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|  | **Energy Workbook and Manual**  **STEM: Engineering Experiments**  **University of Tennessee – Martin**  **Ray Witmer (731) 881 – 7388**  **rwitmer@utm.edu** |
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| Summer  2019 | |  |  | | --- | --- | | Name: |  | | School: |  | |

***Introduction:***

Thanks for coming to the UT-Martin STEM workshop on energy!

Several experiments are presented that illustrate the concepts of energy. There are several types of energy:

Kinetic – things that are in motion

Potential – things that have the ability to go in motion

Thermal – things that have heat (we can always do something useful with heat).

Each experimental guide in this workbook lists the experiment name, discusses a bit of the background of the experiment and guides you through the data you need to collect. This workbook does not actually tell you exactly what to do (well, it kind of does) – we will discuss that together and you can write down the notes about what to do and how to collect the data. We will use MS Excel to plot or manipulate the data and make it meaningful. You can then save the data and plots on your jump drive.

Please bring your **cell phone** to class! (I bet you never tell your students to do that!) Please get familiar with how to use the stop-watch app on your phone. Also, if you have a **hair dryer**, please bring it, too. I have a few you can borrow although I do not have any hair – and no, I do not dry my dog or cat with a hair dryer. Finally, could you also bring in a **paper towel tube** (just the tube, no paper towels).

See you July 10th!

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***Experiment 1:***

Like a roller coaster but with data

***Background:***

A roller coaster takes people and the coasters to the top of a hill. It takes energy to get all that stuff to the top. Once at the top, the people and coaster have potential energy relative to the ground because of gravity. Once over the crown of the hill, gravity takes over and the cars gain speed as they move down the hill – WHOOT!!! At the bottom (ground level) there is no more potential energy and there is only kinetic energy in the form of velocity! (Speed and Velocity – what’s the difference??)

***Procedure and Data Collection:***

1. You have a piece of PVC cut in half lengthwise – it is very bendy.
2. You have several spherical objects (ball bearings) that fit in the PVC pipe.
3. You have steps in the hallway.
4. You have floor tiles that are 12 inches square. (are they??)
5. How fast do the spherical objects go at the bottom of the run given how high (how many stairs high) their ‘roller coaster’ starts?
6. Do you think it might be a good idea to take an average of some number of roller coaster runs?
7. Does the velocity depend on the mass of the spherical object?
8. Does velocity depend on the height of the ramp?

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PrintFreeGraphPaper.com

***Experiment 2:***

BANG! At the end of the ramp (and more data)

***Background:***

Sometimes things bang into each other (collisions). There are several types of collision. A type where neither thing deforms and they don’t stick together. A type where the things deform during the collision and don’t stick together. Finally, a type where the things stick together. We will look at the type where the things don’t stick and don’t deform. Where would you see this type of collision?

***Procedure and Data Collection:***

1. Set up your roller coaster.
2. Use the big ball bearing as the coaster and the smaller ball bearing as the thing at the bottom of the hill.
3. How fast does the big ball bearing normally go at the bottom without a collision?
4. How fast does the little ball bearing normally go at the bottom without a collision?
5. After the collision, how fast does the big ball bearing go?
6. After the collision, how fast does the little ball bearing go?

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***Experiment 3:***

BANG (again)! At the end of the ramp (and more data) – Same as Experiment 2 but now have the little ball bearing as the hitter and the big ball bearing as the hittee.

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***Experiment 4:***

Heat the steel

***Background:***

Heat energy can travel by several methods (what are the methods?). This experiment shows that heat can travel through a solid. What is a real world example – Hint: Do you like to cook?

***Procedure and Data Collection:***

1. Set up the supplied wood pieces and steel bar – we need to be kind of careful how we set this up because we want the heat to only travel by means of the steel and not the air.
2. Heat one end of the steel with the hair dryer.
3. Use your supplied thermometer at the other end to read the temperature and gather enough data to show a good plot of temperature vs time. When do you think you should stop taking data? What is the temperature of the steel at the end with the hair dryer?

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***Experiment 5:***

Heat the aluminum – same as Experiment 4 but use the aluminum. Plot the temperature vs time for the steel and aluminum on the same plot. Are they the same plot?

What type of heat transfer mechanism is this?

***Experiment 6:*** Heat up a paper towel tube.

***Background:***

Heat can travel by air movement. How does this apply to our lives – again, think cooking or a cold day in your car. What kind of heat transfer mechanism is this?

***Procedure and Data Collection:***

1. Get one end of the steel or aluminum as hot as you can.
2. Hold the paper towel tube above the hot end (maybe don’t touch the tube to the bar – maybe it is ok, I dunno. Paper burns at about 451 degrees Fahrenheit so maybe the bar isn’t that hot). Anyhow, hold the Anemometer over the other end of the tube. What is the air velocity? Maybe it would be fun to plot air velocity vs temperature. I hope we have enough time to do that!

***Experiment 7:*** Big Oven.

My department has the coolest oven – it can get to 1700 degrees Fahrenheit (I think). Do you think you can feel the oven heat from across the room? What kind of heat transfer mechanism is that? Give some more examples of this mechanism. Could we do an experiment with this type heat transfer mechanism using an appliance in our kitchen (or the teacher’s lounge)?