Friction Activities

Submitted by: Sheri Caine, Physics
Dwight D. Eisenhower High School, Blue Island, IL

Target Grade: 10th-11th Grade Physics

Time Required: 3 days, 50 minute lessons

Standards

Next Generation Science Standards (NGSS):

- HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).
- HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Lesson Objectives

Students will be able to:

- Identify how friction generates heat.
- Quantify the energy released to the environment as heat to mathematically prove that the energy put into a system equals the energy that comes out of the system.

Central Focus

In this lesson, Students will create a Science Talk over subjects involving force, friction, and energy. They will begin the lesson by traveling to different stations to get hands on experience with each topic. They will then develop their own experiments to support their claim of their given topic. To end the lesson, students will present their question, investigation, and evidence to the class to finalize a conclusion on a given physics topic.

Key terms: Newton's Laws, motion, energy, motion, collaboration

Background Information

Students will need to have some prior knowledge of atomic structure and energy and to connect that information to Newton's Laws, friction, the Law of Conservation of Energy, and rotational motion. The

lesson also delves into advanced chemistry and physics with the discussions of entropic forces, thermodynamics, resistive heating, friction welding, and aerodynamic friction. These are not typically included in regular-level high school physics.

Materials

- Computers/ tablets
- Jars of black sand
- PASCO temperature probe or similar
- Hot wheels track
- Meter sticks
- *Friction & Work Activities* worksheet
- Jars of sand
- Jars of pea gravel
- Rubber bands
- Hot wheels cars
- Masses to attach to cars on the track

Instruction

Day 1

- Before class, the teacher will need to set up five stations around the room.
- The five stations are the following:
    - PhET Simulation: The teacher will need to put one or two laptops/tablets at a table.
    - Sand Jar: Set up a jar with either sand or gravel inside. The students will need a thermometer to record temperature and a jar lid.
    - Rubber Band: Place a bag of rubber bands and a trashcan on the table.
    - Hot Wheels: Students will need some type of recording devise (can be cellphone, ipad, etc.), a ruler, track, and a hot wheels car.
    - Bow Drill: Students will need some type of device to watch the given YouTube video.

Introduction:

- When the students arrive to the class, the teacher should split them into five groups.
    - Each student will need a copy of the Friction & Work Activities worksheet.

Exploration:

- On the student's worksheet, they will choose a topic for a Science Talk. The students will gather photo, video, and/or numeric evidence from the following activities to support their claim conclusions.
- The possible topics the students can choose from are the following:
    - How can you manipulate the amount of friction acting on your mousetrap car to make it travel further?
    - Where does the heat come from in the rubber band activity?
    - Toasters create infrared radiation by passing electricity through nichrome, an alloy of nickel and chromium that has a high electrical resistance. How is heat generated in a toaster?
    - Explain how aerodynamic friction can be catastrophic for spacecraft.

  - Determine the amount of energy converted to heat in the hot wheels investigation and calculate the coefficient of friction between the car and the track. Compare the green and yellow cars for differences in the amount of friction.
  - Years ago, someone did research in tribology (the study of friction) at Argonne National Laboratory. She analyzed the wear marks on steel balls that rubbed together at high temperatures using different lubricant coatings for applications for military trucks in desert environments. How might desert environments produce unique challenges for vehicles?
  - Explain how lighting a match works (don't just Google this, use evidence from your investigation).
  - Friction welding is a process by which two materials are fused together by pressing them against each other while one of the two parts is rotated at high speeds. Explain how this works at the molecular level.
  - When an object is warmer than the surrounding air, how does it cool?
  - Why do car tires heat up while the car is in motion? How does this affect the tire pressure?
- Groups will travel to each station to complete their worksheet.
- The station descriptions are the following:
  - PhET Simulation: Students will open a simulation that explores fiction by sliding a chemistry book back and forth while observing the atoms temperature and movement.
  - Sand Jar: Student will record the initial temperature of the sand jar. Once recorded, the students will seal the jar and shake it for five minutes. After they have finished shaking, they will record the final temperature.
  - Rubber Band: Students will take a rubber band and put it on their lips. They will then stretch it out several times and replace it onto their lips. Students will record their observations. Once finished, they will throw away the used rubber band.
  - Hot Wheels: students will roll a car down a track while recording. Students will measure the change in height from where the car starts and ends with a ruler.
  - Bow Drill: Students will watch a YouTube video and complete different questions about the forces acting on the object.

Closure:

- After the students have completed the stations, their group will devise their own experiment to collect at least three pieces of photo/video evidence to support their conclusion to their Science Talk.
- Students will brain storm what materials their group will need to collect their data.
- They will end the lesson by reflecting on what they learned that day and ideas for their Science Talk.

Day 2

Exploration:

- Students will spend this day constructing their experiment, analyzing data, and creating their Science Talk presentation.

Day 3

Presentation:

- Students will take turns presenting their Science Talk presentation.
- Students will be scored based on the provided rubric.
- The talk will include the following:
    - Topic slide
    - Claim
    - Three types of evidence
    - Reasoning
    - References

Differentiation

- Provide learners with the opportunity to draw a picture and label the picture instead of write a sentence.
- Allow students to demonstrate their understanding verbally, instead writing a response.
- Partner students up with a peer who can mentor and guide them throughout the lesson.
- Chunk the lesson into several smaller lessons.
- The teacher can choose to assign a topic to a group based on their ability level.

Assessment

Formative assessment:

- Teacher can assess group and class discussions to gauge students understanding of a given topic.
- The teacher can review the student's lab responses to observe their understanding throughout the lesson.

Summative assessment:

- The students' final Science Talk will allow the students to apply what they have learned throughout the whole lesson. The teacher may use the given rubric to score the presentations and content.

Friction & Work Activities

Name(s): _____

Learning Objectives:

1. Identify how friction generates heat.
2. Quantify the energy released to the environment as heat to mathematically prove that the energy put into a system equals the energy that comes out of the system.

Directions: Pick one of the following questions from which to base your Science Talk – only one group can present each question, so claim your topic early. Gather photo/ video/ numeric evidence from the following activities to support your conclusions. You can also perform your own investigations tomorrow to gather evidence. Please turn this lab and prepare your Science Talk. Ask for approval if you have a different topic in mind that you would like to explore for your Science Talk.

Possible Topics:

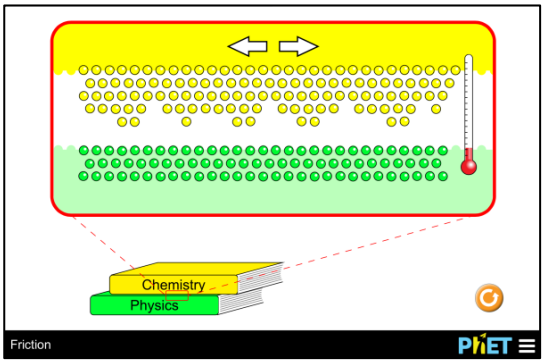
1. How can you manipulate the amount of friction acting on your mousetrap car to make it travel further?
2. Where does the heat come from in the rubber band activity?
3. Toasters create infrared radiation by passing electricity through nichrome, an alloy of nickel and chromium that has a high electrical resistance. How is heat generated in a toaster?
4. Explain how aerodynamic friction can be catastrophic for spacecraft.
5. Determine the amount of energy converted to heat in the hot wheels investigation and calculate the coefficient of friction between the car and the track. Compare the green and yellow cars for differences in the amount of friction.
6. Years ago, someone did research in tribology (the study of friction) at Argonne National Laboratory. She analyzed the wear marks on steel balls that rubbed together at high temperatures using different lubricant coatings for applications for military trucks in desert environments. How might desert environments produce unique challenges for vehicles?
7. Explain how lighting a match works (don't just Google this, use evidence from your investigation).
8. Friction welding is a process by which two materials are fused together by pressing them against each other while one of the two parts is rotated at high speeds. Explain how this works at the molecular level.
9. When an object is warmer than the surrounding air, how does it cool?
10. Why do car tires heat up while the car is in motion? How does this affect the tire pressure?

Required Activities:

1. PhET Simulation: Go to the PhET App → Physics → Friction.

a. Slide the Chemistry book back and forth. What happens to the atoms as you move the chemistry book back and forth?

b. What happens to the temperature (level of fluid in the thermometer) as the atoms begin wiggling?

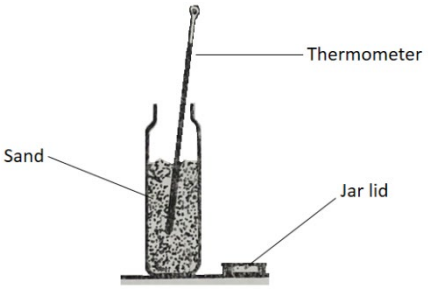


c. Explain why the temperature goes up as the atoms move faster. *Hint: think back to chemistry, what does temperature measure?*

d. Push the chemistry book down onto the Physics book while sliding it back and forth. What variable are you changing in the equation for friction ($F_F = \mu F_N$).

e. Why did the atoms move around faster (and the temperature went up) when you push the two books together? **(Worth 2 points)**

2. **Sand Jar:** Insert the thermometer into the container of sand or gravel. Record the initial temperature here: _____. Put the lid on the jar and take turns shaking the jar for the next 5 minutes. You can go on to the next activity while the jar is shaking. After 5 minutes, record the temperature of the sand or gravel again. Record the final temperature here: _____.



   a. Did the temperature change over the 5 minutes? If so, how?

   b. What type of energy did you give the particles?

   c. How did that energy convert to heat?

   Compare your answer with a group that used the opposite material (if you used sand, compare with a group with gravel.)

   d. Which had a greater change in temperature, sand or gravel?

   e. What does your answer from part d tell you about the properties of that material? *Hint: use the words coefficient of friction, heat, and energy.* **(Worth 2 points)**

3. **Rubber Band:** Take a rubber band and put it on your lip (not in your mouth, that's gross). Answer the first question. Stretch it several times without breaking it. Let it return to its normal size. Put the rubber band up to your lip again. Do this a couple times, answer the questions, and then throw your rubber band away.
   a. How does the rubber band feel before stretching it?

   b. How does the rubber band feel after stretching it?

   c. Where did that energy come from? *Hint: use the words potential energy, kinetic energy, and heat.* **(Worth 2 points)**

4. **Hot Wheels:** Allow the unweighted car to roll down the track and up the other side while using your camera to video record the experiment. Measure the change in height from where the car started to where it ended. Do this process several times to determine the change in height.
   a. What is the average change in height?

   b. Where did the energy that was lost transfer to?

c. Try this again with the weighted car. How did the change in height compare? Why did this happen?

d. Explain your observations. *Hint: use the words potential energy, kinetic energy, friction, and heat.* **(Worth 2 points)**

e. Use your knowledge of potential energy, work, friction, and the Law of Conservation of Energy to develop an equation to calculate the energy lost due to friction and the coefficient of friction. **(Worth 15% of this assignment)**

f. Use the second equation that you derived in 4e to calculate the coefficient of friction between the yellow car and the track. **(Worth 15% of this assignment)**

5. **Bow Drill:** https://www.youtube.com/watch?v=s_GZywRXHSs
   a. Draw a FBD to model what is happening at the molecular level and label the forces involved. **(Worth 10% of this assignment)**

   b. Write a few sentences that explains how the fire started. *Hint: use the words rotation, centripetal force, force of friction, work, and heat.* **(Worth 2 points)**

   c. How can you improve the effectiveness of the bow drill?

6. **Science Talk Requirements & Presentation:** Now that you have a basic understanding of energy lost due to friction, decide how you will answer your science talk question. Devise your own experiment in order to collect at least 3 pieces of photo/ video evidence to support your conclusions. You may also use online resources, but you must cite your work in the references. Information gathered online does not count toward your 3 pieces of evidence but will help you gain a better understanding of your topic. Discuss your plan with the teacher in order to have the appropriate materials ready for you tomorrow. Please review the rubric for specific requirements.

a. Procedures for tomorrow: what evidence will you collect tomorrow and how will you collect it?

b. Materials necessary:

7. Reflection and Evaluation. Answer these upon completion of the science talks and discussion.

a. What did you learn from this laboratory activity?

b. Did your ideas about hot/ cold change after the science talks or the initial explorations? If so, how?

c. How well did your evidence support your science talk? Were you able to use it to defend your answers?

d. If you were to do this lab again, what would you do differently?

Grading Rubric

(Weighted Scores)	Missing/ Inadequate 0 Points ☹	Emerging 1 Point	Satisfactory 2 Points	Above Average 3 Points	Advanced 4 Points ☺
Modeling Question 5a **(10%, 4 points)**	Did not attempt question 5a	Model is missing multiple pieces of information or is incorrect	Model is missing either the movement of the molecules or one of the forces, but the information provided is correct	Model accurately shows the movement of molecules; accurately shows F_N, F_C, F_F, & applied force	Model accurately shows the movement of molecules; is neat and creative; accurately shows F_N, F_C, F_F, & applied force
Calculations Questions 4e & 4f **(15%, 6 points)**	Did not attempt questions 4e or 4f	Attempts to derive both equations and solve for an answer but there are multiple errors or inadequate work	Derives new equations using previous knowledge and calculates values; show all steps in derivations; contains 2+ errors	Derives new equations using previous knowledge and calculates values; shows all steps in derivations; contains 1 error	Derives new equations using previous knowledge; accurately calculates values; shows all steps in derivations
Other Questions **(5%, 12 points)**	Each question is worth 1 point, for a total of 24 points; Your score: _____				
Reflection & Evaluation **(5%, 2 points)**	Each question is worth 1 point, for a total of 4 points. Your score: _____				
Evidence **(25%, 10 points)**	No evidence was provided, or the student did not complete the Science Talk	One or more pieces of evidence does not support argument	Contains 1 piece of photo/ video evidence that accurately supports argument	Contains 2 pieces of photo/ video/ numeric evidence that accurately support argument	Contains 3+ pieces of photo/ video/numeric evidence that accurately support argument
Presentation **(25%, 10 points)**	Did not turn in the presentation	Missing or inadequate information; sloppy; no apparent organization; missing references	Title slide with student name(s) and topic; claim, evidence and reasoning are attempted but contain errors; references if necessary.	Title slide with student name(s) and topic; claim, evidence and reasoning are all listed correctly; references if necessary.	Title slide with student name(s) and topic; claim, evidence and reasoning are all listed correctly and organized well; references if necessary.
Science Talk **(15%, 6 points)**	Did not present	Missing 3-4 of the following: legible slides; speaks to class; speaks loud and clear; answers questions using evidence	Missing 2 of the following: legible slides; speaks directly to class; speaks loud and clear; answers questions using evidence	Missing 1 of the following: legible slides; speaks directly to class; speaks loud and clear; answers questions using evidence	Legible slides; speaks directly to class; speaks loud and clear; answers questions using evidence

Weighted Score: _____ / 50

Friction & Work Activities

Name(s): Jenna [redacted], Matt [redacted]

Learning Objectives:

1. Identify how friction generates heat.
2. Quantify the energy released to the environment as heat to mathematically prove that the energy put into a system equals the energy that comes out of the system.

Directions: Pick one of the following questions from which to base your Science Talk – only one group can present each question, so claim your topic early. Gather photo/ video/ numeric evidence from the following activities to support your conclusions. You can also perform your own investigations tomorrow to gather evidence. Please turn this lab (either this paper or through iTunesU) and prepare your Science Talk. Ask Ms. Caine for approval if you have a different topic in mind that you would like to explore for your Science Talk.

Possible Topics:

1. How can you manipulate the amount of friction acting on your mousetrap car to make it travel further?
2. Where does the heat come from in the rubber band activity?
3. Toasters create infrared radiation by passing electricity through nichrome, an alloy of nickel and chromium that has a high electrical resistance. How is heat generated in a toaster?
4. Explain how aerodynamic friction can be catastrophic for spacecraft.
5. Determine the amount of energy converted to heat in the hot wheels investigation and calculate the coefficient of friction between the car and the track. Compare the green and yellow cars for differences in the amount of friction.
6. Years ago, Ms. Caine did research in tribology (the study of friction) at Argonne National Laboratory. She analyzed the wear marks on steel balls that rubbed together at high temperatures using different lubricant coatings for applications for military trucks in desert environments. How might desert environments produce unique challenges for vehicles?
7. Explain how lighting a match works (don't just Google this, use evidence from your investigation).
8. Friction welding is a process by which two materials are fused together by pressing them against each other while one of the two parts is rotated at high speeds. Explain how this works at the molecular level.
9. When an object is warmer than the surrounding air, how does it cool?
10. Why do car tires heat up while the car is in motion? How does this affect the tire pressure?

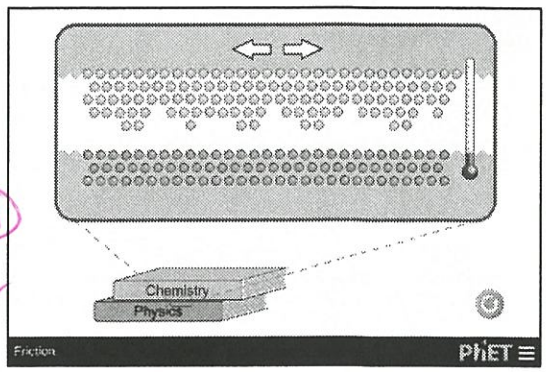
Required Activities:

1. **PhET Simulation: Go to the PhET App → Physics → Friction.**
   a. Slide the Chemistry book back and forth. What happens to the atoms as you move the chemistry book back and forth? when sliding the chemistry book ✓ nothing happens.

   b. What happens to the temperature (level of fluid in the thermometer) as the atoms begin wiggling?
   The temperature goes up. ✓

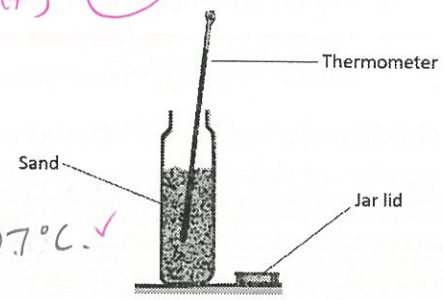
   c. Explain why the temperature goes up as the atoms move faster.
   Hint: think back to chemistry, what does temperature measure? (-1)
   More friction generates more heat. Temp measures KE, so more atomic movement means it is warmer

   d. Push the chemistry book down onto the Physics book while sliding it back and forth. What variable are you changing in the equation for friction ($F_F = \mu F_N$).
   you are changing F_N ✓



e. Why did the atoms move around faster (and the temperature went up) when you push the two books together? **(Worth 2 points)** Higher ~~coefficient of friction~~ generates more heat. Normal force (you can't change the coefficient, you added weight) (-2)

2. **Sand Jar:** Insert the thermometer into the container of sand or gravel. Record the initial temperature here: 21.48°C. Put the lid on the jar and take turns shaking the jar for the next 5 minutes. You can go on to the next activity while the jar is shaking. After 5 minutes, record the temperature of the sand or gravel again. Record the final temperature here: 24.75°C.



a. Did the temperature change over the 5 minutes? If so, how?
Yes, after giving it KE increased around 3.07°C. ✓

b. What type of energy did you give the particles?
We gave the particles kinetic energy. ✓

c. How did that energy convert to heat?
As we gave the particles kinetic energy they were sliding past each other. This sliding creates friction between particles which generates heat energy. great!

Compare your answer with a group that used the opposite material (if you used sand, compare with a group with gravel.)

d. Which had a greater change in temperature, sand or gravel?
The gravel had a greater temperature change → 4.26 for one group → 3.9 for another group ✓

e. What does your answer from part d tell you about the properties of that material? *Hint: use the words coefficient of friction, heat, and energy.* **(Worth 2 points)**
A higher coefficient of friction generates more heat energy. ok

3. **Rubber Band:** Take a rubber band and put it on your lip (not in your mouth, that's gross). Answer the first question. Stretch it several times without breaking it. Let it return to its normal size. Put the rubber band up to your lip again. Do this a couple times, answer the questions, and then throw your rubber band away.

a. How does the rubber band feel before stretching it?
The rubber band feels normal, room temperature ✓

b. How does the rubber band feel after stretching it?
The rubber band feels slightly warmer ✓

c. Where did that energy come from? *Hint: use the words potential energy, kinetic energy, and heat.* **(Worth 2 points)**
We started with potential energy and as we started stretching the rubber band that transfered to kinetic energy which then generated heat energy. Be careful here B/c KE doesn't automatically create heat. (-1)

*Photo evidence

4. **Hot Wheels:** Allow the yellow car to roll down the track and up the other side while using your iPad camera to video record the experiment. Measure the change in height from where the car started to where it ended. Do this process several times to determine the change in height.

a. What is the average change in height? Δh

yellow = 3 cm

green = 13 cm

b. Where did the energy that was lost transfer to?

friction which generates heat energy ✓

c. Try this again with the weighted car (green car). How did the change in height compare? Why did this happen?

The weighted car didn't go as high because a heavier weight this generates more friction ✓

d. Explain your observations. *Hint: use the words potential energy, kinetic energy, friction, and heat.* **(Worth 2 points)**

The car's starting potential energy turns into kinetic energy. However, with the weighted car more friction was generated which causes energy to be lost due to heat

great

e. Use your knowledge of potential energy, work, friction, and the Law of Conservation of Energy to develop an equation to calculate the energy lost due to friction and the coefficient of friction. **(Worth 15% of this assignment)**

energy ← $E_{in} = E_{out}$

~~$F_F = \mu F_N$~~

~~$mgh = \frac{1}{2}$~~

$PE_{in} - KE - PE_{out}$ ✓

$PE_{in} \rightarrow PE_{out} + W_F$

$mgh \rightarrow mgh + W_F$

rearrange

$W_F = mgh_{start} - mgh_{stop}$ ✓

Show your work next time. You are correct though I can see how you did it.

f. Use the second equation that you derived in 4e to calculate the coefficient of friction between the yellow car and the track. **(Worth 15% of this assignment)**

yellow car → $\frac{3}{134.5cm} = 0.02$

green car → $\frac{13}{107.5} = .12$

$W_F = F_F d$

$F_F = \mu F_N$

$W_F = mg(h_{start} - h_{stop})$

$\frac{\mu F_F}{F_F}$ $\frac{\mu F_d}{F_d}$

$\mu = \frac{mg(h_{start} - h_{stop})}{mgd}$

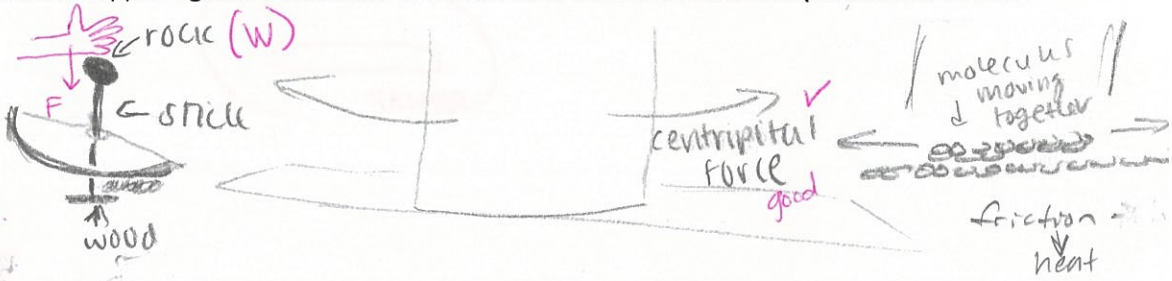
$\frac{h_{start} - h_{stop}}{\text{distance traveled}}$ ✓

SR

good job simplifying like terms!

5. **Bow Drill:** https://www.youtube.com/watch?v=s_GZywRXHSs

a. Draw a FBD to model what is happening at the molecular level and label the forces involved. **(Worth 10% of this assignment)**



Both the rock + your hand push down, adding more weight (F_N) so more friction is generated.

b. Write a few sentences that explains how the fire started. *Hint: use the words rotation, centripetal force, force of friction, work, and heat.* **(Worth 2 points)**

when starting a fire as you are rotating the stick you are doing work on the wood. This rotating motion generates a ~~high coefficient of~~ friction pulling the force to the center (centripital force) which generates heat energy.

SR

Very good!

c. How can you improve the effectiveness of the bow drill?

Make sure the wood you are using is dry wood, make sure friction is being created.

6. **Science Talk Requirements & Presentation:** Now that you have a basic understanding of energy lost due to friction, decide how you will answer your science talk question. Devise your own experiment in order to collect at least 3 pieces of photo/ video evidence to support your conclusions. You may also use online resources, but you must cite your work in the references. Information gathered online does not count toward your 3 pieces of evidence but will help you gain a better

when an object is warmer than the surrounding air, how does it cool.

understanding of your topic. Discuss your plan with Ms. Caine in order to have the appropriate materials ready for you tomorrow. Please review the rubric for specific requirements.

a. Procedures for tomorrow: what evidence will you collect tomorrow and how will you collect it?
TOMORROW we will start with the temperature of a hot coffee cup and then measure the temperature as it sits out to document how heat travels. The temperature probe will be on top of the coffee cup.

b. Materials necessary:
coffee cup, temperature probe, ipad with spark vue ✓

Lets put one in the cup too. And, I'd measure the temp a few times during the class.

7. Reflection and Evaluation. Answer these upon completion of the science talks and discussion.

a. What did you learn from this laboratory activity?
during this lab activity, Matt and I learned that as there is more kinetic energy, more friction is generated which causes more heat. The hot wheels lab also emphasized heavier objects don't go as far due to friction good.

b. Did your ideas about hot/ cold change after the science talks or the initial explorations? If so, how?
Yes. Before our science talk we thought that cold air moved and thats how a surrounding object would cool. However, now we know that warm air travels and moves away from an object allowing it to cool. Great!

c. How well did your evidence support your science talk? Were you able to use it to defend your answers?
our evidence strongly supported our claim in our science talk. we documented that in the beginning temperature of the coffee cup was significantly higher than the ending temperature, meaning that heat traveled away from the coffee mug. ✓

d. If you were to do this lab again, what would you do differently?
we were very happy with our results. If we were to do something different we would do several runs with the coffee mug to make our data more valid.

great!

Grading Rubric

(Weighted Scores)	Missing/ Inadequate 0 Points ☹	Emerging 1 Point	Satisfactory 2 Points	Above Average 3 Points	Advanced 4 Points ☺
Modeling Question 5a **(10%, 4 points)**	Did not attempt question 5a	Model is missing multiple pieces of information or is incorrect	Model is missing either the movement of the molecules or one of the forces, but the information provided is correct (applied F)	Model accurately shows the movement of molecules; accurately shows F_N, F_C, F_F, & applied force	Model accurately shows the movement of molecules; is neat and creative; accurately shows F_N, F_C, F_F, & applied force
Calculations Questions 4e & 4f **(15%, 6 points)**	Did not attempt questions 4e or 4f	Attempts to derive both equations and solve for an answer but there are multiple errors or inadequate work	Derives new equations using previous knowledge and calculates values; show all steps in derivations; contains 2+ errors	Derives new equations using previous knowledge and calculates values; shows all steps in derivations; contains 1 error	Derives new equations using previous knowledge; accurately calculates values; shows all steps in derivations good
Other Questions **(5%, 12 points)**	Each question is worth 1 point, for a total of 24 points; Your score: 20				
Reflection & Evaluation **(5%, 2 points)**	Each question is worth 1 point, for a total of 4 points. Your score: 4				
Evidence **(25%, 10 points)**	No evidence was provided, or the student did not complete the Science Talk	One or more pieces of evidence does not support argument	Contains 1 piece of photo/ video evidence that accurately supports argument	Contains 2 pieces of photo/ video/ numeric evidence that accurately support argument	Contains 3+ pieces of photo/ video/numeric evidence that accurately support argument (discussed website)
Presentation **(25%, 10 points)**	Did not turn in the presentation through iTunesU	Missing or inadequate information; sloppy; no apparent organization; missing references	Title slide with student name(s) and topic; claim, evidence and reasoning are attempted but contain errors; references if necessary. Turned in through iTunesU	Title slide with student name(s) and topic; claim, evidence and reasoning are all listed correctly; references if necessary. Turned in through iTunesU	Title slide with student name(s) and topic; claim, evidence and reasoning are all listed correctly and organized well; references if necessary. Turned in through iTunesU on time
Science Talk **(15%, 6 points)**	Did not present	Missing 3-4 of the following: legible slides; speaks to class; speaks loud and clear; answers questions using evidence	Missing 2 of the following: legible slides; speaks directly to class; speaks loud and clear; answers questions using evidence	Missing 1 of the following: legible slides; speaks directly to class; speaks loud and clear; answers questions using evidence	Legible slides; speaks directly to class; speaks loud and clear; answers questions using evidence great!

Weighted Score: 46 / 50

92% Great Job!

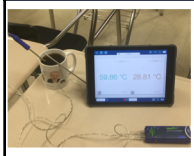
Science Talk: When an object is warmer than the surrounding air, how does it cool?

Jenna and Matt

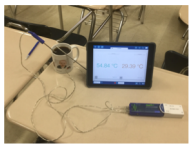
Claim:

Hot air travels. When you have an object that is warmer than the surrounding air the hot air will leave the surrounding object allowing the object to cool down.

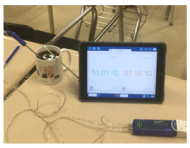
Evidence 1: Coffee Cup



Original temperature

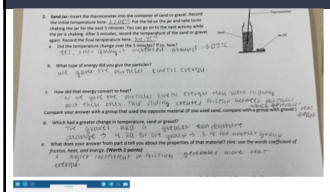


After 5 minutes



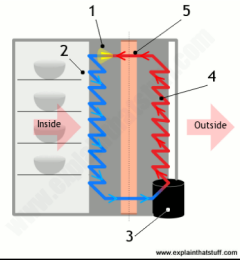
After 10 minutes

Evidence 2: Sand Jar



Results after shaking the sand for 5 minutes. There was an increase in temperature around 3.07 degrees celsius.

Evidence 3: Opening a Refrigerator



The heat from inside the refrigerator is transferred to the coils and is then sent outside of the refrigerator. The food in the refrigerator stays cold and the back of the refrigerator is warm.

Reasoning:

Heat represents the movement of atoms. The atoms can transfer their energy to others, allowing warmer objects to cool and cold objects to warm up. The coffee transferred its heat to the air, the sand jar created heat through friction through the movement of atoms, and refrigerators transfer heat through the coils.

References:

Image: https://www.explainthatstuff.com/refrigerator.html