Unit 3: Work, Energy, Momentum

Content Area: **Science**
Course(s): **Physics/Lab Honors**
Time Period: **6 weeks**
Length: **Weeks**
Status: **Published**

Unit Overview

This unit covers the work energy theorem, power, conservation of energy,conservation of momentum and impulse momentum.

Transfer

Students will be able to use the sling shot launcher to see the energy transfer for Elastic Potential, to Kinetic, to Gravitation Potential in the launcher lab. Students will walk up the stairs at different speeds and calculate their power output each time. Students will complete different collisions with the Pasco carts to understand conservation of momentum.

For more information, read the following article by Grant Wiggins.

http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=60

Meaning

Understandings

1) Students will understand how the work done on an object relates to the amount energy transferred to or from an object.

2) Students will understand how power is related to work done on an object in a certain time.

3) Students will understand the principles of Conservation of Energy.

4) Students will understand the principles of Conservation of Momentum.

5) Students will understand the principles of Impulse and Momentum.

Essential Questions

1) How could I tell my mom I am "working" without lying, but still be relaxing?

2) I feel like when I do work I am losing energy, if this true can we prove it so I can at least get a nap afterwards?

3) If energy is always "conserved" where the heck does it go? I certainly don't feel like I keep my energy all day!

4) How in the world can an investigator say how fast I was going before I crashed into the car in front of me? Are they Wizards?

5) Why can't I hit a baseball off a tee as far as I can hit one that is pitched to me?

6) I have lost every water balloon toss competition ever, but I really want to impress a girl and win one...teach me master!?!

Application of Knowledge and Skill

1) Students will be able analyze situations with energy transfer in their everyday life.

2) Students will be have a better understanding of collisions, the dangers they present and how to avoid them.

Students will know...

1)The definition of work and how it relates to energy.

2) The definition of power and how it relates to th rate at which work is done.

3) What energy is and the main different types of energy.

4) How energy can be transformed from one form to another.

5) Define the Law of Conservation of Momentum.

6) Define the Law of Conservation of Momentum and relate it to collisions.

7) Definition of impulse and how it relates to a change in momentum.

8) How to decrease the force acting on an object while keeping the impulse the same.

Students will be skilled at...

1) Solving for work and power.

2) Solving solving for the three different types of energy.

3) Solving for different variables such as velocity, height, etc. in conservation of energy problems.

4) Solving collision problems using the principles of momentum and energy.

5) Solving impulse problems.

Academic Vocabulary

Academic Vocabulary	Application Vocabulary
work	power
kinetic energy	energy
gravitational potential energy	mass
elastic potential energy	velocity
momentum	time
impulse	absorb
elastic collision	deliver
inelastic collision	friction
	force time
	conservation
	area under the curve

Learning Goal 1

SWBAT describe how work and energy are related along with solving all types of problems relating to work, power, and energy.

[Proficency Scale](#)

- SWBAT describe how work and energy are related along with solving all types of problems relating to work, power, and energy.

MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
SCI.9-12.HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
SCI.9-12.HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Target 1

SWBAT describe what it means to "do work on something" including positive and negative work. SWBAT solve work problems including multiuple forces at angles. SWBAT use a force vs distance graph to find the area under the curve (work)

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Target 2

SWBAT Define Power and solve basic power problems, along with solving for their own power output climbing up the stairs.

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Target 3

SWBAT describe how energy and work are related qualitatively and quantitatively. SWBAT use the work energy theorem to solve problems.

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Target 4

SWBAT Describe the three different types of energy we will be working with in class and solve each equation for the specific type of energy.

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Target 5

SWBAT Solve conservation of energy problems with and without energy lost due to outside forces. As well as solving problems, students should be able to graph the interactions of these energies and work on an energy vs position graph.

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Learning Goal 2

SWBAT solve momentum problems in 1-D and 2-D, and demonstrate an understanding of the principles of conservation of momentum and impulse momentum

[Proficiency Scale](#)

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MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
MA.A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with

	coefficients represented by letters.
SCI.9-12.HS-PS2-2	Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

Target 1

SWBAT Describe what momentum is and solve a basic momentum problem using the equation p=mv.

- SWBAT Describe what momentum is and solve a basic momentum problem using the equation p=mv.

Target 2

SWBAT explain how impulse relates to a change in momentum, solve impulse problems and relate an increase in stopping time to a decrease in force equaling the same impulse. Students will use the square relating impulse = Ft = change in momentum = mv to solve these problems and will use forve vs time graphs to solve for the area under the curve (impulse)

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Target 3

SWBAT describe how the law of conservation of momentum affects moving objects and solve collision problems dealing with the law of conservation of momentum in 1 dimension.

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Target 4

SWBAT solve conservation of momentum problems in 2 dimensions.

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Target 5

SWBAT solve problems that must use energy and momentum such as a conical pendulum.

Note: This target should be the biggest focus of honors in this chapter, which CP will not have to do.

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Formative Assessment and Performance Opportunities

Lab Reports

Worksheets

PowerPoints with Notes

Homework and Classwork Activities

Group Activities

In Class Discussion

Do Nows and Closures

Class Polling

Observation

Summative Assessment

Unit Assessment will be created collaboratively and used for every student in the course. In addition, there will be other assessments in the form of lab reports, pen and paper tests, and quizzes.

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Accommodations/Modifications

All instruction, labs, activities, and assessments will be modified and enhanced to adhere to individual student's IEPs and 504s. As well differentiated classroom management strategies will be utilized as to adhere to these students individual plans as well.

- All instruction, labs, activities, and assessments will be modified and enhanced to adhere to individual student's IEPs and 504s. As well differentiated classroom management strategies will be utilized as to adhere to these students individual plans as well.
- Provide additional visual representations of momentum and conservation of momentum
- Provide assistance with the use of formulas for calculating energy and momentum

Unit Resources

Teacher generated PowerPoints, Notes, Labs and Worksheets

Textbooks

Resource Books

Internet Resources

Computer Based Activities

Projector

Smart Board

Calculators

21st Century Life and Careers

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP10.1	Career-ready individuals take personal ownership of their own education and career goals,

and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.

CRP.K-12.CRP12.1   Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

Interdisciplinary Connections

MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MA.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems.
MA.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
MA.A-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
LA.SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.