ALCOSS: Physics.1
Explain linear, uniform circular, and projectile motions using one- and two-dimensional vectors.

Mastered:
Students have learned simple linear motion and circular motion in one and two dimensions.

Present:
The student will use a combination of motions to describe these in real world applications such as amusement park rides.

Going Forward:
Through further research students will explore the profession of a physicist hired by an amusement park.

Present and Going Forward Vocabulary:
Linear, uniform, projectile, Centripetal force, gyroscopic inertia

Career Connections:
Physicist, Engineer, Architect, Imagineer, Rocket Scientist

Advanced Understanding & Activity (Alternate activity):

Amusement Park Designers

Most motion in real-life situations is not strictly linear or circular, but a combination of both. Combine your knowledge of linear and circular motion into the process of constructing amusement park rides. Build a working amusement park ride/roller coaster. Include an explanation of physics theories applicable to your ride and biological considerations that ensure safety for human passengers.

Teachers: Students may use a K'NEX kit if available. If you do not have a kit, they may build a 3D model or use any online program, such as Sci-Quest http://www.sciquest.org/home/just_for_kids/coaster.html.

Literature Connections/Resources:

- Alcorn, Steve. Building A Better Mouse: The Story Of The Electronic Imagineers Who Designed Epcot. http://themeperks.com ; Theme Perks Press. 2007.
- Alcorn, Steve. Theme Park Design: Behind The Scenes With An Engineer. http://themeperks.com;Theme Perks Press. 2010.
- Baine, Celeste. The Fantastical Engineer: A Thrillseeker's Guide to Careers in Theme Park Engineering. Rutson, LA; Bonamy Publishing. 2007.
- Baine, Celeste. Is There An Engineer Inside You?: A Comprehensive Guide to Career Decisions in Engineering. Belmont, CA; Professional Publ., Inc. 2004.
- The Disney Imagineers. The Imagineering Workout . Glendale, CA; Disney Editions. 2005.
- The Disney Imagineers. Walt Disney Imagineering: A Behind the Dreams Look at Making More Magic Real. Glendale, CA; Disney Editions. 2010.
- Echaore-McDavid , Susan. Career Opportunities in Engineering. New York, NY; Checkmark Books. 2006.
- Hutson, Matt. Totally Amazing Careers in Engineering. San Diego, CA; Sally Ride Science. 2007.

ALCOSS: Physics.2
Define the law of conservation of momentum

Mastered:
Students have learned how to calculate problems involving the law of conservation of momentum and the impulse-momentum theorem.

Present:
The student will create a new "ball" sport and explain how the motion of the ball obeys the law of conservation of momentum.

Going Forward:
Through further research the student will explore how the knowledge of momentum can aid CSI in determining the events in a crime scene.

Present and Going Forward Vocabulary:
Momentum, impulse

Career Connections:

Physicist, Engineer, Criminologist

Advanced Understanding & Activity (Alternate activity):

Ball Game Designers Wanted!

Use your knowledge of momentum to create a new sport. The sport must use a ball of some size. Explain the rules for playing and any other regulations that a player would need to follow. Make a video of the sport being played. Include a narration that explains how the game shows the law of conservation of momentum. You can use other students, dolls, or other objects as the players.

Literature Connections/Resources:

- Bourg, David V. Physics for Game Developers. Sebastopol, CA; O'Reilly Media. 2001.
- Daish, C.B. Learn Science through Ball Games. New York, NY; Sterling Publishing. 1972.
- Daish, C.B. The Physics of Ball Games. London, United Kingdom; Hodder 1981.
- Palmer, Grant. Physics for Game Programmers. New York, NY; Apress. 2005.

ALCOSS: Physics.3

Explain planetary motion and navigation in space in terms of Kepler's and Newton's laws.

Mastered:

Students have mastered simple applications of Kepler's and Newton's laws in terms of planetary motion.

Present:

Using several different resources on the Internet, the student will estimate the number of satellites in orbit today.

Going Forward:

Through further research the student will develop criteria for trusting a Web site's validity.

Present and Going Forward Vocabulary:

Satellite, weightlessness, man-made satellites

Career Connections:

Physicist, Astrophysicist, Engineer

Advanced Understanding & Activity (Alternate activity):

Satellite Investigations

Artificial or man-made satellites are orbiting the Earth for various reasons: forecasting the weather, transferring telephone calls over the oceans, studying the universe, and assisting in navigation. Your assignment is to estimate the number of artificial satellites in orbit around the Earth today. Provide a chart organizing the number of satellites orbiting the Earth by use. Include your total number of estimated satellites. Then provide a chart listing the number of satellites orbiting the Earth organized by countries of origin. Your resources should all come from the Internet. Provide a validity check of the Internet sources using the CARS Checklist method: Credibility, Accuracy, Reasonableness, and Support. (http://www.virtualsalt.com/evalu8it.html)

Use of Satellite	Number of Satellites

County of Origin	Number of Satellites

Literature Connections/Resources:

- Graham, Thomas, & Hanson, Keith. Spy Satellites and Other Intelligence Technologies That Changed History. Seattle, WA: University of Washington Press. 2007.
- Miller, Ron. Satellites. Breckenridge, CO: Twenty-First Century Books. 2007.

- Wikipedia: http://en.wikipedia.org/wiki/Satellite
- NASA-Earth Observatory: http://earthobservatory.nasa.gov/Features/OrbitsCatalog/
- Evaluating Internet Resources: http://www.virtualsalt.com/evalu8it.html

ALCOSS: Physics.4

Describe quantitative relationships for velocity, acceleration, force, work, power, potential energy, and kinetic energy.

Mastered:

Students have mastered force, work, and types of energy and power.

Present:

The students will combine their knowledge of energy and power to decide if a donated power generator is feasible for a remote village to use.

Going Forward:

Through further research, students will decide on additional power-generating methods.

Present and Going Forward Vocabulary:

Force, work, energy, power, kilowatt-hour, generator

Career Connections:

Electrical Engineer, Engineer, Mechanical Engineer

Advanced Understanding & Activity (Alternate activity):

A Water Cycle Problem

A remote village is in dire need of a way to purify their water. They have access to a water purifying device, but had no energy source to power it until now. A donation of a new bicycle powered generator has just arrived in the village. If an average person can generate 80 W of power while riding a bicycle, how many bicycles would be needed to generate the purifier's necessary 16.5 kW • h daily? Determine the strengths and weaknesses of this power generation method, and decide whether it would actually be useful to the village. Finally, compile your research information, comments, and any suggestions you may have in a letter to the donor.

Literature Connections/Resources:

- Chastain, Stephen. Generators and Inverters: Building Small Combined Heat and Power Systems for Remote Locations and Emergency Situations. Chastain Publishing http://stephenchastain.com/shop.html. 2006.
- DeGunther, Rik. Alternative Energy for Dummies. Indianapolis, IN; For Dummies. 2009.
- Gibilisco, Stan. Alternative Energy Demystified. Dubuque, IA; McGraw Hill Professional. 2006.
- Waslisiewicz, Marek. Alternative Energy (Essential Science).London: DK Adult. 2001.

ALCOSS: Physics.

Explain the concept of entropy as it relates to heating and cooling, using the laws of thermodynamics.

Mastered:

Students mastered how to describe entropy and how it relates to heating and cooling.

Present:

Through research of Seawater Air Conditioning (SWAC), explain why this is a positive or negative option for a new building in Hawaii.

Going Forward:

Through further research the students will discover if SWAC could ever be used for a new building in Tennessee.

Present and Going Forward Vocabulary:

Entropy, heat, cooling, Seawater Air Conditioning (SWAC)

Career Connections:

Mechanical Engineer

Advanced Understanding & Activity (Alternate activity):

Seawater Air Conditioning (SWAC)

SWAC was first made available by Makia Ocean Engineering. Students will research the company and the pros and cons of using SWAC.

Student assignment: As the head sales director of Makia, you are to create a brochure of SWAC to persuade the president of a new resort hotel in Hawaii to install SWAC instead of traditional air conditioning units. Explain the pros and cons of SWAC and possible solutions.

Literature Connections/Resources:

- Chastain, Stephen. Generators and Inverters: Building Small Combined Heat and Power Systems for Remote Locations and Emergency Situations. Chastain Publishing http://stephenchastain.com/shop.htm. 2006.
- DeGunther, Rik. Alternative Energy for Dummies. Indianapolis, IN; For Dummies. 2009.
- Gibilisco, Stan. Alternative Energy Demystified. Dubuque, IA; McGraw Hill Professional. 2006.
- Waslisiewicz, Marek. Alternative Energy (Essential Science). London: DK Adult. 2001.

ALCOSS: Physics.6

Describe wave behavior in terms of reflection, refraction, diffraction, constructive and destructive wave interference, and the Doppler effect.

Mastered:

Student has mastered basic wave behavior in light and sound.

Present:

The student will research noise regulations and soundproofing options for new buildings.

Going Forward:

Through further research the student will investigate the health risks of prolonged exposure to loud noises.

Present and Going Forward Vocabulary:

Sound wave, Doppler effect, regulations, decibel

Career Connections:

Architect, Engineer

Advanced Understanding & Activity (Alternate activity):

Airports, Schools, and Noise, Oh My!

A new school is being built but the location has not been decided. One possible site is very cheap but near a busy airport. Research the following points:

1. Noise regulations in your state and community,
2. How far from the airport would the school need to be built to make the sound manageable, and
3. What are the options and costs of soundproofing the school buildings?

State your results in a letter to the superintendent of the school system using the information from the three areas. State whether the school should be built on this location. Support your statement using the information from your research. Cite your sources. Be sure to include the options and costs of soundproofing the school.

Literature Connections/Resources:

- Wikipedia: http://en.wikipedia.org/wiki/Soundproofing
- Soundproofing Company, Inc.: http://www.soundproofingcompany.com/library/articles/what_is_sound/

ALCOSS: Physics.7
Describe properties of reflection, refraction, and diffraction.

Mastered:
Student has demonstrated the path of light through mirrors, lenses, and prisms.

Present:
Research fiber optics to describe how they are used in everyday life.

Going Forward:
Through further research students will explore new and/or upcoming uses for fiber optics.

Present and Going Forward Vocabulary:
Reflection, refraction, diffraction, fiber optics

Career Connections:
Electrical Engineer, Engineer, Physicist

Advanced Understanding & Activity (Alternate activity):

RAFT (Student page found in Appendix A)

Students will research and write a paper on fiber optics based on their RAFT choices. "R" will tell you the role that you are taking in writing the paper. "A" will let you know who your audience is. "F" tells you the format in which you should write the paper. "T" tells you the specific topic on which to write. Students will choose one row. They will write about the TOPIC from the perspective of the ROLE to the AUDIENCE using the FORMAT. You can allow students to choose one item from each of the four columns. Provide an audience for the student to present their product. Students may need to plan their product using the organizational tool, Project Planner.

ROLE	AUDIENCE	FORMAT	TOPIC
Doctor	Patient	Diagram	Exploring Fiber Optics in Exploratory Surgery
Fiber	DirecTV	Persuasive letter	Down With Satellites, Up With Fiber Optic!
Telephone company	Potential Customers	Newspaper Ad	Fiber Optics: A Sound Choice For Your Phone!
David Letterman	Educated adults	Late Night Top 10 List	Future Uses For Fiber Optics

Literature Connections/Resources:
- Wikipedia-Optical Fiber: http://en.wikipedia.org/wiki/Optical_fiber
- Wikipedia-Fiber-optic Communication: http://en.wikipedia.org/wiki/Fiber-optic_communication
- How Stuff Works: http://communication.howstuffworks.com/fiber-optic-communications/fiber-optic.htm

ALCOSS: Physics.8
Summarize similarities in the calculation of electrical, magnetic, and gravitational forces between objects.

Mastered:
Students have mastered basic calculations involving electrical, magnetic, and gravitational forces.

Present:
Students will research electrical, magnetic, and gravitational forces, in depth, based on their choices on the TIC-TAC-TOE.

Going Forward:
Through further research students will discover what, if any, health hazards exist because of extremely low frequency (ELF).

Present and Going Forward Vocabulary:
Electrical force, magnetic force, gravitational force, maglev trains, *Aquaspirillum* bacteria, Magnetotacticum bacteria

Career Connections:
Electrical Engineer

Advanced Understanding & Activity (Alternate activity):

TIC-TAC-TOE (Student page found in Appendix A)

Students will use a tic-tac-toe graphic organizer to learn more about electrical, magnetic, and gravitational forces between objects. There are three electrical choices, three magnetic choices, and three gravitational choices. Choose one from each column to make a tic-tac-toe. You must choose one from each of the three types of forces: electrical, magnetic, and gravitational. Students will choose three activities in a row, column, or diagonal, just like TIC-TAC-TOE. Students may need to plan their product using the organizational tool, Project Planner.

Electrical	**Magnetic**	**Gravitational**
1. Why would the force between a sodium ion and a water molecule be weaker than that between the same ion and a chloride ion the same distance away? Explain your answer in a written document, video, Prezi, or podcast.	2. The Chinese were the first to use magnets to help in navigation. Describe their first compass. How did it look? How did it work? Present your findings in a PowerPoint, written document, or video.	3. You are an astronaut orbiting Earth in a space shuttle. How would you go about "dropping" an object down to Earth? Create a blueprint, written document or video to share your results.
4. Gravitational forces are smaller in comparison to electrical forces between charges. Explain why we can sense gravitational exchanges with Earth, but we cannot sense electrical forces between us and our environment.	5. Explore the bacteria *Aquaspirillum* and Magnetotacticum. Some scientists believe that homing pigeons have these bacteria in their brains. How would this explain the pigeon's sense of direction? Explain this homing ability in a written document, video, Prezi, or Photo Story.	6. When in space an astronaut's face may appear puffy from excess fluids. Explain this phenomena in a written document, video, Prezi, or Photo Story.
7. Develop a theory as to why television screens seem to get dusty more rapidly than other surfaces. You can use Prezi, PowerPoint, or Word to develop your and present your theory.	8. Research "maglev trains." How do they work? What countries currently have a working maglev train? Present your findings in a PowerPoint, written document, or video. Include a map illustrating the locations of maglev trains.	9. Henry Cavendish found the value for "G." What kept Sir Isaac Newton from making this calculation? Present your findings in a PowerPoint, written document, or video.

Literature Connections/Resources:
- How Stuff Works-Maglev trains: http://science.howstuffworks.com/transport/engines-equipment/maglev-train.htm
- Magnetotaxis in Bacteria: http://www.calpoly.edu/~rfrankel/magbac101.html

ALCOSS: Physics.9
Describe quantitative relationships among charge, current, electrical potential energy, potential difference, resistance, and electrical power for simple series, parallel, or combination direct current (DC) circuits.

Mastered:
Student has mastered simple concepts regarding electricity.

Present:
The student will construct a working circuit using an online simulations program.

Going Forward:
Through further research, students will explore Edison's development of the system for distributing electrical power.

Present and Going Forward Vocabulary:
Alternating current, direct current, resistance, conductivity, series circuit, parallel circuit, voltmeter, ammeter, fuse

Career Connections:
Electrical Engineer

Advanced Understanding & Activity (Alternate activity):

Students will construct a working circuit using the following Web site:
http://phet.colorado.edu/en/simulations/category/physics/electricity-magnets-and-circuits
There are several applications to from which to choose on this page. A good one for reviewing many concepts is Circuit Construction Kit (AC+DC).
After constructing the working circuit, write several paragraphs explaining what the circuit is and how you created and closed it.

Literature Connections/Resources:

- How Stuff Works: http://science.howstuffworks.com/environmental/energy/circuit.htm
- Energy Story: http://www.energyquest.ca.gov/story/chapter04.html