The Mission of the Chardon Local Schools is High Achievement for All Students, Where Learning is Our Most Important Work.

Science Course of Study:

DESIGN for SCIENCE

Revised March 2022

CHARDON
LOCAL SCHOOLS
#WeAreChardon

Committee Members: Eric Bartley, Dan Robertson

Strand: Energy and its conservation

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<td>Learning Standards: Conservation Laws

MS-ETS1-1 Engineering Design
Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

P.M.2: Problem solving

P.E.1: Gravitational potential energy
P.E.2: Energy in springs
P.E.3: Work and power

P.F.2: Gravitational force and fields
P.F.3: Elastic forces
P.F.4: Friction force (static and kinetic)
P.F.5: Air resistance and drag
P.F.6: Forces in two dimensions

Possible Projects

Thermo
Students will conduct experiments to determine what added material(s) make ice melt faster.
Plastics
Students will determine which recipe is best for making plastic from milk to build a functional product.
Crystals
Students will determine the best conditions in which to grow the largest and purest crystals.</td>
<td>How Taught?
Teaching activities may include, but are not limited to:
• Students closely read select passages from documents to analyze text structure, development, and consequent meanings.
• Teacher provides direct instruction, give feedback, and model critical thinking
• Small group and class discussions
• Cooperative learning groups
• Students to define, use, and connect to content area and based vocabulary
• Students analyze video content related to standards that provide a broader global perspective of content.
• Design and conduct lab-based investigations that connect content to real-life experiences.
• Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards.
• Using technology and mathematics to improve investigations and communications.
• Utilize data to impact instruction</td>
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<td>Materials:

Thermo
• Identical bowls or saucers
• Ice
• Salt
• Sand
• Sugar
• Measuring spoons
• Stop watch
• Graduated cylinder
• Funnel
Plastics
• Masking tape
• Measuring spoons</td>
<td>How Assessed?
Assessments may include, but are not limited to:
• Pre-Assessments (pre-tests, observation, questioning, diagnostics)
• Formative Assessments (entry/exit slips, mini analysis assignments, group work, discussions, homework/classwork, self and peer evaluations, checklists, guided notes, observations,quizzes, conferences, rubrics, lesson review questions, lab reports)
• Summative Assessments (formal essays, using rubrics; tests/exams, project, evaluation, demonstration, lab practicals)</td>
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• *Measuring cups* • *White vinegar* • *Milk* • *Microwave* • *Microwave safe cups or bowls* • *Thermometer* • *Spoons* • *Cotton cloth* • *Rubber bands* • *Clear cups (plastic or glass)* • *Electronic balance* • *Wax paper* • *Paper towels* • *Molds, cookie cutters, food coloring, paint, glitter, colored markers* *Crystals* • *Large bowl* • *Ice* • *Water* • *Thermometer* • *Scissors* • *String* • *Stir sticks* • *Jars* • *Hot plate* • *Measuring cup(s)* • *borax*	**How Re-Taught?** **Re-teaching activities may include, but are not limited to:** • descriptive feedback on original task/assessment • student examples of expectations • modeling • student self assessments • manipulatives • presenting the information again in a different way • review sessions • graphic organizers • small-group instruction • practice activities • computer tutorials / programs • peer tutoring • breaking down concept into smaller components • games and hands-on activities • cooperative learning • Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Force Interactions P.M.2: Problem solving P.M.3: Projectile motion When an object has both horizontal and vertical components of motion, as in a projectile, the components act independently of each other. P.F.1: Newton's laws applied to complex problems P.E.1: Gravitational potential energy P.E.2: Energy in springs P.E.3: Work and power P.F.2: Gravitational force and fields P.F.3: Elastic forces P.F.4: Friction force (static and kinetic) P.F.5: Air resistance and drag P.F.6: Forces in two dimensions P.F.7: Momentum, impulse and conservation of momentum *Possible Projects*	**How Taught?** **Teaching activities may include, but are not limited to:** • Students closely read select passages from documents to analyze text structure, development, and consequent meanings. • Teacher provides direct instruction, give feedback, and model critical thinking • Small group and class discussions • Cooperative learning groups • Students to define, use, and connect to content area and based vocabulary • Students analyze video content related to standards that provide a broader global perspective of content. • Design and conduct lab-based investigations that connect content to real-life experiences. • Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. • Using technology and mathematics to improve investigations and communications. • Utilize data to impact instruction

Mousetrap racer
Students will create a race car utilizing a mousetrap as the energy source to obtain the greatest distance traveled. Work, power and energy transfer will be discussed and applied.

Egg drop
Students will create a device that when dropped from a determined height will allow the survival of an egg "passenger". Students will determine the effects of a gravitational field on an object. Concepts of momentum, impulse, air resistance, work and energy will be applied.

Catapults
Students will build a ping pong ball launcher to compete in a competition of accuracy. Concepts of force, acceleration, motion will be utilized

Materials:

Mouse trap
Egg
Catapults
Various student determined materials will be used in all projects.

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- computer tutorials / programs
- peer tutoring
- breaking down concept into smaller components
- games and hands-on activities
- cooperative learning

	● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Fields	**How Taught?** **Teaching activities may include, but are not limited to:**
P.M.2: Problem solving P.F.1: Newton's laws applied to complex problems P.F.2: Gravitational force and fields P.EM.1: Charging objects (friction, contact and induction) P.EM.2: Coulomb's law P.EM.3: Electric fields and electric potential energy P.EM.4: DC circuits • Ohm's law • Series circuits *Circuits* *Students will design electric circuits based on criteria determined by the instructor. Ohm's law, series and parallel circuits, electric fields and electric potential will be utilized by the student.* *Motors/generators* *Students will build devices to produce electrical current from various materials. Devices will be used to power circuits designed by the students.* Electrolytes Students will design an experiment to determine if orange juice or sports drinks provide more electrolytes.	● Students closely read select passages from documents to analyze text structure, development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions ● Cooperative learning groups ● Students to define, use, and connect to content area and based vocabulary ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction
Materials: *Electrolytes* ● *Multimeter* ● *Various solutions* ● *Orange juice* ● *Sports drink* ● *Alligator clips* ● *Copper wire* ● *Battery* ● *Labels* ● *Distilled water* ● *Resistors* *Circuits* ●	**How Assessed?** **Assessments may include, but are not limited to:** ● Pre-Assessments (pre-tests, observation, questioning, diagnostics) ● Formative Assessments (entry/exit slips, mini analysis assignments, group work, discussions, homework/classwork, self and peer evaluations, checklists, guided notes, observations,quizzes, conferences, rubrics, lesson review questions, lab reports) ● Summative Assessments (formal essays, using rubrics; tests/exams, project, evaluation, demonstration, lab practicals)

Motors/generators *Bomber*	**How Re-Taught?** **Re-teaching activities may include, but are not limited to:** ● descriptive feedback on original task/assessment ● student examples of expectations ● modeling ● student self assessments ● manipulatives ● presenting the information again in a different way ● review sessions ● graphic organizers ● small-group instruction ● practice activities ● computer tutorials / programs ● peer tutoring ● breaking down concept into smaller components ● games and hands-on activities ● cooperative learning ● Universal Design for Learning principles offering students opportunities to experience and engage material in new and different ways

Learning Standards: Change in Motion P.M.2: Problem solving P.F: FORCES, MOMENTUM AND MOTION P.F.1: Newton's laws applied to complex problems P.F.2: Gravitational force and fields P.F.3: Elastic forces P.F.4: Friction force (static and kinetic) P.F.5: Air resistance and drag P.F.6: Forces in two dimensions • Adding vector forces • Motion down inclines • Centripetal forces and circular motion P.F.7: Momentum, impulse and conservation of momentum Possible activities: *Rockets* *Student will build, modify and launch estes type rockets to determine the effects on launch speeds and height attained.*	**How Taught?** **Teaching activities may include, but are not limited to:** ● Students closely read select passages from documents to analyze text structure, development, and consequent meanings. ● Teacher provides direct instruction, give feedback, and model critical thinking ● Small group and class discussions ● Cooperative learning groups ● Students to define, use, and connect to content area and based vocabulary ● Students analyze video content related to standards that provide a broader global perspective of content. ● Design and conduct lab-based investigations that connect content to real-life experiences. ● Provide opportunities for out of building excursions (field trips) to provide additional real world application of standards. ● Using technology and mathematics to improve investigations and communications. ● Utilize data to impact instruction

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Student will participate in bicycle race to obtain constant speed over a given course. Average speed, instantaneous speed, distance, displacement

Crash test cars
Student will design the best restraint devices to protect passengers during a car crash. Concepts of momentum, impulse and energy will be discussed.</td><td></td></tr>
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Estes alpha rockets
accelerometer
Bicycles
Meter Stick
stopwatches
Dynamics carts and tracks
Vernier interfaces
Motion detectors
Force sensors</td><td>How Assessed?
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