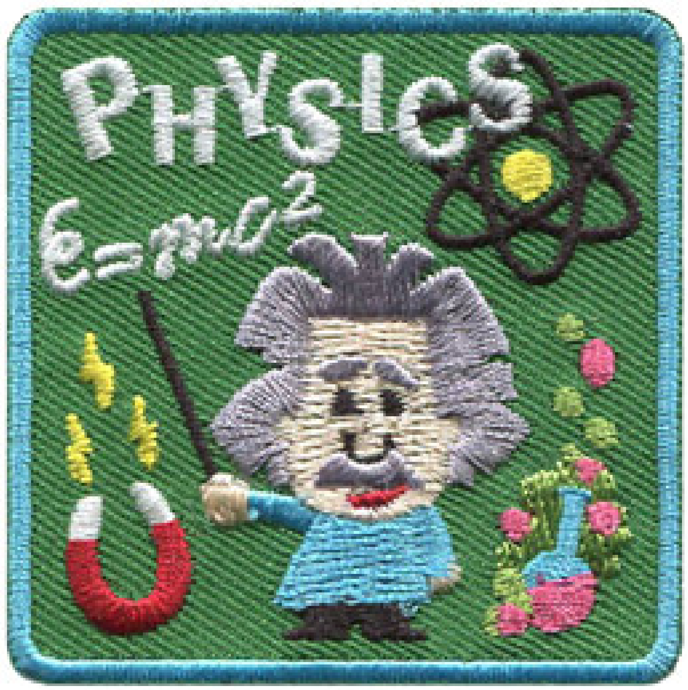
Physics Meeting Plan



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Meeting plan: Physics night

Tuesday, November 1, 2016

Materials required

• Piece of paper for each girl • Coins for each girl • Tennis ball • Masking tape • Three glass bottles with a narrow neck	• Pie Pan • Flour • Hot Chocolate Mix • 3 Sizes of Marbles • Spoon • 2 pop cans	• Sharp nail • String • Plastic bottle • Funnel • Rice • Spoon • Chopstick

Gathering activity – 10 minutes

- Thank-you cards for donated tents and recent visits to the unit. Have girls work on signing and decorating the cards until everyone arrives.

Opening – 10 minutes

- Horseshoe
- Dues
- Talking circle:
    - What does physics mean?
    - Do you like science?
    - What sort of careers are possible in science?
    - What do you know about physics?

The laws of motion (50 minutes)

- Ask the girls if they have ever heard of Newton's Laws of Motion
- State the laws:
    - Objects in motion tend to stay in motion, objects at rest tend to stay at rest unless acted upon by an unbalanced force
    - Force is equal to mass times acceleration
    - For every action there is an equal and opposite reaction
- Explain that we are going to conduct experiments to explore these laws.

Inertia – bodies at rest[1]

- Have each girl place several coins on her sheet of paper. Have each girl try to whisk the paper away without having the coins drop.

[1] (Bloomfield, 2013)

- Gather the girls in a circle. Ask them what they thought was happening to the coins, and why the coins did not fly off with the paper when you moved it away.
- Why do the coins stay where they are?
  - The coins remain where they are because of inertia. Objects in motion tend to stay in motion, and objects at rest tend to stay at rest unless they are acted upon by an outside force. When you pull the paper out quickly and smoothly, the coins experience only a tiny change in velocity (their speed in a specific direction) and do not really move.

Inertia – bodies in motion[2]

- Place a target about 10-15 meters away from a starting line. Mark the starting line with tape.
- Hold the tennis ball and do not let your elbow leave your side as you run and drop the ball. Do not throw the ball. You should hold the ball from its sides so that you can release your grip as you let it drop. Remember to drop the ball and not throw it, otherwise you will change the intent of the experiment.
- Three girls will act as observers: one before, at, and after the target. They are to determine when the runner released the ball and where it strikes the ground
- The runner will then sprint towards the target as fast as she can and will try to drop the ball on the target
- We will rotate out so that each girl gets to try
- Why can't you drop the ball on the target?
  - As the ball drops, its horizontal motion remains unchanged because we didn't apply a force in that direction
  - Newton's first law applies to the horizontal motion, and so the ball continues to move forward as it drops

Newton's second law – Comets![3]

- Put several spoons of flour in the pie pan
- Next have the girls sprinkle a layer of hot chocolate mix on top
- Have one girl hold a marble a specific height above the pan and then drop the marble
- Repeat with the other two marbles from the same height
- Have the girls carefully remove the marbles and examine the impact craters
- Which marble left the biggest crater? Why?
  - The force of an object is equal to its mass times acceleration
  - The bigger marble had a larger mass, and so had a larger force
  - To visualize this, think about destroying a cake. You could either give it a bigger push (acceleration) or punch it with a big boxing glove (more mass). Both would increase the force on the cake

Newton's third law – Hero engines[4]

- Take the girls to the kitchen
- Fill the sink with water

[2] (Granger & Whitlock, 2009)
[3] (The Indianapolis Public Library , 2013)
[4] (NASA, 2012)

- Punch holes in the side of the can with a nail. Make sure to angle the holes by pushing the nail head to the left when it has been inserted
- Tie a string to the tab of the pop can
- Submerge the can in water and then raise it up
- Ask the girls to explain what is moving the can
- What happens to the can?
  - Explain how Newton's third law is illustrated in the motion of the can
  - The water is forced out of the holes due to gravity
  - The can then moves in the opposite direction of the water exiting the can
  - Explain how different sized and angled holes impact how the can moves

Friction (15 minutes)

- Ask the girls what they think friction is
- Ask the girls to give examples of friction in their everyday lives

Friction with rice[5]

- Ask the girls if they think I can lift a bottle of rice with a chopstick
- Have one of the girls pour rice into a bottle using a funnel
- Bang the bottle gently to get the rice to settle
- Continue pouring the rice until the bottle is almost full
- Push the chopstick into the rice, making sure to bang the bottle so the rice is settled
- Once the chopstick is in, try and life the bottle
- How is this happening?
  - Static friction opposes the movement of one substance against another
  - The rice in the bottle has air pockets around the grains, which prevents friction
  - When we work the chopstick into the bottle, this settles the rice and eliminates the air pockets
  - The frictional force overwhelms the rice and the rice pushes back against the chopstick, keeping it in place and allowing us to pick up the bottle

Resonance (15 minutes)

- Ask the girls how they think sound travels
- Explain the concept of waves

Pop bottle music[6]

- Fill one of the bottles halfway up with water
- Fill another bottle three quarters up
- Leave the third bottle empty
- Give each girl a turn blowing across the three bottles
- Explain the concept of pitch
  - Sound is a wave

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[5] (Carrots are orange, 2015)
[6] (Science Buddies, 2014)

    - The frequency of a sound is a measure of the number of vibrations or waves per second
    - A sound with a high frequency makes a high-pitched sound
- Ask the girls how the notes from the three bottles compare with one another
- Why do the girls think the pitch changes?
- Explain what is happening inside the bottle
    - The bottle is an example of an instrument with a closed-end air column
    - The pitch of the note depends on the length of the air column (how much space is left in the bottle other than water)
    - The shorter the height of air in the bottle, the higher the frequency
    - If you add water or use a smaller bottle, there is less space available so it takes less time for the pressure to build up. This means the vibration happens more quickly and so produces a higher pitch

Closing activity: Mind map[7] (10 minutes)

For this activity, we will use the Girl Guides of Canada closing for their International Day of the Girl: Closing the Gap meeting.

- Take four sheets of paper and write "science" in the middle of one of the pieces of paper, then "technology," "engineering" and "math" on the other three sheets.
- Each piece of paper should have one of these four words in the centre.
- As a unit create a "mind map" of each of these words.
    - Using crayons, markers, drawings, stickers, etc., ask the girls to consider how they are affected or impacted by these different subject areas.
    - Having just completed a unit meeting on STEM, are they thinking about these areas differently than before?
    - Did they learn something new, and if so, what?
    - Are they inspired to try something new related to STEM? Do they still have questions?
    - When they think of engineering are they picturing buildings, roads, and bridges?
    - Ask each girl to draw things they use in their daily lives that come from these fields, or even their favourite things related to STEM, on each piece of paper to help create a large mind map of STEM!
- Have the girls read out the stories of notable women in STEM from the Girl Guides meeting, if there is time[8]
- Have each girl complete the short reflection in Appendix 1 to highlight what they have learned

[7] (Girl Guides of Canada, 2016)
[8] (Girl Guides of Canada, 2016)

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Appendix 1: Learning reflection

What do I think about physics (before activities): ____________________

What is the coolest thing I learned today? ____________________

What do I think about physics now (after activities): ____________________

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