's Law be applied to solve practical electrical problems involving voltage, current, and resistance?

LEQ: How does Watt's Law help in solving electrical problems related to power, voltage, and current?

LEQ: How can you calculate the power consumption and operating costs of electrical devices based on wattage and usage time?

LEQ: What are the key techniques for performing high-quality soldering, and how do you troubleshoot common issues to ensure safe and reliable electrical connections?

Understandings: Students will know that...

- Following precautionary safety guidelines and practices can significantly reduce the risk of experiencing an electrical shock.
- All materials can be classified based on their electrical conductivity into either a conductor, an insulator, or a semiconductor.
- Schematic diagrams of electrical circuits are used to represent different components, how they are connected, and what function they serve within the electrical circuit.
- Voltage, current, and resistance in series and parallel electrical circuits differ based on their configuration and electrical behaviors.
- Ohm's Law can be used to find unknown values and describes the relationship between voltage, current, and resistance in an electrical circuit.
- Watt's Law is crucial for calculating the power consumption of appliances, choosing appropriate fuses or circuit breakers, and analyzing energy usage in a circuit.
- Proper soldering requires precise control over temperature, technique, and materials to create reliable connections and troubleshoot common soldering issues.
- Magnetism is a force exerted by magnets when they attract or repel each other and relates to electric currents and magnetic fields.
- Electric motors work on the principle that a current-carrying conductor in a magnetic field experiences a force, leading to rotational motion.
- The behavior of batteries connected in series or parallel affects the voltage and current in a circuit.

<p>LEQ: How does electricity create magnetic fields, and how can magnetism affect the flow of electricity?</p> <p>LEQ: How do electrical motors utilize the principles of magnetism to transform electrical energy into mechanical motion?</p> <p>LEQ: How does the configuration of batteries in series or parallel affect the voltage and current in an electrical circuit?</p>	
<p>Safety & Electrical Shock Nature of Matter Electron Theory Conductors, Insulators, & Semiconductors Schematic Diagrams & Electrical Components Voltage, Amperage, & Resistance Series & Parallel Circuits Ohm's Law Watt's Law Soldering Magnetism & Electrical Motors Sources of Electricity (Batteries)</p>	<p><u>Do/Skills:</u> Students will be able to...</p> <ul style="list-style-type: none"> ● Demonstrate specific safety guidelines and practices when working with electricity. ● Predict electron actions of atoms and classify them as conductors, insulators, or semiconductors. ● Read and interpret a schematic diagram of an electrical circuit. ● Properly operate a multimeter to accurately measure voltage, current, and resistance properties in a circuit. ● Build and test series and parallel circuits, observe differences in behavior, and collect data to support theoretical principles. ● Calculate and measure unknown values of voltage, current, and resistance in simple circuits using Ohm's Law. ● Calculate and measure unknown values of voltage, current, and power in simple circuits using Watt's Law. ● Determine the wattage (power) of an electrical product and calculate the cost of operating that product over time. ● Safely apply proper soldering techniques to basic soldering projects and troubleshoot common soldering issues. ● Explain the principles of electromagnetism that allow electric motors to function. ● Analyze the difference between series and parallel battery connections and calculate how each affects the overall voltage and current in a circuit.
<p><u>Vocabulary:</u> Atom, Proton, Neutron, Electron, Ionization, Valence Electron, Conductor, Insulator, Semiconductor, Coulomb, Electron Theory, Schematic Diagram, Resistor, Capacitor, Transistor, Diode, Inductor, Cell, Battery, Transformer, Switch, Fuse, Electromotive Force (EMF) Voltage, Current, Resistance, Volts, Amperage (Amps), Ohms, Multimeter, Series Circuit, Parallel Circuit, Ohm's Law, Watt's Law, Electrical Power, Watts, Kilowatt-hour, Printed Circuit Board (PCB), Soldering, Desoldering, Soldering Iron, Solder, Tracks, Pads, Tinning, Flux, Alloy, Capillary Action, Heat Sinking, Oxidation, Magnetism, Domains, Electromagnetism, Inductance, Anode, Cathode</p>	<p><u>Core Resources:</u> Schoolology LMS</p>

Common Assessment(s):

1. Electricity Safety Quiz
2. Electron Quiz
3. Electronic Component Identification Quiz
4. Resistance Lab
5. Resistor Color Code Quiz
6. Electricity Quiz
7. Series & Parallel Circuits Lab
8. Ohm's Law Lab
9. Ohm's Law Quiz
10. Power: Watt's Law Lab
11. Power: Watt's Law Quiz
12. Solder Practice Project
13. Soldering Quiz
14. Magnets & Magnetism Lab
15. Magnets & Magnetism Quiz
16. Electric Motor Project
17. Cells & Batteries Lab

Supplemental Resources: