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**Introduction**

**Student Teacher** \_Dawn Martin\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Cooperating Teacher** \_Steve Pinkall\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**School** \_Seward High School\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Context of Teaching**

The class consists of nineteen students in 10th grade with varying math abilities. There is not ethnic diversity apparent in the classroom, however the students come from a wide range of socioeconomic backgrounds. The class does not have any IEPs. Overall, the class is well behaved and stays on task when appropriately prompted. Some students require more attention during group activities.

My TWS covers chapter 6, temperature and thermal energy. The class will have a unit test over chapter 5 & 6 after the completion of my TWS unit. I had a lot of freedom when creating my unit. However, I did not create the Unit Test.

**Understanding by Design Stage One**

|  |
| --- |
| **Stage 1 – Identify Desired Results** |

Established Goals:

|  |
| --- |
| SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)  Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world. |

What understandings are desired?

|  |
| --- |
| *Students will understand that…*  … thermal energy and temperature is related to kinetic energy.  … thermal energy can be transferred just like mechanical energy.  … thermal energy depends on temperature.  … thermal energy can be quantified.  … thermal energy transfers by conduction, convection, and radiation.  … conductors and insulators are used to control the transfer of thermal energy.  … the first and second laws of thermodynamics govern the nature of heat flow. |

What essential questions will be considered?

|  |
| --- |
| How are heat and thermal energy related?  What is the nature of transfer thermal energy in conduction, convection, and radiation?  How is temperature different than heat?  What materials make good conductors and insulators?  What do the laws of thermodynamics tell us about the nature of thermal energy and how does that impact controlling temperatures? |

What key knowledge and skills will students acquire as a result of this unit?

|  |  |
| --- | --- |
| ***Students will know. . .***  **…** key vocabulary.  … the relationship between thermal energy, heat, and temperature.  … materials used to control thermal energy by either conduction or insulation.  … phase changes of water in relation to heat and thermal energy. | ***Students will be able to. . .***  … define key vocabulary.  … explain how thermal energy depends on temperature.  … explain how thermal energy and heat are related.  … calculate the change in thermal energy.  … compare and contrast conduction, convection, and radiation as forms of transferring thermal energy.  … identify thermal conductors and insulators  … explain how conductors and insulators control the transfer of energy.  … explain phase changes of water using key terminology discussed in class.  … explain how cooling systems works using the words heat, coolant, evaporate, radiate, and condense. |

**Pre-Assessment**

As a bell ringer on Monday, students completed a quick objective quiz consisting of the following questions:

1. T or F: Temperature is the same thing as Heat
2. T or F: Work and Heat are related.
3. Y or N: I have seen the equation Q=mCΔT before.
4. T or F: Metals make good insulators.
5. Y or N: I could use the words conduction, convection, and radiation to describe boiling water.

Results for Pre-Assessment: 1 indicates correct answer or Yes; 0 indicates incorrect or No.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Student** | **1** | **2** | **3** | **4** | **5** | **Total** |
| Vinney Bye | 1 | 1 | 0 | 0 | 0 | 2 |
| Adam Caler | 1 | 1 | 0 | 1 | 1 | 4 |
| Brittanya Allen | 0 | 1 | 0 | 0 | 0 | 1 |
| Faith Davidson | 1 | 0 | 0 | 0 | 0 | 1 |
| Jarrod Decker | 1 | 0 | 0 | 0 | 0 | 1 |
| Kyle Glandt | N/A | N/A | N/A | N/A | N/A | N/A |
| Kalley Herrold | 1 | 0 | 0 | 1 | 0 | 2 |
| Emile Jensen | 0 | 1 | 0 | 0 | 0 | 1 |
| Allison Kadavy | 1 | 1 | 0 | 0 | 0 | 2 |
| Jared Kordova | 0 | 0 | 0 | 0 | 0 | 0 |
| Seth Majerus | 1 | 1 | 0 | 0 | 0 | 2 |
| Andrew Marr | 1 | 1 | 0 | 1 | 0 | 3 |
| Josh Mayhew | 0 | 0 | 0 | 0 | 0 | 0 |
| Riley Riser | 0 | 0 | 0 | 0 | 0 | 0 |
| Hope Robson | 0 | 0 | 0 | 1 | 0 | 1 |
| Duncan Stewart | 1 | 0 | 0 | 1 | 1 | 3 |
| Lindsey Tamasi | 0 | 0 | 0 | 1 | 0 | 1 |
| Brittany Uhing | 1 | 1 | 0 | 1 | 0 | 3 |
| Brittany Winn | 0 | 0 | 0 | 1 | 0 | 1 |

**Chart shows total correct answers for each question and class average.**

Students may have guessed on the true/false questions, however the Yes/No questions involving communicating vocabulary and an equation ranked lowest. The results do not surprise me after being in the classroom several weeks. I see that the students need to build strengths in communicating key concepts using vocabulary from the material and some students also struggle bridging the concepts to mathematical equations.

**Understanding by Design Stage Two**

|  |
| --- |
| **Stage 2 – Determine Acceptable Evidence** |

What evidence will show that students understand?

|  |
| --- |
| *Performance Tasks\* (summary in GRASPS form):*  Heat Transfer Lab  **Goal:** To observe how heat moves from one place to another.  **Role:** Investigator  **Audience:** Write your lab report like you are talking to your grandma on the phone.  **Situation:** Students will heat a beaker of water on a hot plate and observe activity of pepper in the water. The student will also investigate whether a glass stirring rod or metal spoon conducts heat faster. The students will see all three forms of heat transfer in this activity.  **Performance:** The students will write a lab report following the rubric and complete with a conclusion displaying their understanding of heat transfer.  **Standards:** The rubric for the lab report are as follows:  Introduction – 3pts  Materials & Procedure- 7pts  Data – 5pts  Conclusion – 1pts  Total – 25pts  \*Activity Handout is provided below. |

**Transfer of Heat**

**Materials**

Hot plate, water, 250 mL heat resistant beaker, pepper(aluminum foil) thermometer, metal spoon, glass stirring rod.

**Purpose:** to determine how heat moves from one place to another.

**Procedure**

1. Plug in a hot plate. Turn the setting to high. Hold your hand about 10 cm to the side and slightly above the hot plate. Do you feel the heat? What type of heat transfer is this?
2. Turn the hot plate setting to low. Fill the beaker a little more than half full with water. Carefully place the beaker on the hot plate. Drop the pepper into the water. Observe what happens to the pepper as it warms. Record observations.
3. Leave the water on the hot plate for about 5 minutes. After the 5 minutes, hold a thermometer so that the bulb is just below the surface of the water. Read and record the temperature of the water near the top.

Temperature at top of water:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Hold the thermometer so that the bulb is near the bottom of the beaker. Read and record the temperature of the water near the bottom.

Temperature at the bottom of water: \_\_\_\_\_\_\_\_\_\_\_\_

1. Hold a metal spoon in one hand. Hold a glass rod in the other hand. Place the end of each in the heated water. Does the **glass** or the **metal** transfer heat to your hand first?
2. Turn off the hot plate. Allow it to cool before returning it to its storage location.

**Questions for Conclusion:**

1. What type of heat transfer did you observe when you held our hand by the hot plate?
2. Was the water near the top of the beaker or near the bottom of the beaker hotter?
3. What does the movement of the pepper tell you about the movement of the water in the beaker?
4. How does the water near the top get warm? What is this process called?
5. Explain what it means to be a conductor. Was the glass or metal a better conductor?
6. Define the three forms of heat transfer.

Conclusion must be in paragraph form, but be sure to discuss all 5 questions above .

Other Evidence (quizzes, tests, prompts, observations, dialogues, work samples):

|  |
| --- |
| -Tuesday Exit Pass:compare and contrast temperature and heat in a short paragraph.  -Wednesday Specific Heat Lab Activity class discussion. “In your own words, use the term *specific heat* to explain the class results” (see p 3 of notes)  -In class examples included in notes  -In class demonstrations included in notes.  -“Vocab Match-up” Each student given a card. Students match card with vocab word to card with definition.  - Review Day – vocab practice quiz  -End of Unit Test |

Student Self-Assessment and Reflection:

|  |
| --- |
| 1. What major insight did you glean from this learning experience?  2. What challenges did you encounter?  3. Which part was particularly helpful or enjoyable?  4. How may I improve the unit to assist your learning? |

**Post-Assessment**

Copy/Paste post-assessment document, rubric, criteria sheet, etc here.

Students took same post-assessment quiz that started the unit.

1. T or F: Temperature is the same thing as Heat
2. T or F: Work and Heat are related.
3. Y or N: I have seen the equation Q=mCΔT before.
4. T or F: Metals make good insulators.
5. Y or N: I could use the words conduction, convection, and radiation to describe boiling water.

Results for Assessment: 1 indicates correct answer or Yes; 0 indicates incorrect or No.

Shaded columns show Pre-Assessment results.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Student** | **1** | **1** | **2** | **2** | **3** | **3** | **4** | **4** | **5** | **5** | **Total** | **Total** |
| Vinney Bye | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 5 |
| Adam Caler | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 4 | 4 |
| Brittanya Allen | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 5 |
| Faith Davidson | 1 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 0 | N/A | 1 | N/A |
| Jarrod Decker | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 4 |
| Kyle Glandt | N/A | 1 | N/A | 1 | N/A | 1 | N/A | 0 | N/A | 1 | N/A | 4 |
| Kalley Herrold | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 2 | 5 |
| Emile Jensenn | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 4 |
| Allison Kadavy | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 4 |
| Jared Kordova | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 5 |
| Seth Majerus | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 4 |
| Andrew Marr | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 3 | 5 |
| Josh Mayhew | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 4 |
| Riley Riser | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 4 |
| Hope Robson | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 4 |
| Duncan Stewart | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 5 |
| Lindsey Tamasi | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 5 |
| Brittany Uhing | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 3 | 4 |
| Brittany Winn | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 4 |

Chart compares pre-assessment results of class to post-assessment results of class.

Performance Task Results: Total points possible 25

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Student** | **Introduction**  **(3)** | **Methods & Materials (7)** | **Results**  **(5)** | **Discussion**  **(10)** | **Total**  **(25)** |
| Vinney Bye |  |  |  |  |  |
| Adam Caler | 3 | 7 | 5 | 10 | 25 |
| Brittanya Allen | 3 | 7 | 5 | 7 | 22 |
| Faith Davidson | 3 | 7 | 5 | 10 | 25 |
| Jarrod Decker | 1 | 5 | 3 | 5 | 14 |
| Kyle Glandt | 3 | 7 | 4 | 10 | 24 |
| Kalley Herrold | 3 | 7 | 5 | 10 | 25 |
| Emile Jensen | 3 | 7 | 5 | 10 | 25 |
| Allison Kadavy | 3 | 7 | 5 | 10 | 25 |
| Jared Kordova |  |  |  |  |  |
| Seth Majerus |  |  |  |  |  |
| Andrew Marr | 3 | 5 | 3 | 7 | 18\* |
| Josh Mayhew | 1 | 4 | 3 | 6 | 14 |
| Riley Riser | 3 | 6 | 3 | 7 | 19\* |
| Hope Robson | 3 | 7 | 5 | 10 | 25 |
| Duncan Stewart |  |  |  |  |  |
| Lindsey Tamasi | 3 | 7 | 5 | 10 | 25 |
| Brittany Uhing | 3 | 7 | 5 | 10 | 25 |
| Brittany Winn | 2 | 5 | 5 | 7 | 19 |

\* indicates late submission. Will receive a grade reduction.

**Lesson Plans**

**Student Teacher: Dawn Martin Grade Level: 10th Date:** 2.11.13

**State Standard: SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)**

**Subject: Physical Science**

**Name of Lesson: Temperature vs. Heat Period / Time: 2nd 9:45-10:13**

|  |  |
| --- | --- |
| **I. Goal:**  The student will know the difference between temperature and thermal energy. | **Required Adaptations/Modifications:** |
| **II. Objectives:**  1. The student will be able to calculate Mechanical Advantage on the review problems.  2. The student will be able to define temperature after completing the reading guide  3. The student will be able to explain how thermal energy depends on temperature after direct instruction.  4. The student will be able to explain how thermal energy and heat are related after direct instruction. | **Required Adaptations/Modifications:** |
| **III: Faith / Values Integration:**  Group work | **Required Adaptations/Modifications:**  - Make sure Josh contributes in group. |
| **IV. Integrated Technology:**  Powerpoint presentation | **Required Adaptations/Modifications:** |
| **V. Materials:**  thermometers, ice water, hot water, large tub of water, 2 beakers, note packet, review flash cards, Problem set, reading guide , powerpoint slides, Temp vs. Heat video | **Required Adaptations/Modifications:** |
| **VI: Procedure:**     1. Set / Hook:   Bellringer: Get activity book, textbook, and hand out on filing cabinet.  Take Pre-Chapter Survey on half-sheet of paper. Students will turn it in to the front of class.  5 min     1. Transition:   “Before we start our new chapter on Heat and Temperature, I have a fun game planned to review last weeks vocab words!"  C. Main Lesson:  1. The students will play "vocab match-up," and discuss the matchups.  15min  - The students will review the words: work, Joule, watt, power, machine, effort force, resistance force, mechanical advantage, simple machine, lever, resistance arm, effort arm, fulcrum, pulley, wheel & axle, incline plane, screw, wedge, compound machine.  2. The students will complete #1-6 Problem Set to review calculating Mechanical Advantage from last week.  25min  3. When the student completes #1-6, the students will begin reading ch. 6 section 1 with Reading guide.  15min  4. Watch "Temp & Heat" Eureka Video  5 min  5. The teacher will begin 6.1 notes (complete top half)  25min  Demonstrations include:  -Big tub of water vs small cup to show temperature vs Heat  -food coloring in hot water and cold water to show particles move faster in substances with higher temperature  D. Transition: “Please put away text book. “  E. Conclusion:  “Tomorrow we will continue building on the section 1 concepts and reviewing last week’s material.” | **Required Adaptations/Modifications:**   * for vocab match-up may need to pair up if there is an odd number * Monitor Riley & Josh’s progress on reading guide. |
| **VII. Assessment:**  "Vocab match-up"  Review problems  Reading guide  Informal questioning | **Required Adaptations/Modifications:** |
| **VIII. Assignment:** | **Required Adaptations/Modifications:** |
| **IX. Self-Evaluation:**  Most of the lesson went smoothly. The review portion took longer than I originally planned, but it didn’t pose any problems. The students were able to catch onto the reading guide quickly. | **X. Coop’s Comments:**  Good vocab game. Its good to get students to interact and move around. Good with pacing of the agenda. Students always had something to do. |

**Student Teacher: Dawn Martin Grade Level: 10th Date:** 2.12.13

**State Standard: SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature).**

**Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.**

**Subject: Physical Science**

**Name of Lesson: More Temperature vs. Heat Period / Time: 2nd 9:45-10:13**

|  |  |
| --- | --- |
| **I. Goal:**  The students will observe differences between temperature and thermal energy. | **Required Adaptations/Modifications:** |
| **II. Objectives:**  1. The student will be able to define temperature after completing the reading guide.  2. The student will be able to explain how thermal energy depends on temperature after direct instruction.  3. The student will be able to explain how thermal energy and heat are related after direct instruction.  4. The student will be able to calculate the change in thermal energy given the necessary information. | **Required Adaptations/Modifications:** |
| **III: Faith / Values Integration:**  Group work | **Required Adaptations/Modifications:** |
| **IV. Integrated Technology:**  Powerpoint presentation | **Required Adaptations/Modifications:** |
| **V. Materials:**  Thermometers, notes, practice problems, reading guide, powerpoint slides | **Required Adaptations/Modifications:** |
| **VI: Procedure:**     1. Set / Hook:   Bellringer: Get text book and have notes and reading guide ready.   1. Transition:   “Today we’ll start by reviewing last week’s material with practice problems.  C. Main Lesson:  1. The students will complete # 7-13 problem set from last week's material. Students will work individually or in small groups.  35 min  2. After student completes problems, the student will work on reading guide. Once all students complete 6.1 reading guide we will continue notes  20min  3. Teacher will lead the class in direct instruction finishing p. 1-2 of notes.  Class demonstration included "sand in a bottle." Class will discuss how kinetic energy affects temperature.  20min  4. As an exit pass the students will compare and contrast temperature and heat in a short paragraph. When the student completes exit pass, the student will work on reading guide.  15min    D. Transition: “Please put away text book. “  E. Conclusion:  “On your way out of class, please leave your exit pass on the back desk. Tomorrow we have a fun lab activity planned.” | **Required Adaptations/Modifications:**   * Monitor Riley & Josh’s progress on reading guide. * Get absent students caught up. |
| **VII. Assessment:**  Review problems  Reading guide  Informal questioning  Exit pass | **Required Adaptations/Modifications:**  - Keep Adam and Vinny from blurting out answers for informal questioning. |
| **VIII. Assignment:** | **Required Adaptations/Modifications:** |
| **IX. Self-Evaluation:**  The lesson had less action than I would have liked, but in order for the students to be ready for the activity tomorrow, it had to happen this way. The exit passes showed me the students are grasping the first big concept for the section. I’m confident they’ll be ready for tomorrow’s material.  For sand demonstration, I needed to sell out the crazy more. | **X. Coop’s Comments:**  Make sure students who have already completed the first task move on to the next and do not distract others while you’re giving individual attention to a student. Good videos to keep students engaged. |

**Student Teacher: Dawn Martin Grade Level: 10th Date:** 2.13.13

**State Standard: SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)**

**Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.**

**Subject: Physical Science**

**Name of Lesson: Specific Heat & Heat Transfer Period / Time: 2nd 9:45-10:13**

|  |  |
| --- | --- |
| **I. Goal:**  The students will observe differences between temperature and thermal energy and be able to quantify specific heat. | **Required Adaptations/Modifications:** |
| **II. Objectives:**  1. The students will be able to determine the specific heat of various materials in the specific heat lab activity.  2. The students will be able to compare and contrast the transfer of thermal energy by conduction, convection, and radiation after direct instruction.  3. The students will be able to compare and contrast thermal conductors and insulators after direct instruction.  4. The students will be able to explain how insulators are used to control the transfer of thermal energy after completing the reading guide. | **Required Adaptations/Modifications:** |
| **III: Faith / Values Integration:**  Group work | **Required Adaptations/Modifications:** |
| **IV. Integrated Technology:**  Powerpoint presentation | **Required Adaptations/Modifications:** |
| **V. Materials:**  for lab activity: graduated cylinder, 2 Styrofoam cups, 1000mL beaker, hot plate, thermometer, 70g metal sample, safety goggles, string.  notes  Reading guide  powerpoint slides | **Required Adaptations/Modifications:** |
| **VI: Procedure:**   1. Set / Hook:   Bellringer: Calculate the change in temperature if the thermal energy is 1,000,000J, the water in the pond has a mass of 1000kg and a specific heat of 4,184 J/kg°C. (Example 3 in Notes)   1. Transition:   “Go back to your desk and open your activity book to Specific Heat - Activity Lab.”  C. Main Lesson:  1. The teacher will give directions for lab activity.  2. The students will complete lab activity.  Remind students to record results on board.  30 min    3. The teacher will lead the class in discussion about specific heat.  10 min  4. The students will work on reading guide and complete 6.2.  10min  5. The teacher will lead the class in direct instruction over 6.2 notes.  - Youtube examples: simple conduction and convection currents in Earth’s mantle.  20 min  6. The students will complete Problem Set #14-18.  10min    D. Transition: “Please put away text book. “  E. Conclusion:  “Tomorrow we will do another lab. This time we'll write a lab report.” | **Required Adaptations/Modifications:**   * Make sure Josh joins a group. * Monitor Riley & Josh’s progress on reading guide. * be prepared to catch up absent students.   **Groups**  Vinney & Adam  Brittanya & Kalley  Faith & Allie & Brittany U.  Jarrod & Seth  Jared & Riley  Emile & Brittany Winn  Andrew & Duncan  Hope & Lindsey  Josh & Kyle |
| **VII. Assessment:**  "Vocab match-up"  reading guide  activity lab discussion  informal questioning | **Required Adaptations/Modifications:**  - Keep Adam and Vinny from blurting out answers for informal questioning. |
| **VIII. Assignment:** | **Required Adaptations/Modifications:** |
| **IX. Self-Evaluation:**  Not the greatest day. The lab didn't go as smoothly as I hoped because the measurements weren't very accurate. That made it difficult to use the results from the lab for illustration of “specific heat.” I needed to be more assertive about our lab procedure also. We wasted some time trying to get things moving.  Plan ahead twice as much for boiling water! | **X. Coop’s Comments:**  Have a backup when results aren’t accurate. Sometimes that happens. Good job trying to pick up the pieces. Students still understood concepts. |

**Student Teacher: Dawn Martin Grade Level: 10th Date:** 2.14.13

**State Standard: SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)**

**Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.**

**Subject: Physical Science**

**Name of Lesson: Heat Transfer & Phase Changes**

**Period / Time: 2nd 9:45-10:13**

|  |  |
| --- | --- |
| **I. Goal:**  The students will directly observe convection currents and develop key concepts for phase changes | **Required Adaptations/Modifications:** |
| **II. Objectives:**  1. The student will be able to discuss the convection currents occurring in the Activity Lab using terminology discussed in class.  2. The student will be able to quantify heat energy given mass, change in temperature, and specific heat of an object. | **Required Adaptations/Modifications:** |
| **III: Faith / Values Integration:**  Group work | **Required Adaptations/Modifications:** |
| **IV. Integrated Technology:**  Powerpoint presentation | **Required Adaptations/Modifications:** |
| **V. Materials:**  For lab: hot plate, water, 250 mL heat resistant beaker, pepper, thermometer, metal spoon, glass stirring rod  reading guide  notes  powerpoint slides | **Required Adaptations/Modifications:** |
| **VI: Procedure:**   1. Set / Hook:   Bellringer: get textbook and handout from filing cabinet. Read through "Heat Transfer Lab" handout.  5min   1. Transition:   "We have a lot of fun things planned today. So lets dive in."  C. Main Lesson:  1. Review conduction, convection, and radiation forms of heat transfer discussed in class yesterday.  5min  2. Teacher will give directions for Heat Transfer Lab.    3. Students will complete Heat Transfer Lab in groups of 2-3  20min  4. Students will section 6.3 of reading guide when completed with the lab.  15min  5. Teacher will guide class discussion over Lab and transfer of heat. Teacher will discuss expectations for Lab Report.  10min    6. Teacher will lead class through last section of notes - Phase Changes  20min  7. The students will complete problem set #19-21. When completed, if time remains, the students will work on Lab report.  15min    D. Transition: “Please put away text book. “  E. Conclusion:  "Remember we have a unit test next Wednesday. Tuesday will be a review day, but I'm not stopping you from reviewing over this long 4-day weekend!" | **Required Adaptations/Modifications:**   * Make sure Josh joins a group. * Monitor Riley & Josh’s progress on reading guide. * Keep Andrew, Lindsey and Hope on task during activity. * be prepared to catch up absent students.   **Groups:**  Vinney & Adam & Josh  Brittanya & Kalley & Lindsey  Faith & Allie & Brittany U.  Jarrod & Seth  Jared & Riley & Kyle  Emile & Brittany Winn & Hope  Andrew & Duncan |
| **VII. Assessment:**  Class discussion over Lab Activity  Reviewing vocab from previous day  practice problems. | **Required Adaptations/Modifications:** |
| **VIII. Assignment:** | **Required Adaptations/Modifications:** |
| **IX. Self-Evaluation:**  I had a lot of fun with this activity! Again, it took a while for the water to boil. I could have given students some practice problems to do while waiting for the water to heat up. Over all, the class went smoothly. | **X. Coop’s Comments:**  Good directions. Good Lab procedure for students to follow. Good illustrations for direct instruction. |

**Student Teacher: Dawn Martin Grade Level: 10th Date:** 2.19.13

**State Standard: SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)**

**Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.**

**Subject: Physical Science**

**Name of Lesson: Unit Review**

**Period / Time: 2nd 9:45-10:13**

|  |  |
| --- | --- |
| **I. Goal:**  Students will use class time to prepare for test tomorrow. | **Required Adaptations/Modifications:** |
| **II. Objectives:**  1. The student will be able to explain a cooling system using the words coolant, evaporate, heat, condense, and radiate.  2. The student will be able to express mastery to 80% of ch. 7 vocabulary on a practice matching quiz | **Required Adaptations/Modifications:** |
| **III: Faith / Values Integration:** | **Required Adaptations/Modifications:** |
| **IV. Integrated Technology:** | **Required Adaptations/Modifications:** |
| **V. Materials:**  **Practice vocab quiz**  **ch 7 Vocab Match-up cards**  **Review guide**  **Review question** | **Required Adaptations/Modifications:** |
| **VI: Procedure:**     1. Set / Hook:   Bellringer: Get textbook and note packets.  5min   1. Transition:   “Today is a review day for your test tomorrow.”  C. Main Lesson:  1. The class will play "vocab match-up" with ch. 7 vocabulary to review for practice vocab quiz.  10min  2. The class will take practice vocab quiz, a 10 word matching quiz.  10min  3. The class will spend time working individually or in small groups preparing for test. Each student will be given a review guide and practice questions.  45 min  4. The class will discuss cooling systems using the words coolant, heat, evaporate, condense, and radiate by looking at the mini-fridge in the room.  10 min  5. The students will present any questions, concerns or clarifications they have about the test tomorrow.  15min    D. Transition: “Please put away text book. “  E. Conclusion:  "Remember we have a unit test next Wednesday. Tuesday will be a review day, but I'm not stopping you from reviewing over this long 4-day weekend!" | **Required Adaptations/Modifications:**   * for vocab match-up, may need to pair up if there is an odd number * be prepared to catch up absent students. |
| **VII. Assessment:**  Reviewing vocab  practice problems  questions presented by class | **Required Adaptations/Modifications:** |
| **VIII. Assignment:** | **Required Adaptations/Modifications:** |
| **IX. Self-Evaluation:**  It was difficult to keep students reviewing for test when they wanted to work on their Lab report. But overall, the students seem prepared for the test tomorrow. | **X. Coop’s Comments:**  Easy day. Good job answering questions and directing review. |

**Student Teacher: Dawn Martin Grade Level: 10th Date:** 2.20.13

**State Standard: SC12.2.3.d Distinguish between temperature (a measure of the average kinetic energy of atomic or molecular motion) and heat (the quantity of thermal energy that transfers due to a change in temperature)**

**Students will integrate and communicate the information, concepts, principles, processes, theories, and models of the Physical Sciences to make connections with the natural and engineered world.**

**Subject: Physical Science**

**Name of Lesson: Unit 3 Test**

**Period / Time: 2nd 9:45-10:13**

|  |  |
| --- | --- |
| **I. Goal:**  Students will display knowledge of material in the form of an objective and subjective test. | **Required Adaptations/Modifications:** |
| **II. Objectives:** | **Required Adaptations/Modifications:** |
| **III: Faith / Values Integration:** | **Required Adaptations/Modifications:** |
| **IV. Integrated Technology:** | **Required Adaptations/Modifications:** |
| **V. Materials:**  **Review guide**  **Unit 3 Test**  **Answer Sheet** | **Required Adaptations/Modifications:** |
| **VI: Procedure:**     1. Set / Hook:   Take out review sheet to review for test.     1. Transition:   Remember, we have our test today. I'll give you time to review, but first, can I answer any questions regarding the test?  C. Main Lesson:  1. Students will review and ask questions.  15min  2. Teacher will hand out test and give directions after test is complete.  5min  3. Students will complete test.  45min  4. Students will work on Lab Report or chapter 8 note taking guide  25min  D. Transition:  “Tomorrow your Lab Report is due. Let me review the expectations for the Lab Report.”  E. Conclusion:  Remind students the rubric and what should be included in the conclusion. | **Required Adaptations/Modifications:**   * be prepared to catch up absent students. |
| **VII. Assessment:**  Reviewing vocab  practice problems  questions presented by class | **Required Adaptations/Modifications:** |
| **VIII. Assignment:**  Typed - Lab report | **Required Adaptations/Modifications:** |
| **IX. Self-Evaluation:** | **X. Coop’s Comments:**  Not present today. |

*Student Learning Progress*

Student learning was apparent judging by the pre-assessment and post-assessment quizzes. The table and chart shows improvement from the class as a whole and as each individual. Most students received 5/5 on the post-assessment quiz, and I am confident the students that received 4/5 have showed mastery of the material indicated in the performance task. While the students worked on the performance task (Heat Transfer Lab), I was hearing many great conversations and explanations regarding the lab and the concepts involved. I was, however, upset more students did not turn in the Lab reports. Each student had all the information and did most of the work in class, but many of them chose not to type a Lab report outside of the classroom.

Each objective was met on the objective level. The unit test indicated a portion of students struggled with the subjective items including free response questions or math problems. The performance task displayed mastery of the majority of the objectives, especially communicating with key vocabulary.

The class certainly made progress as a whole evident in the performance task. However, the understanding each student built through the Lab activities, class demonstrations, and in-class discussions seemed to be disconnected from the student’s ability to communicate the understanding in the form of the unit test. The unit test results were not horrible on the class level, but they were not has high as I expected.

I could improve the amount of guidance I give the students in math problems. Looking back, and after hearing the feedback from the students, I should have provided better direct instruction moving from simple math problems to more complex problems. The students would have benefitted from more practice.

*Personal Professional Growth*

This was the first complete unit I had made a reading guide corresponding with the textbook. Individually, the students were able to build a foundation with the text before we discussed concepts as a class in the class notes. I was very impressed with they way the students could use the textbook to find information.

I learned the importance of always having a back-up plan. When the specific heat lab activity did not provide as accurate results as it should have, I needed to do a better job of correcting our mistakes to nail down the concept. In class demonstrations often do not produce the most accurate data measurements, so I will need to become comfortable enough with the demonstrations to pick up the pieces when they seem scattered.

I certainly had fun teaching this unit because of all the demonstrations and application we could discuss in class. That is exactly how I perceive myself as a teacher and what envision for my upcoming years of teaching, lots of fun.

Student Handouts

Ch. 6 Reading Guide

**Section 1**

**Read p. 158**

Because all the particles around you are in constant random motion, they have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Look at figure 1. Why does the blacksmith heat the horseshoe?

**Read p. 159**

Define temperature:

As temperature of an object increases, the average ­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the particles in random motion \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Define Thermal Energy:

**Read p. 160**

How are thermal energy and temperature related?

If you go to the ocean and fill a bucket with ocean water, the bucket of water and the ocean have the same temperature. Do they also have the same thermal energy? Why or Why not?

Define heat:

**Read p. 161**

Define Specific Heat:

Touch the top of your desk with your hand. Touch the leg of your desk with your hand. Both objects are the same temperature. Why does one feel colder than the other?

The book says water makes a good coolant? Why?

**Read p. 162**

Write the equation for thermal energy. Be sure to tell what each variable means and include units.

**Read p. 163.**

Do you have any questions about what you read this section?

**Section 2**

**Read p. 164**

Define Conduction:

Copy the last sentence on the page.

**Read p. 165**

What type of materials does heat move faster in?

solids & liquids, liquids & gases, or solids & gases

Look in the second paragraph. What are the best conductors?

Define convection:

How in convection different than conduction?

**Read p 167**

“Electromagnetic waves” is a fancy way of saying light.

Define Radiation:

Look at the section “Radiant Energy and Matter.”

Materials that are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-colored \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ more radiant energy, while \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-colored materials \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ more radiant energy.

Reread the last sentence on the page. Explain why radiation passes more easily through gases than through solids or liquids.

**Read p. 168**

Give some examples for controlling heat flow.

**Read p. 169**

Define insulator:

How are insulators different than conductors?

Name some materials that are good insulators.

Do you have any questions over section 2?

**Section 3**

**Read p 172-173**

Give 3 types of heating systems. (The red titles)

Use passive solar heating to explain why your car gets hot inside even when it’s cooler outside.

**Read p. 174**

Define solar collectors:

Define thermodynamics:

What is the 1st law of thermodynamics?

An Increase in thermal energy = \_\_\_\_\_\_\_\_\_\_\_\_ done in a system + \_\_\_\_\_\_\_\_\_ transferred to a system.

2nd law of thermodynamics: heat \_\_\_\_\_\_\_\_\_\_\_\_\_\_ flows from a hot object to a cold object unless \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is done.

**Read p. 176**

Name a device that converts heat into work.

**Read p. 177**

Why does a refrigerator stay cool, moving heat from inside to the warmer kitchen?

**Read p. 178-179**

Explain how your body is considered to be a heat mover.

Do you have any questions over section 3?

Ch. 6 - Thermal Energy

Section 1 – Temperature and Heat

Key Concept

**Temperature** - the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of hotness.

- measures \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ particles are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

- measures the average \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the particles.

**Heat** – a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of hotness.

- depends on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of particles.

- a type of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Thermal Energy –** the sum of the \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy of the molecules.

True or False? For any two objects, the one with the higher temperature always has more thermal energy. Explain.

What happened to the temperature of the sand? Why?

**History Lesson!**

James \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ found a relationship between \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Both can raise the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Both are kinds of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What are the temperatures of the two containers of water? Explain what happened

\*\*Recall: **Law of Conservation of Energy** – energy cannot be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but energy can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to another.

Key Concept

Specific Heat is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of heat needed to change the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_ of a substance by \_\_\_\_\_\_\_\_\_\_\_\_\_.

Each \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ specific heat.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ specific heat means it takes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy (and more time) to change the substance’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The amount of heat lost/gained by something depends on 3 things:

1.

2.

3.

Equation & Units

The heat \_\_\_\_\_\_\_\_\_\_\_\_ by an object should \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the heat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by another object.

**Example 1:** Calculate the change in thermal energy of the water in a pond with a mass of 1000 kg and a specific heat of 4,184 J/kg °C if the water cools by 1°C.

**Example 2:** Calculate the specific heat of a metal if .5kg of the metal absorb 9000J of heat as it warms by 10 °C.

**Specific Heat- Lab Activity:**

Record your data here

1. Type of metal: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Initial temperature of water: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Final temperature of water: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Change in temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Aluminum | Brass | Copper | Lead | Zinc |
| ΔT |  |  |  |  |  |

In your own words, use the term *specific heat* to explain the class’s results

**Example 3:** Calculate the change in temperature if the thermal energy is 1,000,000J, the water in a pond has a mass of 1000 kg and a specific heat of 4,184 J/kg °C.

**Section 2 – Transferring Thermal Energy**

**Conduction** – \_\_\_\_\_\_\_\_\_\_\_\_\_ moves \_\_\_\_\_\_\_\_\_ a material without moving the material

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy is transferred as particles collide
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (metals) are good heat conductors.

Watch “SIMPLE CONDUCTION” youtube.

Explain why nails fell off one by one. Draw a picture.

**Convection** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_ moves through a material by \_\_\_\_\_\_\_\_\_\_\_\_ the material

* convection \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ transfer heat from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ parts of a fluid
* convection currents create \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_ over different regions of the earth.

\*watch “The Earth 3D:” <http://www.youtube.com/watch?v=Kpoko_l34ZE> - in mantle

Watch “The Earth 3D” youtube.

Convection currents in the Earth’s \_\_\_\_\_\_\_\_\_\_\_\_ move the Earth’s \_\_\_\_\_\_\_\_\_\_\_\_. How?

**Radiation** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ moves through an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_

* energy transfer by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ waves or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Some radiation is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and some is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a material
* Heat transfer by radiation is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a \_\_\_\_\_\_\_\_\_\_\_ than in a liquid or solid.

**Insulators:** a material in which \_\_\_\_\_\_\_\_\_\_\_\_ flows \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

\*watch “conduction, convection, radiation rap”

**\*\*Extra Practice\*\***

Calculate how much thermal energy is needed to raise the temperature of 4kg of water from 25°C to 75°C. The specific heat of water is 4184 J/kg°C.

How does the temperature of 33g of graphite (C = 710 J/kg°C) change when it absorbs 350J of thermal energy? Hint: notice the units for the mass and for the specific heat.

**Phase Changes**

**Heating engine** – an engine that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ thermal energy into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.

Key Concept

Gaining or losing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can cause \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes.

There is \_\_\_\_\_\_ temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ until \_\_\_\_\_\_\_ the substance has changed phase.

**Freeze** - a liquid ­­­­­­­­\_\_\_\_\_\_\_\_\_\_ heat energy and becomes a \_\_\_\_\_\_\_\_\_\_\_

**Melt** – solid \_\_\_\_\_\_\_\_\_\_\_\_\_ heat and becomes a \_\_\_\_\_\_\_\_\_\_\_\_\_

**Heat of Fusion** – amount of heat that must be lost or \_\_\_\_\_\_\_\_\_\_\_ to freeze or \_\_\_\_\_\_\_\_\_ (solid <-> liquid)

**Evaporation** – liquid \_\_\_\_\_\_\_\_\_\_\_\_ heat and becomes a \_\_\_\_\_\_\_\_\_\_\_ (vapor)

**Boiling point –** temperature when the \_\_\_\_\_\_\_\_\_ in the liquid has the same pressure as the environment.

**Condensation** – gas \_\_\_\_\_\_\_\_\_\_\_\_\_ heat and becomes a \_\_\_\_\_\_\_\_\_\_\_\_\_

**Heat of vaporization** – amount of heat that must be \_\_\_\_\_\_\_\_\_\_\_\_ or gained to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or condense (gas <-> liquid)

Equations:

**Example 4:** More energy to freeze or more energy to boil 10kg of water?

**Problem Set**

1-13 cover ch. 5 material

1. An automobile jack has an effort arm of 45 cm. The resistance arm is 6cm. What is the MA of the jack?
2. An iron bar is used as a lever to pry a slab of sidewalk. The MA of the bar is 6. The slab weighs 402N. What is the effort force required to lift the slab?
3. A doorknob with a diameter of 8cm turns an axle with a diameter of 2cm. What is the MA of the doorknob?
4. A pulley system has 6 ropes that support a 72kg car transmission. If each rope is 1.5m long, what is the MA of the pulley?
5. A 10m long ramp is placed behind a semi trailer so cattle can be loaded. The back of the truck is 200cm high. What type of machine is the ramp? What is the MA of this machine?
6. You use a pulley system to pull the engine out of a car. You pull with a force of 545N, moving the rope 10m This causes the 2520N engine to be raised out of the car to a height of 1.5m. How efficient is this machine?
7. Santa runs up a flight of stairs to get in shape for climbing chimneys. If Santa weighs 1100N and the chairs are 5m high, how much work has he done?
8. If Santa does the work described in question 7 in 5 seconds, how much power has he used?
9. A pulley system uses 5 ropes that pull on a 90kg spool of fence wire so that it can be lifted into a pickup. If you pull the rope 10m, what will be the MA of the pulley system?
10. A car has a steering wheel with a diameter of 30cm. It turns an axle with a diameter of 6cm. What is the MA of this type of machine?
11. A crow bar is used to pull nails out of a piece of lumber. It has an effort arm of 48cm and a resistance arm that measures 6cm. What is the MA of the crow bar?
12. A wheel chair ramp has a height of 2m and a length of 8m. What would be the ideal MA of the ramp if friction didn’t exits?
13. You use a pulley system to pull the transmission of a car. You need 400N of force to pull the rope 10M. The transmission is raised 1.5m and weighs 220N. What is the efficiency of the machine?
14. How much heat is absorbed by 250 g of water when it is heated from 10°C to 85°C?
15. How much heat is absorbed by 60g of copper when it is heated from 20°C to 80°C?
16. A 38kg block of lead is heated from -26°C to 180°C. How much heat does it absorb during the heating?
17. How much heat in kilojoules would be absorbed as .025 kg of water at 100°C changes to water vapor? (Hvap = 2260 kJ/kg)
18. A 400g glass coffee cup at room temperature, 20°C, is plunged into hot dishwater, 80°C. If the temperature of the cup reaches that of the dishwater, how much heat does the cup absorb?
19. 5 kg of ice cubes are moved from one freezer to another. The first freezer is kept at -4. The second freezer is kept at -17°C. How much heat does the freezer’s cooling system remove from the ice cubes?
20. If you move the 5 kg of ice cubes to the kitchen sink at room temperature, how much heat would the ice cubes absorb as they melt. (Hfus of water = 334 kJ/kg)
21. How much heat in kJ would be absorbed as a .5kg of water at 100°C changes to water vapor? (Hvap of water is 2260 kJ/kg)

**Vocab Practice**

|  |  |
| --- | --- |
| 1. The average kinetic energy (speed) of an objects atoms or molecules; degree of hotness | a) conduction  b) conductor  c) convection  d) heat  e) heat of fusion  f) heat of vaporization  g) insulator  h) radiation  i) specific heat  j) temperature |
| 2. Depends on the speed and mass of particles; quantity of hotness |
| 3. Heat required to change a liquid to a vapor |
| 4. Heat moving through empty space |
| 5. Heat needed to raise the temperature of 1 g (1kg) of a material by 1°C. |
| 6. Heat moves through a material without moving the material. |
| 7. Material that does not let heat flow through it easily |
| 8. Material that lets heat flow through it easily. |