Week one Physics in Action!
Force and Motion

Begin the day with an introduction activity.

Students will help to create classroom rules.

The instructor will go over safety rules for the day.

Learning Objectives

- A force is something that pushes or pulls on an object.
- Gravity is a force that pulls on an object.
- Every object always has different forces acting upon it.

Indiana State Standards

3.1.3 Keep and report records of investigations and observations using tools, such as journals, charts, graphs, and computers. (Core Standard)

3.1.4 Discuss the results of investigations and consider the explanations of others.

4.3.2 Begin to investigate and explain that air is a substance that surrounds us, takes up space, and whose movements we feel as wind. (Core Standard)

Materials
6 poster boards
6 text books (used for weight)
6 sets of markers
Blackboard
6 toy cars
6 tennis balls
6 ramps
Science journal for each student

Description of lesson
Part one: Engage

A KWL (Know – Want to know – Learned) chart will be created before the lesson to see what the students know about forces, what they want to know, and at the end of the lesson, what they have learned. Some of the questions will be answered during the lesson. The class will come back to the chart at the end of the lesson to readdress these questions.

Students will be divided into 6 groups at desks with a textbook, a set of markers, and a poster board at each desk. The teacher will read a probe to stimulate students' thinking about force. Each group will be asked to decide on the best possible answer and explain why in their journals.

Each of the 6 groups will observe the textbook that was handed out to them earlier. The groups will be asked to think about if there is anything pushing or pulling on the apple. Students will be given a few minutes to discuss with group members then share answers with the class.

After the discussion, the instructor can say, “Did anyone think about the force of gravity? Don’t worry if you didn’t because we’re going to talk about gravity another time. The force of gravity is what is keeping the apple from floating away (arrows showing the forces will be drawn on the board) but there is one other force acting on the apple. Does anyone know what it might be?

Students may answer.

“What would happen to the apple if the desk wasn’t there anymore? The apple would fall, right? So what does that mean the desk is doing? (Answer: pushing the apple up/ applying force). We can show how the desk is applying force by doing an experiment. I need one volunteer.
Have the volunteer hold out his or her hand. “Now I need you to hold your hands very still, don’t move them, okay?” The teacher will place a stack of textbooks in the student’s hands. “Can you tell us what it feels like?”
“Can anyone see that the books are pushing on (student’s name) hands?”

Ask the volunteer what he or she is doing to the book so that it does not fall (holding them up/pushing them back up). Ask students, *“Can anyone tell me what (student’s name) is doing so these books do not fall to the ground?”* Thank the volunteer and ask them to return to his or her seat.
(Draw this force on the blackboard with a different colored arrow).

Part Two: Explore

“Now that I've drawn what forces are on the apple, you all get to take turns to draw different scenarios containing forces. In your groups, divide your poster board into the number of people in your group. In each square, I would like you to draw a picture like mine of force being applied to an object. Can anyone tell me what a force is (Answer: applying a push or a pull to an object).”

Let students know what they are free to use any of the examples shown, including the apple, or textbooks but they can only use one. As groups students will have to think of another example on their own. Ask students to brainstorm for a minute before they begin drawing.

After students are done drawing, they will present their examples to the whole class. The definition of force and motion will be revised here to see if students have anything to add.

BREAK

Exploration continued:
After thinking about and exploring forces, students will experiment with other forces. Each group will receive a toy car and a ramp. Groups will be challenged to see if they can make the car go from one end of the table to the other end without physically touching it. (students can use the ramp to move the car, or use their breath to blow on the car). Methods students used will be shared with the class.

The awareness of other forces will be discussed such as wind. The instructor will address how the force of wind affects the environment, especially the weather, such as moving rain clouds and more.

The teacher will introduce motion (movement or change in position of place) to students. Students will then be challenged to construct a paper airplane to show the air resistance on motion. If weather permits, the students will have the opportunity to fly their planes outside to see the force of wind acting upon it.

Students may come to realize that they design of the plane makes a big difference. After they come inside, the teacher will help them to create their own definition of motion and discuss the differences between their planes and how well they performed outside.

After both activities, the class will go back to the KWL chart and address questions they have learned the answer to, what they have learned, and if they still have any more questions about motion or forces. This is also the time for students to give questions or comments. Students will also be asked to write one thing they learned about forces and motion.

Embedded Assessment/ Evaluation

Questions that are going to be asked in the “Engage” section questions are italicized. They will also be assessed during their presentations and during class discussions.

Week Two Physics in Action!
Magnets

- Begin with an introduction activity to reintroduce students to one another.
- Remind students of classroom rules.
- The instructor will go over safety rules for the day.

Learning Objectives

- There are two different poles on a magnet
- The same poles repel and opposite poles attract
- Magnets are attracted to some metals
- The distance between magnets impacts the magnet's strength
- The Earth's magnetic field impacts wildlife and navigation

Indiana State Standards

4.3.15 Demonstrate that without touching them, a magnet pulls all things made of iron and either pushes or pulls other magnets.

3.4.2 Explain that features used for grouping depend on the purpose of the grouping.

Materials
12 bar magnets
A container of paperclips
4 balancing scales
Iron filings
Doughnut magnets
12 pieces of cork
12 needles
12 individual cups of water

Description of Lesson
Part one: Engage

The instructor will introduce the topic of magnets by reading them a book about magnets. After reading the book, the class will discuss different uses for the magnets in the book. The class will also discuss the ways in which magnets are used in everyday life.

Part two: Explore
1. What materials can magnets attract?

After the discussion, students will participate in a scavenger hunt. The class will be divided into groups depending on how many helpers there are. Each student will receive a magnet. Each group will journey around the building to discover and document which materials were attracted to the magnet and which materials were not. After around 20 minutes, the groups will come back to the classroom and discuss which things were attracted to the magnets and which were not. The class will then write their own

statement about what kinds of things are attracted to magnets. And also, students will explore what materials can let magnetic force to go through it, such as paper, or plastic bag.

2. Magnetic poles

After the discussion of what things magnets are attracted to, students will explore the magnets' poles using the donut magnets on a pencil to demonstrate the attraction and repulsion properties of magnets. The instructor will lead students in a discussion about the properties of magnets. The students will write down properties of magnets they have discovered.
Students will further explore poles by creating a compass. The students will see how magnets affect the position of a compass' needle depending upon its distance. Students may add more properties to the list if they find any more.
After this, students will learn the affect Earth's magnetic field has on the migration patterns of certain animals. They will also discuss the use of magnets in everyday life.

3. Strength of different magnets

Students will realize the strength of magnets by doing an investigation with a balancing scale. Students will place a magnet on each side but will have a magnet attracted to the magnet on one side, holding it down. Students will continue to place magnets into the other side to see how strong a magnet is. Students will do this for different types of magnets. After this investigation, students will see how long a paper clip chain can be made with different magnets testing the strength. Students will also explore whether the shape , or how big it is, affect the strength of the magnetic force) students record how many washers are needed to compare the force. Students may add more properties to the magnet list.

4. Magnetic Fields

In this demonstration of magnetic fields, the instructor will place two bar magnets with both north poles facing each other. The teacher will cover both magnets with a sheet of paper. Iron filings will then be sprinkled on that sheet of paper to see the magnetic field of both bar magnets. This demonstration will be repeated except with the north pole of one magnet facing the south pole of the other magnet. The class will state the differences. More properties will be added to the magnet property chart.

Force and Motion - Week Three
Electricity

Begin with introduction activity
Remind students of classroom rules
The instructor will go over safety rules for the day

Learning Objectives

- The flow of electricity requires a closed circuit.
- There always has to be a power source within the electrical circuit.
- Some things conduct electricity (conductors) while others do not (insulators).

Indiana State Standards

4.2.3 Make simple and safe electrical connections with various plugs, sockets, and terminals.

3.2.6 Make sketches and write descriptions to aid in explaining procedures or ideas.

Materials
25 pennies
15 paper clips
10 rubber stoppers
10 donut magnets
12 index cards
22 paper fasteners
10 potatoes
20 steel nails
22 wires
10 light bulbs
10 industrial batteries (D)
10 balloons

Description of Lesson
Engage
The lesson will begin with the readings of, *A Book About Electricity* and *If the World Were a Village* to introduce the topic of electricity to students. After reading the books, the instructor will conduct a discussion about what the students already know about the topic and some things they learned from the book.

Explore

Circuits
The students will then begin exploring magnets through circuits. Each student will be given a battery, a light bulb, and a wire. They will be asked to illuminate the light bulb only using those three things. The students will draw out what they will do with the three items before carrying out the task. After they have completed that task, the students will have a class discussion about the struggles they had. They will also be asked to make changes to their initial picture if needed. The instructor will continue the lesson by explaining more about electricity, closed, and open circuits.

Switches
Students will now explore how to create a switch for their electrical circuit. Students will work in pairs to create the switch. Throughout the process they may remember the need for a closed circuit for the light bulb to be illuminated. To assess them the instructor will ask each student to take turns disconnecting parts of their circuit and have their partners figure out what went wrong.

Conductors and Insulators
Students will learn the importance of conductors and insulators. They will test different items such as pennies, rubber stoppers, etc. to see if they complete the circuit. The instructor will then lead a discussion on what insulators and conductors are used for in everyday life.

Static Electricity
During this part, students will experiment with static electricity. They will use balloons to rub on their head or a piece of cloth to transfer energy and electrons resulting in static electricity. The students will further explore this property of electricity by seeing how it reacts with water. The instructor will introduce electrons and protons to them to explain the reaction between the balloon and water.

Potato Battery
Students will be asked to remind one another about the components of a closed circuit. They will then be asked if it would be possible for a fruit or potato could act as a battery. The students will then create a closed circuit using a potato instead of a battery. Students will learn that the juices inside the potato can also act like a battery, but to have the light bulb ignite, there must be proper conductors.

The class will then regroup at the end to discuss different properties of electricity or make changes to their initial ideas.

References
(2005). *FOSS Teacher Guide: Magnetism and Electricity* . Nashua, NH: Delta Education .

Potato Battery exploration:
http://docs.google.com/gview?a=v&q=cache:Jcl0To-OFFsJ:www.mathinscience.info/public/electric_circuits/potatolight.pdf+potato+battery+light+bulb&hl=en&gl=us&sig=AFQjCNFJkW1wXPIYBKedT5auCH2aFOOa_w

Wade, Harlan. (1977). *A Book About Electricity*. Milwaukee, WI: Raintree Publishers Limited.

Smith, David J. (2002). *If The World Were A Village* . Tonawanda, NY: Kids Can Press Ltd..s

Physics in Action – Week Four
Chemistry

Learning Objectives
- Different solids have different properties.
- Solids look different when they are magnified
- A base is opposite from an acid
- Acids can eat away at objects

Indiana State Standards
3.2.2 Measure and mix dry and liquid materials in prescribed amounts, following reasonable safety precautions.

3.6.5 Observe that and describe how some changes are very slow and some are very fast and that some of these changes may be hard to see and/or record.

Materials
10 Magnifying glasses
10 zip lock bags
box of cornstarch
sugar
baby powder
flour
baking soda
vinegar
distilled water
10 balloons
10 small bottles or tubes with openings
balloon ends can fit over
pH test strips
lime or lemon juice
soap (liquid or bar)
hydrochloric acid

Description of Lesson
Engage
Students will be shown pictures of water, water vapor, and salt magnified to many times their normal size. Students will then guess which picture is which. This will introduce students to the differences between solids, liquids, and gases. Students will then complete a chart, stating the differences between these three states.

Explore

Solid, Liquid, or Gas?
Students will most likely have a good idea about what solids, liquids, and gases are. In this investigation, they will make a 'goop' that is composed of cornstarch and water. Students will mix these two things together and see that the mixture is neither solid nor liquid. They will then

discuss which category they think it belongs to and why. Students will explore with the mixture. They will be asked to leave it alone and see what happens or to roll it up. After students have come to a conclusion, we will revisit the chart from the beginning and add or change things to it.

Elaboration

Properties of Unknown Solids

Students will list the identities of each unknown solid (baby powder, cornstarch, sugar, and flour) in their notebooks. Students will explore the properties of solids with their senses, except for taste, and a magnifying glass. They will also observe the interaction of vinegar and water with each solid. After students have observed the solids, they will see pictures of the solids magnified many times, draw it, and compare it with how it looks like to the naked eye. If time permits, students will be asked to construct riddles for a solid and read it to a partner. When students are done writing down properties belonging to the different solids, the class will come together to discuss and share his or her findings. Students will understand that although some solids might look and feel the same, they can have very different properties.

Explore new material…(not completed this week)

Acids and Bases

Students will be introduced to what acids and bases are. The class will discuss what some common bases and acids are and what they are used for such as stomach acid, saliva, acid rain, vinegar, etc. The benefits and drawbacks of too much acid or base exposure/intake can do to an object or even a person. This will be done through pictures and video clips. After that, students will come up with a list of acids and bases that were not mentioned.

Acid or A Base?

Students will test different liquids and solids to see if they are acidic or basic using a pH test strip. Before students do this, the pH scale will be explained to them. They will learn what the numbers on the scale represent and which side is basic and which is acidic. Students will then continue the lesson by testing cornstarch, baking soda, vinegar, distilled water, lemon juice, soap, and hydrochloric acid to see where they lie on the pH scale.

Mixing Acids and Bases

Students will continue the investigation by mixing an acid and a base and watching the reaction. Students will mix baking soda and vinegar together in a bottle and put the balloon on the mouth covering to see that the reaction makes a gas that causes the balloon to rise.

References

(2005). *FOSS Teacher Guide: Chemistry*. Nashua, NH: Delta Education .

Class Properties Table

	How it looks	How it smells	How it feels	Other observations?
Red				
Yellow				
Blue				

	How it looks	How it smells	How it feels	Other observations?
Brown				
Green				
White				

Shi En Lim
Q405 Saturday Science

Physics in Action! – Week Five
Chemistry Continued – Chemical Reactions

Learning Objectives

- Acids and bases are used in everyday life
- A base is opposite from an acid
- Some chemicals have acidic properties
- Some chemicals have basic properties

Indiana State Standards

3.6.5 Observe that and describe how some changes are very slow and some are very fast and that some of these changes may be hard to see and/or record.

Materials

baking soda
vinegar
10 sandwich bags
pH test strips
tap water
flour
lemon juice
soap (liquid or bar)
hydrochloric acid
10 pennies
salt
2 gloves for each student
goggles for each student

Description of Lesson

Engage

Students will be shown pictures of chemical reactions that happen all around them. These chemical reactions include cucumbers turning into pickles, baking bread, rusting, corrosion: *marble (calcium carbonate) and HCl (like acid rain corrodes buildings), Iron or aluminum and HCl can produce hydrogen.*

etc. The class will then discuss how fast these chemical reactions take and what things cause them. The class will then make more suggestions about chemical reactions they see in their lives. Students will then be shown 5 statements about acids and bases. As a class, they will decide if the statements are true or false. Throughout the lesson, students will discover if they were correct about the statements. At the end of the lesson, we will discuss these statements and see what they found out during the lesson. The five statements are:

- The pH scale is used to test acids and bases (T)
- Acids cannot break things up (F)
-There are acids in fruits (T)
- Water is not an acid or a base (neutral) (T)
- Bases cannot break things up (F)

Explore

Acids and Bases

Students will be introduced to what acids and bases are. The class will discuss what some common bases and acids are and what they are used for such as stomach acid, saliva, acid rain, vinegar, etc. The benefits and drawbacks of too much acid or base exposure/intake can do to an object or even a person. This will be done through pictures and video clips. *Acids can neutralize bases and vice versa. This can further show them acid and base have opposite properties.*

After that, students will come up with a list of acids and bases that were not mentioned.

Acid or A Base?

Students will test different liquids and solids to see if they are acidic or basic using a pH test strip. Before students do this, the pH scale will be explained to them. They will learn what the

numbers on the scale represent and which side is basic and which is acidic. Students will then continue the lesson by testing baking soda, vinegar, tap water, lemon juice, soap, and hydrochloric acid to see where they lie on the pH scale.
During this investigation, students will have a worksheet to fill out about each juice. They will first predict if it will be an acid or a base. They will then test it to see which one it is. They will then record the acidity and put them in order according to the pH scale.

Cleaning Pennies

Students will see the effects of acids on materials with vinegar, salt, and dull pennies. Students will be given the salt and vinegar solution and a few dull pennies. They will predict what will happen to half of a penny when they dip it into the solution. After students dip half the penny into the solution, they will see the chemical reaction taking place and the penny will not be as dull as before.
Students will then infer why this reaction happens or is possible.
I will then explain to them that pennies dull because the copper reacts with the air which makes copper oxide and the penny dull. The acid reacts with the copper oxide to make the penny shiny again (http://chemistry.about.com/cs/demonstrations/a/aa022204a.htm).
After some pennies are cleaned, I will ask half of the class to rinse their pennies in water while the other half to place their shiny pennies on a paper towel. During the class session, we will let the pennies dry to hopefully find that a blue-green color has come upon the pennies not rinsed in water while the pennies rinsed in water will become dull again due to the water stopping the acid from reacting further with the copper in the penny (http://chemistry.about.com/cs/demonstrations/a/aa022204a.htm).

Mixing Acids and Bases

Students will continue the investigation by mixing an acid and a base and watching the reaction. Students will mix baking soda and vinegar together in a bottle and put the balloon on the mouth covering to see that the reaction makes a gas that causes the balloon to rise.

Apple Browning Experiment

This experiment involves cutting up an apple and putting the slices in different acids and bases. Students will already know that apples brown when left outside in the air. The oxygen acts upon the chemicals in the apple, turning it brown. The apple slices will be placed in the different liquids(lemon juice, baking soda and water) in the beginning of class. Students will make their hypothesis at the beginning of class to see which liquid will prevent the apple from browning. They will check each apple slice during transition periods throughout the lesson. At the end of the lesson, students will see if their hypothesis were correct. If the changes do not take place during the lesson, I will take a picture of what happens to each apple slice, keep their hypothesis papers and show them the results next week (http://chemistry.about.com/od/demonstrationsexperiments/ss/appleenzyme_5.htm).

Shi En Lim
Q405 Saturday Science

Physics in Action! – Week Six

Learning Objectives

- Students will be able to learn that chemical reactions can cause a force
- Students will recall how to create a circuit. They will use this information to learn how to create a switchboard on their own
- Students will learn that a sound wave is a result of a force
- Students will be able to learn that combinations of different colors create other colors

Indiana State Standards

3.6.5 Observe that and describe how some changes are very slow and some are very fast and that some of these changes may be hard to see and/or record.

Materials

paper clips
paper fasteners
insulated wires for circuit creation
10 light bulbs
10 industrial batteries (D)
10 battery holders
20 sheets of paper
10 film canisters with lids
1 toilet paper roll
masking tape
1 paper plate
Baking soda
Vinegar
10 glass bottles
10 plastic cups
String
1 pair of scissors
10 matchbox cars
25 donut magnets
10 bar magnets
5 Coffee filters
3 kinds of black water based ink pens

Exploration

Switchboard

From lesson 3 on electricity, students will recall what they have learned about how to make circuits and what is required to make a circuit. We will review this in class before we start the investigation. Students will create a science quiz to use for their switchboard. It can consist anywhere from three to 5 questions. Students will be given wires, a sheet of paper, tape, a light bulb, and a battery to make a switchboard. They will then test their switchboard with a partner to see if it works. If their switchboard is not successful, they will write down why it did not work or maybe a partner can help them to troubleshoot. I will be walking around the classroom to assess students on how their switchboard worked or if they

knew what went wrong if it did not work. I will also ask students to draw a picture of a working switchboard.

Rockets

Students will remember that there are forces all around us from the first lesson. Students will also remember from lesson 5 that chemical reactions are capable of creating a force. Students will see this in action with a film canister, baking soda, and vinegar. Students will create rockets with the help of the instructor. This investigation will be completed outdoors. Students will begin by hypothesizing what will happen to their rocket, how far it will reach into the air, and which direction they think it will go. For the rocket fuel, students will put 1 tbsp of vinegar in the canister and the instructor will put ½ a tsp of baking soda in the rocket, snap the lid shut, and launch it. Students will then observe what their rocket does when it is shooting off. If their rocket does not launch as they predicted, they will state why and how they could get it to launch in the future. As an assessment, students will design their own rocket experiment and test it out. If it works, students will write down why it worked. If their rocket does not launch as they predicted, they will state why and how they could get it to launch in the future. They will share their results with the class.

Sounds

Students will already have been familiar with sounds around them every day. They will investigate and figure out that sounds are from vibrations. They will explore sound with water and glass bottles. They will then write down what they have learned from their explorations and share with the class. The things they may find out are:

- The more water in the bottles, the lower the pitch is when the bottle is hit.
- The more water in the bottles, the higher the pitch is when the bottle is blown into
- Holding the bottle creates a different sound when nothing is touching the bottle

Students will further explore with sounds by making a “cup of sound”. Students will poke a hole in the bottom of a plastic cup and secure one end of the string to the bottom of the cup. They will then wet the string with water and pull tightly on one end of the string while holding the cup in their other hand. They will then observe the sounds coming from the cup. Different strings will be used for students to see the different sounds that various types of string emit.

Students will draw how they think the sound comes from the bottles and share their thoughts with a partner and then the whole class will have a discussion.

The instructor will go into detail about animals that use sound waves and vibrations to communicate such as whales, dolphins, bats through video clips and diagrams.

Colors

Students should be familiar with different colors all around them by now. Some may be aware of primary and secondary colors. They may also be aware that two colors mixed together make a certain color. Students will be exploring the science of colors in chromatography. They will have different types

of water based black ink markers, mark coffee filters with them, place the bottom part of it in water, and watch the different colors emerge from the black ink. Students will realize that the possible colors made by mixing other colors may be endless. Students will first come up with a hypothesis of what colors will come out of the ink. Afterwards, students will record their findings and compare their results with the rest of the class. Students will be assessed by their ending statements written down at the end of the investigation.