RIALTO UNIFIED SCHOOL DISTRICT
CURRICULUM PROPOSAL

Name of Course:	Integrated Science 3 (APEX)	Grade Level(s):	11-12

Brief Course Description:

Integrated Science 3 is the last of three year integrated science course. It was designed telling the story of energy and using the APEX NGSS Libraries of Biology, Physics, Chemistry, and Earth and Spatial Sciences. In this course students will explore energy in the world of physics, chemistry, biology and earth and space sciences. The interconnectivity of energy in these worlds will be examined. From kinetic and potential energy in physics, energy will be examined in atoms in terms of atomic and sub-atomic energy, in light and electromagnetism examining particles both as matter and waves. The implication of energy in the biological world with the importance of the oxygen, carbon and nitrogen cycles in the natural world and how these cycles can contribute to harming mankind and the universe. Sustaining our energy and thereby sustaining our universe will also be discussed.

Proposed By:	Ed D'Souza/ Juanita Chan	School:	Educational Services	Date:	4/20/2020

The Following is Proposed for this Course:

☒	Addition	☐	Revision	☒	A – G "D" area	☐	Deletion
☒	Required Course	☐	Content	☐	Honors	☐	Name of Course
☐	Elective	☐	Name Change	☐	Career Tech. Ed.		

The Following *Maximum* Credits are Proposed for this Course:

10	Units of Credit in (Subject Area):	**Integrated Science- Yr 3**	or in:

The Following Schools will Offer this Course:

☒ Carter High	☒ Eisenhower High	☒ Rialto High	☒ Milor/Zupanic

The Proposed Course will have the Following Budget Implication:

Individual School Site:	
District Level:	
Total Estimated Cost:	

Approval Signatures for the Proposed Course:

Printed Name	Signature	Title	Yes/No	Date
Lance Atkinson		Submitting School Department Chair	☒ Yes ☐ No	4/28/2020
Dr. Greg Anderson		Carter High School Principal	☒ Yes ☐ No	5/14/2020
Frank Camacho		Eisenhower High School Principal	☒ Yes ☐ No	5/14/2020
Dr. Caroline Sweeney		Rialto High School Principal	☒ Yes ☐ No	5/14/2020
Kayla Griffin		Milor/Zupanic High School Principal	☒ Yes ☐ No	5/14/2020
Ed D'Souza/ Juanita Chan (Science Chair)		District Curriculum Committee Chair	☒ Yes ☐ No	5/14/2020
Dr. Patricia Chavez		Curriculum Council Chair	☒ Yes ☐ No	5/14/2020

Approved by Juanita Chan/ Ed D'Souza Curriculum Committee on (Date) 4/28/2020

Approved by Curriculum Council on (Date): 5/14/2020

Approved by Rialto Unified School Board on (Date): 06/10/20

Approved by UC (or N/A) on (Date):

Integrated Science 3

Rialto Unified School District

Submitted: May 12, 2020
Decision: Pending

⚠ Pending UC review

asic Course Information

hool(s) Offering This Course:

School Name	Course Learning Environment	Transcript Code(s)	
isenhower High School (052622)	Online	Abbreviation APEXIN3	Course Code
ialto High School (052629)	Online	Abbreviation APEXIN3	Course Code
r. John H. Milor High School (052642)	Online	Abbreviation APEXIN3	Course Code
Vilmer Carter High School (053855)	Online	Abbreviation APEXIN3	Course Code

Title:	Integrated Science 3
Length of course:	Full Year
Subject area:	Science (D) / Integrated Science 3
UC honors designation?	No
Prerequisites:	Integrated Science 1 (Recommended) Integrated Science 2 (Recommended) The Living Earth (Recommended) Chemistry in Earth Systems (Recommended)
Co-requisites:	Math 1 or Math 2 (Recommended)
Integrated (Academics / CTE)?	No

Grade levels: 11th, 12th

ourse Description

urse overview:

Integrated Science 3 is the last of three year integrated science course is online customized course using APEX Science Libraries. The labs are done in a classroom setting. In this course students will explore energy in the world of physics, chemistry, biology and earth and space sciences. The inter-connectivity of energy in these worlds will be examined. From kinetic and potential energy in physics to the energy of atomic and sub-atomic particles, in light and electromagnetism examining particles both as matter and waves. The implication of energy in the biological world with the importance of the oxygen, carbon and nitrogen cycles in the natural world and how upsetting these cycles can contribute to harming mankind and the universe. Sustaining our energy and thereby sustaining our universe will also be discussed.

urse content:

Unit 1: Crash Into Me!

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This unit is on momentum, work, and energy. Students will be able to determine the momentum of vehicles involved in a collision, know how work affects changes in a vehicle's velocity and energy, figure out a vehicle's stopping distance using the work-energy theorem.

Unit Assignment(s):

When people talk about conserving energy, what they really mean is to reduce our use of limited energy sources like coal, oil, and natural gas. When these sources are converted to types of energy, such as electrical, to run our appliances, much of it is also converted to energy that isn't as useful (and can even be harmful), like thermal energy (heat). Keep the law of conservation of energy in mind as you discuss the following question.

There's a limited amount of fossil fuels (our main source of energy for powering our appliances and cars) on Earth. Why? What's an example of a "renewable" energy source, and why is it considered "renewable"?

Unit Lab Activities:

Losing My Marbles

How do the mass and number of objects affect a collision? Specifically, does the mass of the marbles in a collision affect the outcome? Does the number of marbles in a collision affect the outcome?

Prediction: Make a prediction as to the effect the mass of the marbles used will have on the nature of the collision between them. Explain your answer.

Make a second prediction as to whether or not the number of marbles in a collision affects the outcome of the collision. Be sure to explain your answer.

Materials used in this virtual lab: Five small marbles, two large marbles, two meter sticks

Observations: Record your observations. Use clear terms to describe what you see in the collision. For example, the larger marble seemed to continue on its path without slowing down much while the small marble gained a lot of speed. Make a table with 2 columns, using the following headings: **Marbles used and Description of the Collision**. These are the collisions you need to try: Collision 1: two small marbles, Collision 1: two large marbles, Collision 2: large target marble and small shooter marble, Collision 3: small target marble and large shooter marbles, Collision 4: five small marbles, Collision 5: two small marbles at opposite ends , Collision 6: two large marbles at opposite ends, Collision 7: one small marble and one large marble at opposite ends,

Answer the following questions after you have completed the observation chart.

1. Which collisions showed the shooter marble changing directions?
2. How did the mass of the shooter marble compare with the mass of the target marble in the collisions where the shooter marble changed directions?
3. Explain how momentum was conserved in your choice of two of these collisions. Collision #1 & Collision #2

Summary

How close were your predictions to what you observed? For each prediction, give specific examples that either support or give evidence against your initial prediction.

Unit 2: Electricity and Matter

In this unit students determine the force between two electric charges and learn how to use the right-hand rule to determine the direction of an electric force. They learn the difference between an electric field; potential energy; potential difference; and capacitance; and learn how to perform calculations on electrical systems using these concepts.

They learn how to build series and parallel circuits and learn about relationships between current; voltage; resistance and power and learn how to solve problems using Ohm's law and how to calculate energy dissipation in a resistor. Finally they learn about the properties of magnetic fields and learn how magnetic fields produce electric fields, and vice versa; and also learn about the properties of electromagnetic waves.

Designing A Circuit

Series Circuit with Two Resistors, Designed in Terms of Resistance

Design and construct a circuit that has two resistors connected in series. Given that you have a 20 V battery, choose resistors that will produce a current of 0.2 A. Record the resistance.
Connect a wire to a resistor using an alligator clip. Connect a second wire to the other side of the resistor, and connect another resistor to the other end of the second wire. Connect a third wire to the other side of the second resistor. You should have a single line consisting of three wires and two resistors, as shown below

Now connect one end of the line to the high potential (positive) side of the power source, using an alligator clip or electrical tape, and connect the other end to the low potential (negative) side of the power source. Turn on the power source to start current flow in the circuit. CAUTION: Do not touch any elements of the circuit once the circuit is connected to both sides of the power source. When you have finished using this circuit, use insulated tweezers to remove the wire from the power source.

Using the ammeter and voltmeter, determine the current through and voltage drop across each resistor by touching leads to the wires before and after each individual resistor. Record the values. Use a resistance multimeter to check the resistance of each resistor and confirm it matches the resistance selected.

Unit Assignment(s):

Circuits in Your Home and School

An electrical circuit is a loop of material through which electricity flows. The circuit can be as simple as a lamp plugged into an outlet: The outlet is the power source, and the lamp is the resistor. (Remember, a resistor is any device that draws electricity). This type of circuit is called a series circuit, because it has only one loop (from the outlet to the lamp and back again). A series circuit can include multiple resistors, such as multiple holiday lights connected to each other, but the entire circuit must consist of only one loop.

Another type of circuit is a parallel circuit. In this type of circuit, multiple loops are present. Imagine that you plug a power strip into an outlet and then plug two lamps into the power strip. Each lamp consists of one circuit, but they both use the same power source. They are parallel with each other.

List five parallel circuits you use at home or school, including the item or items that cause resistance.
(***Hint: Look at power strips that have more than one device plugged into them. These circuits are parallel.)***

Unit Lab Activities:

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Unit 3: Waves

In this unit students will learn about different types of waves; about properties of waves; and about how waves move; learn how to solve problems involving wave speed; frequency; and wavelength. The importance of how waves interact with media and with other waves we studied. The differences between constructive and deconstructive interference will be examined. Properties of sound waves; about the Doppler effect with respect to sound waves; and about practical applications of sound waves in technology and engineering will be examined.

Students will learn about the regions of the electromagnetic spectrum and how electromagnetic waves travel. They will solve problems involving electromagnetic wave speed; frequency; and wavelength; learn about engineering applications of electromagnetic waves.

Finally, the will learn how to draw and interpret ray diagrams; learn about the process of image formation and learn how light reflects and refracts.

Unit Assignment(s):

Sounds You Hear

Sound waves are longitudinal waves that occur when something vibrates. In the case of a musical instrument such as a guitar, the guitar strings vibrate and produce sound. Sound can vary in its pitch or volume. Pitch depends on frequency. The higher the frequency, the higher the pitch. For instance, high notes on a piano have sound waves with a higher frequency than low notes on a piano. Volume depends on amplitude. The greater the amplitude of a sound wave, the louder the sound. Bang hard on a piano key, and you produce a sound wave that has a large amplitude. List five objects in your daily life that produce sounds with a high pitch and five that produce sounds with a low pitch.

Remember, frequency is related to pitch, which is the quality of how high or low a sound is. The higher the frequency, the higher the pitch. The lower the frequency, the lower the pitch.

Unit Lab Activities:

Optics

In this lab, students will investigate the relationship between the focal lengths of a mirror and lens and the type of image that is generated.

Students will investigate the image from a lens when the lens is placed between the light source and the screen on an optics bench, and the light source is at a distance greater than 2f from the lens. They will measure the height of the light

source (object- h_o) and record the distance between the lens and the light source (d_o). Using the lens equation and the given focal length they will calculate the distance from the lens to the image (d_i) and the height of the image (h_i), using the object, distance, focal length formula and the objective distance, image distance proportion versus object height versus image height formula.

They will repeat this experiment where the object distance is exactly at 2f and finally where the object distance is between f and 2f and examine the image produced in each case.

Unit 4: Modern Physics

Unit 4: Modern Physics

Modern Physics is the physics of the 20th century. The main building blocks, the **theory of relativity** and **quantum mechanics**, were developed early in that century. Students will learn about Albert Einstein's general theory of relativity, the "most beautiful of theories." They will learn about quantum mechanics, where the most baffling aspects of modern physics lurk and the cosmos: the architecture of the universe that we inhabit and about nuclear forces and fusion and fission. They will learn about atomic physics and quantization and about the dual nature of light and key experiments that led to the current understanding of the nature of light and learn about the concept of quantization. Finally, they will learn, the importance of the concept of relativity and the difference between general and special relativity; and about the connection between Newton's laws and Einstein's special theory of relativity; and learn about the difference between quantum and Newtonian mechanics and about the development of the big bang theory.

Task

What Do You Think about the Big Bang?

The big bang theory is the idea that the universe began as a single point and has been expanding ever since. It is the most widely accepted scientific explanation of the origin of the universe. It's mind-boggling to imagine the size of the universe. Almost 14 billion years ago, the universe started out as an unimaginably tiny, dense ball of energy. According to the big bang theory, this tiny ball of energy expanded, similar to a balloon inflating. In one-millionth of a second, it grew to the size of our solar system, and some of its energy was converted to matter. After just 1 second, it grew to 1000 times the size of our solar system. Since then, it has continued expanding. Right now, it is 43 trillion times the size of our solar system, and its expansion is actually accelerating.

Some people dismiss this explanation of the formation of the universe, saying that the big bang theory is "just a theory." However, a theory is based on large amounts of scientific evidence, and it is not just a guess. Theories are consistent with observations of nature. They also can be used to predict natural events. Unlike a hypothesis, a theory may not be directly testable. But, like a hypothesis, a theory can be changed as scientists make new discoveries.

What do you think of the big bang theory

Unit Assignment(s):

What Do You Think about the Big Bang?

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Unit Lab Activities:

Lab

Radioactive Decay of Pennies

In this experiment, pennies that are placed heads-up will represent unstable, radioactive atoms (atoms that have not yet decayed). Pennies that are placed tails-up will represent stable atoms (atoms that have already decayed).

1. Place 200 pennies heads-up in the bottom of the plastic box. Record the number of pennies in the box that are unstable (heads-up) and the number that are stable (tails-up) in data table 1, in the row for *0 half-lives passed.*
2. Place the top on the box and shake the box vigorously for a few seconds. Remove the top. Count and remove all pennies that are now stable (tails-up). Record the number of unstable (heads-up) and stable (tails-up) pennies in a data table, in the row for *1 half-life passed.* Remove all stable (tails-up) pennies from the box and set them aside.
3. Repeat step 3 nine more times, counting and removing all pennies that become stable (tails-up) each time. Record your data in a data table
4. Use a computer to graph the data. Follow instructions in the graphing software package or from your teacher in order to make the graphs. Plot the number of half-lives on the *x*-axis and the number of unstable (heads-up) pennies on the *y*-axis.

Analyze

- What happens to the number of unstable pennies as the number of half-lives increases?
- Approximately what percentage of pennies were removed after each half-life? Why do you think this was the case?
- What does the shaking of the pennies represent? Would the amount of time spent shaking the pennies affect your data?

Draw Conclusions

- Imagine that you repeat experiment 1 with a sample of 500 pennies. About how many pennies would be unstable after 3 half-lives?
- Does the number of shakes in experiment 2 represent the number of half-lives that have passed? Why or why not?
- Let each shake of the pennies represent 1 year. What is the half-life, in years, for the pennies in the experiment?

Unit 5: Where is Earth?

In this unit students will explore the universe and Earth's position within it. Examine the events that led to the formation of the universe. Discover the Big Bang theory and learn about what evidence is used to support it. The Milky Way is only one of many galaxies. Learn about the different types of galaxies in the universe. E xplore the life cycle of stars. Learn about why the size of a star influences how it dies. Explore solar-system formation using our solar system as an example. Learn about comets and asteroids and how they are formed. Examine the structure of the sun and learn about its energy. Analyze similarities and differences among Mercury, Venus, Mars, Earth and Jupiter, Saturn, Neptune, Uranus, and the Gas Planets and Pluto. Then discover how Earth's movements affect conditions on the planet and why life is able to survive on Earth. Finally, how the moon came into being and how it influences the Earth.

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Unit Assignment(s):

Choose a Planet

The Earth is a cradle of the mind, but one cannot live in a cradle forever.
— Konstantin E. Tsiolkovsky*, father of Russian astronautics (1896)

Choose a planet other than Earth, and ponder what it would be like to live there. Create a newspaper article, real estate advertisement, or letter to share your thoughts. Regardless of which planet you choose, one thing is for sure — it would be very, very different from Earth.

Unit Lab Activities:

Exploring Orbits

In 1609, German mathematician and astronomer Johannes Kepler deciphered a major puzzle of the solar system. The strange back-and-forth movement of planets in the sky were nearly impossible to predict until Kepler figured out the true shape of planetary orbits around the sun. Orbits always had been believed to be circular, but Kepler used mathematics to discover they actually are elliptical.

An ellipse is an oval characterized by certain quantities. The first quantity is the width of the ellipse, called the major axis. The second quantity is called eccentricity, a measure of how stretched out the ellipse is. Eccentricity is defined by the distance between two mathematically determined points within an ellipse, called foci.

For planets, one focus of their orbital ellipse is the sun; the other is an empty point in space. The orbit of each planet is an ellipse, but each planet's elliptical orbit has different major axes and eccentricities. Once Kepler understood the proper nature of orbits, the movement of planets in the sky could be predicted with precision.

In this investigation, you will draw ellipses, calculate their eccentricities, observe an interesting property of ellipses, and compare the ellipses you draw with the orbital eccentricities of Earth and other planets in the solar system.

What do the elliptical orbits of the planets look like?

- Read the entire investigation. Then work with a partner to answer the following questions.
- Each planet's orbit is shaped like an ellipse. Predict whether the shapes of the planet's orbits will be more circular or more elongated.
- What is the one thing that the elliptical orbits of all planets, asteroids, and most comets have in common?

- What is the independent variable for the ellipses you will draw?
- What are the dependent variables for the ellipses you will draw?

Unit 6: Energy

Students will learn about the four fundamental forces and how the strengths of the different forces vary with distance. They will learn how to calculate the kinetic energy of a moving object and the potential energy of a system; and learn how temperature is related to the kinetic energy of molecules. They will explore how energy transforms and is conserved in simple and complex systems; and learn how to perform calculations that illustrate the law of conservation of energy.

Students will also learn how to differentiate between energy and work and between work and power. They will calculate work done and power produced in simple systems. They will learn about different types of simple machines and calculate their mechanical advantage and work done. They then analyze the advantages and disadvantages of different energy sources and earn how to apply scientific reasoning to analyze socially relevant energy issues.

1.

Unit Assignment(s):

Energy and You

The law of conservation of energy says that it is impossible to create or destroy energy. This means that the amount of energy you start with equals the amount of energy you end up with, except that the final energy might be in a different form. Take a lightbulb, for instance. Before you turn on your light, there is electrical energy waiting to be tapped in the wire. After you flip the switch, the electrical energy transforms into light energy.

Different kinds of energy include light, heat, sound, chemical, kinetic, nuclear, and gravitational potential energy. Chemical energy can come from things like batteries, gasoline, and natural gas. Nuclear energy is the type of energy created in the Sun. What kinds of energy transformations do you see around you?

Identify five more types of energy transformations that you see at home, at school, or outdoors. Make sure to name the action, such as turning on a light, as well as the two types of energy involved. Remember, for energy to be transformed, the type of energy before and after a task must be different.

(A*s you look around you, make note of technology that is turned on and off. This indicates that some sort of energy is present before the switch is flipped. Also look at objects that move from one height to another, because that will involve kinetic and gravitational potential energy. Finally, look for actions that involve changes in temperature, sound, and light. Often these actions mean that energy is being transformed.)*

Unit Lab Activities:

Conservation of Energy

Using a dynamic ramp and a photogate sail and keeping the angle of the ramp constant, students will determine the final velocity of a cart as they increase the mass of the cart by small increments. Keeping the mass of the cart stable they will repeat the lab but now decreasing the height of the ramp, they will measure the final velocity of the cart as it goes down the ramp. They will record their findings and then answer the following questions based on their data:

1. What happened to the final velocity (v_f) of the cart as you increased the mass in the cart? Was there any pattern to your results?
2. What happened to the final velocity (v_f) of the cart as you decreased the starting height of the cart? Was there any pattern to your results?
3. How does the gravitational potential energy of the cart at the top of the ramp compare with the kinetic energy of the cart at the bottom of the ramp?
4. What does the percent difference between *GPE* and *KE* tell you about the efficiency of energy transformations in this experiment?
5. Into what form(s) of energy do you think the original gravitational potential energy was transformed? How was this energy transformed?

Unit 7: Thermodynamics

In this unit students will learn about the first and second laws of thermodynamics and how to apply them and learn about differences between open, closed, and isolated systems. They will learn how energy is connected and will be able to compare and contrast the difference between enthalpy and entropy, the difference between exothermic and endothermic reactions and learn how to draw a potential energy diagram for a chemical reaction.

They will apply what they have learned to examine heat flow and how work is done in a heat engine and what factors affect its efficiency. Finally, they will apply this knowledge to solve problems using specific heat capacity, latent heat values, and to determine the final temperature when two objects of different temperatures are in contact.

Unit Assignment(s):

Endothermic and Exothermic Reactions

You're on a camping trip with some friends, and it's time to roast marshmallows. First you help gather firewood and start a fire. When the fire is ready, everyone grabs a marshmallow, spears it on a stick, and holds it over the flames until it turns a delicious golden brown.

- Can you explain the two different kinds of chemical reactions that are taking place on this camping trip?
- What kinds of endothermic and exothermic reactions do you see around you? Can you identify at least three examples of both types?

Unit Lab Activities:

Lab: **Thermodynamics**

In this lab, students will investigate how heat is transferred from one material to another.

1. **Heat Transfer from Liquid to Liquid**
2. **Heat Transfer from Solid to Liquid**
3. **Heat Transfer from Solid to Gas**

Students will use a computer to measure the real-time temperature from two temperature probes. They will perform a normal calorimeter experiment pouring water from the two beakers of water into the calorimeter. They will take perform the experiment three times: **1.Heat Transfer from liquid to liquid**

- Equal volume of water in each beaker, one at a hotter temperature and one at room temperature
- Unequal volume of water in each beaker, where the volume of the hotter water is more than the volume of the water at room temperature
- Unequal volume of water in each beaker, where the volume of the hotter water is less than the volume of the water at room temperature
- Using the equation $Q = mc\Delta T$and the fact that $Q_{lost} + Q_{gained} = 0$. (The specific heat capacity (c) of water is 4.18 J/g·°C.) They will calculate the resulting temperature and also measure the temperature they measured on their thermometer.
- What happened to the temperature of the cold water when you mixed it with the warm water?

2.Heat Transfer From Solid to Liquid

Repeat the same experiment now filling the beaker with a certain volume of water at room temperature, emptying it in the calorimeter and adding a block of hot mystery metal. After measuring the temperature of both the liquid and the solid, use the equations above to calculate the specific heat of the metal. Can you predict the type of metal being tested?

- What happened to temperature of the water at room temperature when you placed the warm metal block in it?

3. Heat Transfer From Solid to Gas

Repeat the same experiment now ensuring the calorimeter is absolutely dry. Heat the beaker of water with a solid block of steel in it until it reaches 60°C. Also measure the temperature of the dry calorimeter. Now add the steel block to the empty calorimeter and measure the temperature after it remains stable. Can you determine the temperature that the air in the calorimeter reaches?

- How did your calculated final temperature compare with the actual temperature of the air-metal mixture?
- Based on your observations of heat transfer through different states of matter, how would you create an efficient system of heat transfer?

Unit 8: Transferring Energy

This unit returns to transferring energy using a chemistry lens. Students will learn about thermal energy and heat flow and will continue to calculate heat using the specific heat of various substances. They will learn about heat transfer in chemical reactions, about energy storage in chemical bonds, and about the enthalpy of reaction and the enthalpy of formation. They will calculate enthalpy using Hess's law and learn about entropy and its relationship to physical and chemical changes.

Unit Assignment(s):

Heat Transfer Around You

Imagine you have just baked a pizza in the oven. You've only let it cool for a minute, but you're hungry and you want to take a bite. To minimize your chances of burning your mouth, should you take a bite with a lot of sauce on it or a bite near the crust that contains very little sauce? Explain your answer based on what you have learned about thermal energy and specific heat capacity. (*Think about how the specific heat capacity of the watery sauce compares with that of the much drier pizza crust.)*

Unit Lab Activities:

Lab

Heats of Reaction

In this lab students will understand: (1) the heat of reactions (2) Observe an endothermic reaction and (3) Observe an exothermic reaction

Some chemical reactions absorb energy. In these reactions, energy is required in order for the reaction to take place. Most other chemical reactions release energy. This could be in the form of heat, light, and/or sound. Enthalpy of a reaction is the amount of energy or heat absorbed or released in a reaction. If energy is required, this is a positive number and the reaction is endothermic (endo = in). If energy is released, this is a negative number and the reaction is exothermic (exo = out). Photosynthesis is an example of an endothermic chemical reaction. Sunlight is the energy source used to cause the reaction to take place. Burning of hydrocarbons like wood, oil, gasoline, and food are common examples of exothermic reactions.

In these experiments, students will experiment with two reactions.

The first reaction is between baking soda and vinegar. Through experimentation, they will determine if the reaction is endothermic or exothermic and because of the method used, they will be able to quantify the enthalpy of the reaction.

- Calculate the approximate enthalpy of the reaction in joules.
- Estimate that 1.0 mL of vinegar has the same thermal mass as 1.0 mL of water. Ignore the thermal mass of the sodium bicarbonate. Note: It takes about 4.2 joules (J) to change 1.0 gram (1.0 mL) of water 1.0 °C. 2. Is the reaction endothermic or exothermic?
- What steps could be taken to improve the accuracy of your results?

The second reaction will be using iron and vinegar. The chemistry of iron is more complex than the chemistry of most other metals.

- Did the temperature go up or down? How much?
- Is this an exothermic or endothermic reaction?
- Think of some other chemical reactions. List them and the type of reaction: exothermic or endothermic. Example: Burning coal – exothermic

Unit 9: Quantum and Nuclear Chemistry

In this unit students will study light as a wave and as a particle. They will learn about frequency, wavelength, velocity, and energy of light waves, and about the electromagnetic spectrum and also about the quantization of light and electrons. They will revisit the structure of the nucleus, and the forces that act within the nucleus and examine reactions such as fission and fusion reactions, and about half-lives and radioactive decay.

Unit Assignment(s):

Reflecting on Quantum Mechanics and Nuclear Structure

You learned that waves in the ocean, sound waves, and light waves all have certain things in common. They all carry energy. The velocity, frequency, and wavelength of each is connected by the same equation. Which type of wave would you most want to learn more about? Why does it interest you? What would you want to find out about it? Write your answers in 2-3 paragraphs.

Unit Lab Activities:

Radioactivity and Radiation

You are surrounded by various types of radiation. Radiation from the sun and even from outer space is constantly entering the Earth's atmosphere. Luckily, most of it is absorbed in the atmosphere and only a fraction reaches the surface of the Earth.

Certain types of rock, such as granite, are also naturally radioactive and produce types of radiation. This radiation is caused by the radioactive decay of unstable elements that make up the rock. If you had a device called a Geiger counter, you could measure how much radiation they emit.

A radioactive material is an element that is unstable and emits a particle or ray of energy from its nucleus in an attempt to become stable. Radiation is what the element emits. A half-life is the amount of time over which the radioactive element changes half of itself. Some unstable elements emit the radiation quickly, meaning they have short half-lives, and some emit over a long time, or have long half-lives. Whether for a short or long half-life, the process of emitting radiation is a very random. However, a very large number of random events can become predictable. That is where half-life enters. Sometimes the product of radioactive decay, called a daughter product, is unstable and radioactive. In fact, there can be an entire series of radioactive decays before a stable product is found.

In this experiment, you will model radioactive decay of an unstable element. You will collect data to determine the model element's half-life and that of its radioactive product. You will be given 50 small cubes (dice), 50 small spheres, a foam cup (8 oz) , 50 dimes (or pennies), graph paper and lab goggles.

This experiment is a simulation of a radioactive event where the daughter product is also radioactive. The dimes represent the radioactive parent, and the cubes represent the radioactive daughter. Since the above two objects have a different number of sides, they simulate different half-lives. The spheres represent a stable end product.

Procedure:

Look at the cubes and observe that they have dots on six sides. The side with two dots will indicate the cube has experienced radioactive decay.

- Count out 50 dimes and place them in the cup.

- Holding one hand over the cup, shake the cup and pour the dimes onto the table.
- Count and remove the dimes that landed with the heads side facing up. Replace those with a cube. Record the number of dimes remaining and the number of cubes.
- Repeat Procedures 2 and 3, but also remove all cubes that land with the two dots side up and replace them with a sphere. Note: Make sure you have a total of 50 items, whether dimes, cubes, or spheres, to represent atoms.
- Do the above procedures for a total of 20 trials and record your findings.

Use your graph paper to plot a graph of the number of remaining dimes versus the number of throws (trial number)

1. What is the half-life of the dimes according to the graph? (The half-life will be indicated by the number of throws.)
2. Since the chance of a dime "decaying" is one in two, what is its theoretical half-life?
3. How does this graph simulate a decay graph of a radioactive substance?

On the same graph, use a different color and plot the number of remaining cubes versus the number of throws. Staring with 50 cubes, redo the experiment, replacing cubes with spheres when the cube lands on 2 dots. Stop after 10 trials. Record and graph the results.

4. From the graph, what is the half-life of the cubes?
5. How does this graph simulate the behavior of a radioactive daughter product?

On the same graph, use a third color to plot the number of spheres versus the number of throws.

6. How does this graph simulate the behavior of a stable product?

Unit 10: Earth's Resources

Unit 10: Earth's Resources

In this unit students will learn about the cycles of water and oxygen in the atmosphere and the importance of these cycles to the preservation of life. They will learn how humans have changed the natural balance of the carbon cycle because of the use of coal, oil, and natural gas to supply our energy demands. Fossil fuels are a sink for CO_2 when they form but they are a source for CO_2 when they are burned. Trees naturally absorb CO_2 while they are alive. Trees that are cut down lose their ability to absorb CO_2. Also important is nitrogen which is one of the most abundant gases on the earth. Plants and animals could not live without nitrogen. It is an important part of many cells (https://www.ducksters.com/science/the_cell.php) and processes such as amino acids, proteins (https://www.ducksters.com/science/biology/proteins_and_amino_acids.php), and even our DNA (https://www.ducksters.com/science/biology/dna.php). It is also needed to make chlorophyll in plants, which plants use in photosynthesis to make their food and energy. Unfortunately, human activity has altered the cycle. We do this by adding nitrogen into the soil with fertilizer as well as other activities that put more nitrous oxide gas into the atmosphere. This adds in more nitrogen than is needed by normal cycle and upsets the cycle's balance.

Most of the human activities responsible for the increase in global nitrogen are local in scale, from the production and use of nitrogen fertilizers to the burning of fossil fuels in automobiles, power generation plants, and industries. However, human activities have not only increased the supply, but also boosted the global movement of various forms of nitrogen through air and water. Because of this increased mobility, excess nitrogen from human activities has serious and long-term environmental consequences for large regions of the Earth. More people require more resources, which means that as the population increases, the Earth's resources deplete more rapidly. The result of this depletion is deforestation and loss of biodiversity as humans strip the Earth of resources to accommodate rising population numbers. Population growth also results in increased greenhouse gases, mostly from CO_2 emissions. For visualization, during that same 20th century that saw fourfold population growth, CO_2 emissions increased twelvefold. As greenhouse gases increase, so do climate

patterns, ultimately resulting in the long-term pattern called climate change. Acid rain is a result of air pollution. When any type of fuel is burnt, lots of different chemicals are produced. The smoke that comes from a fire or the fumes that come out of a car exhaust don't just contain the sooty grey particles that you can see - they also contains lots of invisible gases that can be even more harmful to our environment.

Student hydrogen s will also get to explore alternative energy sources other than fossil fuels (https://www.studentenergy.org/topics/fossil-fuels) such as wave energy, biofuels, geothermal power, wind energy, biomass energy, tidal energy and hydrogen gas. This includes all renewable (https://www.studentenergy.org/topics/renewable-energy) sources and nuclear (https://www.studentenergy.org/topics/nuclear). Nuclear (https://www.studentenergy.org/topics/nuclear) is not classified as a renewable energy (http://www.studentenergy.org/topics/renewable-energy) source. A renewable energy (http://www.studentenergy.org/topics/renewable-energy) source is produced from sources that do not deplete or can be replenished within a human's life time. Nuclear (http://www.studentenergy.org/topics/nuclear) is produced from mined elements like uranium and thorium which cannot be replenished.

Unit Assignment(s):

Your Contribution

Carbon dioxide in the atmosphere traps heat. Scientists are concerned that too much carbon dioxide is being released into the air by human activity. Using your knowledge of the carbon cycle, where do you think this carbon dioxide is coming from? List at least three possible sources of human-related carbon dioxide production. What do you think could be done to reduce levels of carbon dioxide in the atmosphere? What could people change that would reduce the burning of fossil fuels?

Unit Lab Activities:

Acid Rain and Brine Shrimp

Human activity can have a significant effect on the natural world. Burning fossil fuels, for example, causes rainwater to become more acidic. This acidic water falls to Earth in the form of acid rain. When it mixes with natural water, it changes the water's pH.

How does acid rain affect living things? Students will explore this question in this lab.

They will model the formation of acid rain by observing how a burning match affects a wet piece of pH paper. They will then use vinegar and baking soda to make solutions of varying pH and observe the hatching of brine shrimp in the solutions.

They will also get an opportunity to research how buffers can reduce the effects of acid rain. In addition, they will reflect on how human activity causes acid rain and find out how the Clean Air Act of 1990 helped reduce this impact of humans on the environment.

Unit 11: Environmental Changes

Unit 11

Environmental Changes

In this unit students will be able to identify and differentiate between renewable and nonrenewable resources on which humans depend. They will evaluate the cost-benefit trade-offs of using renewable resources instead of non-renewable resources and will describe how the use of natural resources will affect future generations of humans. They will also alternative forms of energy production.

Students will also identify point sources and non-point sources of air, land, and water pollution and be able to describe the effects of pollution on oceans, freshwater supplies, air, and land and recognize the consequences of this pollution on human health and societies.They will evaluate the hazards pollutants pose to wildlife and other types of natural resources and describe methods of waste management, including burial in a landfill, dumping, incineration, composting, recycling, and reuse. They will evaluate the impact of waste management and reduction strategies on resource availability.

Finally students should be able to describe the effects of air pollution on the natural systems that regulate Earth's climate. They will analyze the historical trends observed in global climate data and relate human activities to observed changes in global climate. They should be able to evaluate differing views on global warming and climate change and summarize scientists' predictions about the effects of global climate change on the biosphere in terms of the validity of the research and the impact of scientific research on environmental issues related to human activities.

1.

Unit Assignment(s):

Effects of Climate Change Exploration

Use the information in the article "Habitat Fragmentation" to answer the questions below. Use scientific processes to explore, apply, and communicate information related to the problem of habitat fragmentation.

Habitat fragmentation has increased as the human population has grown.

1.According to the first page of the article, what is habitat fragmentation?

2.Why has the growing human population led to habitat fragmentation, according to the first two pages of this article?

3. According to page 3 of the article, what are some estimates for the amount of wilderness habitat lost because of fragmentation?

Fragmentation of habitats affects species in many different ways.

1. According to pages 1 and 3 of the article, why does habitat fragmentation favor edge species?

2.How does increased isolation of habitats, as described on page 4 of the article, lower the genetic diversity of a population?

3.Which of the primary effects of habitat fragmentation described in this article do you think would most harm an animal's ability to hunt for food?

Explain your answer.

Unit Lab Activities:

Project: Explore Your Local Environmental Challenges

Part 1: Background Check

1. Read all of the instructions for the project, including the questions you will answer after your observations are complete.
2. During the project, you will use multiple online sources. Explore the websites listed on the landing page of this assignment.
3. Identify the websites you think are reliable sources of the information you need, and describe your reasons for these selections.
4. Identify the websites you think are *not*reliable sources of information, and describe your reasons for these selections.
5. State the city, county, and state in which you live. Before making any new observations or completing anyresearch, describe what you would predict to be challenges of the environment. Include both natural and man-made challenges.

Part 2: Observations and Data Collection

Explore and Research

- Use the Internet to research topics related to environmental hazards that may or may not be present in your environment (your city and county).
- You can use each site given as a starting point for your research, but you may need to branch out on your own to research topics that are specific to your area.
- To perform your own searches, a great way to start is to enter the name of a topic and the county where you live. For example, enter "water quality" and "San Bernardino County" if you live in Rialto, California.
- Be sure to:
  Follow safe practices during this investigation.
  Use discretion when selecting websites to view for research purposes.

Observe and Record Data

Natural Challenges— Explore the first three websites using the links on the landing page: Natural Hazards, Volcanoes, and Karst in the United States. In each site, look for information about your local area. Again, you may need to do some research on your own to answer the questions.

1. Describe the natural geological challenges that exist in your environment. Examples are fault zones, earthquakes, volcanoes, tidal areas, landslides, karst areas (sinkholes and caves), avalanches, soil erosion, and wildfires. Include in

your description how people in your area prepare for these events, and provide data from your research to explain your answers.

2. Describe the fragile ecosystems in your environment that need protecting, such as wetlands, desert areas, riparian areas, forested and deforested areas, etc. How are these areas protected? Provide data from your research to explain your answers.

Human-Influenced Challenges— Explore each of the remaining sites on the landing page: Water Quality, Drought, Water Conservation, Energy Sources, Invasive Species, Agriculture, Air Quality, and Natural Resources and Waste Management. In each site, look for information about your local area. Again, you may need to do some research on your own to answer the questions. Looking up your local power/water/sewer/trash company could be very helpful here.

What is the main power source in your community? (You may need to explore your power company's website to find this out.) What environmental challenges does producing power in this way cause? What are its benefits? What are some alternative sources of energy, given the resources and features of your area? Provide data from your research to explain your answers.

2. What is the main water source in your community? (You may need to explore your water company's website to find this out.) How is water treated in your community? What environmental challenges are related to water availability (drought, flooding, etc.)? What are some ways to prevent these issues? Provide data from your research to explain your answers.
3. As you explore the sites, create a table with information about the human-induced challenges in your area. The table should have five columns titled : Environmental Hazard, Description of Hazard, Important Events/ examples, Local Causes and Prevention. It should have the following rows under column 1 (Environmental Hazard) titled : Invasive Species, Land Use (urbanization), Land Use (agriculture), Air Pollution, Water Pollution, Land Pollution, Waste management, Natural resources (mining, fish, lumber, etc), Industries (specific to Rialto), and Other (specify)

3. **Local Independent Research**— Use non-Internet resources in order to learn more about a specific environmental challenge in your environment. Choose either a natural environmental hazard of a human-caused hazard that you learned a little bit about in your Internet research. Research this topic in more depth using two sources from the list that follows.

- Scientific journal article (can be found online but should be published in a print journal)
- Local expert (visit or phone someone at a local plant nursery, town records office, power company, water company, parks and rec office, etc.)
- Book (Local libraries are good sources)
- Magazine/Newspaper
- Radio program
- State park/Power company/Water company pamphlet
- Summarize what you learned about the topic from each source.

1. Describe the first source, and summarize the information learned from it in a paragraph or two.
2. Describe the second source and summarize the information learned from it in a paragraph or two.

ourse Materials

Websites

itle	Author(s)/Editor(s)/Compiler(s)	Affiliated Institution or Organization	URL
APEX Learning California Libraries for The Living Earth, hemistry in Earth Systems, Physics in the Universe	[empty]	APEX LEARNING	Apex learning.cor

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