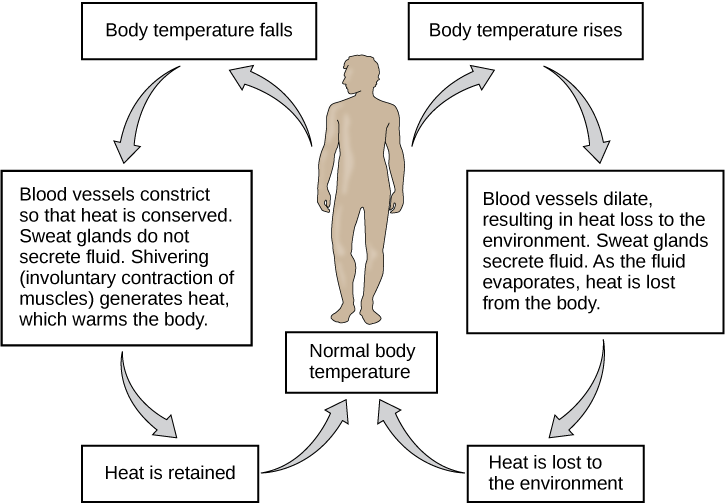
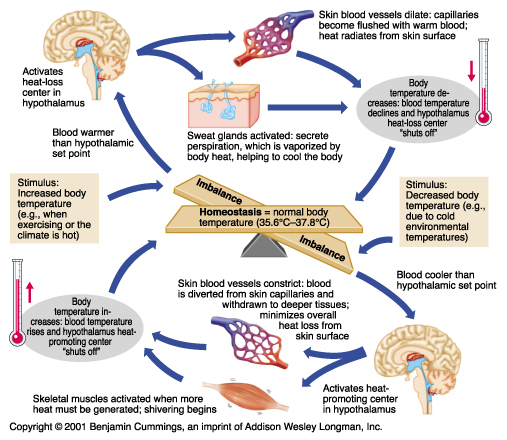
|  |  |
| --- | --- |
| Title | **Keeping Your Balance: Measuring Thermoregulation in Humans and Animals in Relation to Hypothermia and Hyperthermia** |
| Introduction | This lesson will introduce students to thermoregulation and homeostasis in humans. Students will learn how homeostasis works to regulate body temperature and the difference between endotherms and ectotherms. Students will also learn what hyperthermia and hypothermia are, and their effects on the body. Student will utilize TI Sensor Tags to measure IR temperature and ambient temperature. They will then compare and contrast the readings In addition to this classroom activity; students can also collect data with similar activities with their pets. Students will graph their results and then compare and contrast this data to look for patterns. Based on their findings, students will discuss ways hyperthermia and hypothermia can be prevented. Student will present their findings to the class, discuss the accuracy of their data, discuss as a group their results, and relate this to the One Health Initiative. In addition students will learn about what citizen science is and look at various projects and how this relates to One World One Health Initiative. |
| Real Science Application | This Unit encompasses the concepts of thermoregulation, ectotherms and endotherms, hypothermia and hyperthermia. These concepts are discussed in detail in the supplementary materials. This Unit takes those concepts and applies them to Field Research, comparing and contrasting humans and animals in relation to Hyperthermia. Hyperthermia or Heat Stroke causes over 600 deaths a year in the USA, with projected cumulative toll of approximately 33,000 additional heat-related deaths by midcentury in these cities, and more than 150,000 additional heat-related by the end of the century due to Global Warming. Animals will be facing more hyperthermia due exposure from higher temperatures due to global warming. Students will learn about this growing health issue.  In addition, students will start to see the similarity and differences between species and also in relation to health issues. Students will develop their own Hypothesis and complete Field Research. Students will relate this research to One World One Health Initiative. Students will learn what Citizen Science is. Citizen Science is research conducted, in whole or in part, by amateur or nonprofessional volunteer scientists which can help scientists collect data. This is a great way for students to get in involved and utilize their skills in real ongoing research projects. Students will also discuss how Citizen Science can help the One World One Health Mission. |
| Curriculum Alignment | Grade 7 NC: Understand the processes, structures and functions of living organisms that enable them to survive, reproduce and carry out the basic functions of life  NGSS: MS. Structure, Function, and Information Processing   |  |  | | --- | --- | | MS-LS1-3. | Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. | | MS-LS1-8. | Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. | |
| Learning Outcomes | * Participants will study thermoregulation systems in humans * Participants will discern differences between ectotherms and endotherms   compare hypothermia and hyperthermia, use the scientific method to hypothesize around a given subject   * Participants will conduct a field test to test the hypothesis and take data utilizing graphing * Participants will create a mind map of how to utilize the TI Sensor Tag to develop an application to help prevent or solve a One World Health issue. |
| Time Required and Location | This lesson requires both an indoor and outdoor component. It also has an extension which can be done at the student’s home. This is a unit with four, 60 minute lessons. |
| Materials Needed | **Teacher Preparation**  1Texas Instrument Sensor Tags per group  1Timers or Online Timers (if student have phones) per group  1 graphic organizers per student at the end of this lesson of:  -Endotherm/Ectotherms  -Hypothermia/Hyperthermia  -Thermoregulation Diagram  1 Lab report sheets per student  1 Graph Paper per student  1 pack of markers per group  1 Poster paper or access to computers per group  1 Wrist band with Velcro per group  1 Dog or cat collar with Velcro per group  1 Smart Phone or other Blue Tooth compatible device to read the data per group  1 White boards with markers per group |
| Safety | Students should be supervised and aware of their surroundings when outside and not remain in very hot or cold temperatures too long. |
| Student Prior Knowledge | Students should know about:   * Basic body systems * How to capture and read data with the TI Sensor * How to graph data and analyze data * Sections were added in the lesson plan if understanding of hour to utilize TI Sensor Reading will be within this lesson. |
| Activities | **Day 1 Time: 60 Minutes**  **Activities**   1. To introduce the subject discuss Real World Example about Thermoregulation. For example: being cold at the bus stop or hot at the beach. As a group list other examples. Have students watch “Bozeman Science: Thermoregulation” <https://www.youtube.com/watch?v=TSUCdLkI474>      1. Have students Listen to “Homeostasis Song by Mr. Parr” <https://www.youtube.com/watch?v=1iPndNB7mjw> 2. Hand out a graphic organizer on Endotherm/Ectotherms As an assessment have pictures ready of the following animals and ask students to do a card sort of which are endothermic, ectothermic, homoeothermic, poikilothermic. Use the following pictures for endothermic: human, dog , lion, bird, bear and bats ectothermic: lizard, fish, turtle, mudpuppy, snakes poikilothermic: bats, bear and snakes homoeothermic: mudpuppy, human, dog   Have students notice that some ectothermic and endothermic animals are in both categories of; poikilothermic and homoeothermic. Another power point to utilize to clarify this information if needed is:  <http://adm.sumterschools.net/download.axd?file=f39038f1-6907-4cd1-86b8-2b8eeab8f4e3&dnldType=Resource>     1. Hand out the graphic organizer on Hypothermia/Hyperthermia and the Thermoregulation diagram. Review the information with the class. Ask the students what behaviors they demonstrate when they are hot or cold and how this relates to these diagrams. For example: When they are hot they are thirsty or drink more, or move to shade due to their body sweating and needing more water, or being too hot and moving to shade to cool down their skin. 2. Explain to students we will be using IR sensor to measure body surface temperature, with TI Sensors. Show two short video clips for review:     "What is Remote Sensing” <https://www.youtube.com/watch?v=sBI3MIbzIBA>    “How IR Sensors Work” <https://www.youtube.com/watch?v=5_I5eIQsHq8>     1. Have students read E How Articles on how IR sensors works out loud or have students read it silently depending on how much background knowledge the students have. Major points should be discussed afterwards. This can be skipped if the students already have prior knowledge about TI sensor and IR sensors and devices to measure body temperatures.   “How do IR Sensors Work “<http://www.ehow.com/how-does_5561845_do-ir-sensors-work.html>  “ Tools to Measure Temperatures “ <http://www.ehow.com/info_8243342_tools-used-measure-temperature.html>  Reinforce the following points:  -Infrared (IR) sensors have been utilized successfully in noncontact temperature measurement in industrial and research settings and provide the following benefits:  -Saving time - typical IR temperature measurement takes less than 500 m/Sec.  -Ability to measure moving targets  -Ability to measure hazardous or inaccessible objects  -Ability to measure high temperatures (greater than 1300°C/2372°F)  -No energy interference or energy loss  -No risk of contamination or damage from contact with the target.  -This measures surface temperature not internal body temperature and they are different. Average core temperature, which is 37°C, can rise to 38°C or 40°C during exercise. During sleep, core temperature usually drops 1°C. The average comfort zone of skin temperature is 33°C to 34°C. If skin temperature drops to 32°C, the person feels cold. Note there are variations between people, it a hot room it can increase 2.5°C.   1. Show the students the following diagrams   - “Temperature of Healthy Human Skin Chart” <http://hypertextbook.com/facts/2001/AbantyFarzana.shtml>. Make sure students note different body parts can have different temperatures depending on the environmental factors but normal body temperature is 37°C and skin temperature is 31°C  - Show Diagram “Healthy Heating”  <http://www.healthyheating.com/Definitions/facts_about_skin.htm#.VaZXMflVhBc> Share the quote about skin temperature“"...your skin temperature varies from 83°F. (28.2 C) at an ambient temperature of 49 °F. (9.5° C) to 98 °F. (37.2° C) at an ambient temperature of 95 °F (35°C).” To check for understanding ask students what they estimate their skin temperature would be on a cold day and a hot day, higher or lower than 31°C. Ask student why their fingers and toes might be colder than their chest area.   1. Show the video clip: “TI Sensor Tag How to Connect and Save Data” <https://www.youtube.com/watch?v=IM3yBPlP5v8> . Go through the process as a group and have the students’ together with direct instruction measure the ambient air temperature of the room, by placing the sensor on the table and taking measurements. Measure the IR Temperature of their skin. Remind students that ambient air temperature is the air around us, IR Temperature is the temperature of the surface of the object measured 2. Ask students what factors might influence the accuracy of the data or the data in general? For example: if the temperature is measured in the sun or shade. If using the wrist band versus placing the sensor directly on their skin changes the results. Write the list on the board. 3. For Home Learning: Assign each student a term to teach in the next day lesson. Use the following words: Endoderm, Ectoderm, Homeostasis, Negative Feed Back, Hypothermia Symptoms, Hypothermia Treatment, Hyperthermia Systems, Hyperthermia Treatment, Core Body Temperate and Surface Body Temperature, IR Radiation what it measures, Ambient Temperature what it measures, diagram of Thermoregulation, How to use TI Sensors. Give each student a word and more than one student can teach the same: word. The goal for the students to learn the material and improve their communication and teaching skills.   **Day 2 Time: 60 Minutes**  **Activities**  1. Have students teach their word or concept to the class for review.  2. As a group, have student brainstorm ways their IR Temperature will vary. For example running, resting, in shade in the sun, inside and outside.  2. Lab: Break into groups depending on how many TI Sensors you have. Have one student will wear the TI Sensor and the other students will collect the data on the following: ambient air temperature and IR temperature in different settings. Have students pick a part of their body they will use the IR Sensor and if they will place it directly on the skin or use a wrist band with Velcro to attach the sensor.  3. Students will create a hypothesis for example: If I \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. An Example is: If I run with a high Ambient Temperature, my IR Temperature will be higher than all the other readings. The class could also pick one hypothesis to test.  4. Students will complete measurements of ambient air and IR Temperature based on the following criteria:  Inside:  -Sitting on a chair for 3 minutes  -After running in place for 3 minutes  -After walking around the room for 3 minutes  Outside:  -Sitting in the sun for 3 minutes  -Running in place for 3 minutes in the sun  -Walking for 3 minutes in the sun  -Sitting in the shade for 3 minutes  -Running in place for 3 minutes in the shade  -Walking for 3 minutes in the shade   * Students will collect the data on data sheet of their Lab Report. * Students will graph their results from their data sheet. The x axis will be the activities and IR temperature on one line and Ambient Temperature on another line (two separate lines) on the Y axis. Students should put like activities together (sitting; in classroom in the shade, in the sun, see the attached sheet) * Students will see if their findings support their hypothesis. * Students will share their hypothesis and data with the class. * The class will discuss why the data was the same or different in each setting, different body parts, using or not using the wrist band. Students should also brainstorm other factors that may cause data change: body type, time of day, temperature that day etc. * Home Learning: Assign again the words and concepts for students to teach from Day 1. Give students a different word or concept the next day.   ***Day 3 Time: 60 Minutes***  ***Activities***   1. Have students review by teaching the concept they are responsible for. 2. Divide the class in lab teams with at least one partner if possible having a pet cat or dog 3. Watch: "One World One Health” <https://www.youtube.com/watch?v=ENSDZ_VPtAU> and   Video clip “ Cool Comparison Between People and Animals  ”https://www.youtube.com/watch?v=09w4C-yjNXk as a class and discuss the interconnection between both from disease spreading from animals to humans, food safety and diseases effecting both species.   1. Divide the class in four groups. Have each group read the following articles and report back to the class the cause, symptoms, treatment and prevention of hyperthermia in cats and dogs.   <http://www.petmd.com/dog/conditions/cardiovascular/c_dg_heat_stroke>  <http://www.petmd.com/dog/emergency/common-emergencies/e_dg_hypothermia?gclid=CLKp1sPSicsCFYo2gQodhvoCpg>  <http://www.petmd.com/cat/emergency/common-emergencies/e_ct_heat_stroke>  http://www.petmd.com/cat/emergency/common-emergencies/e\_ct\_hypothermia   1. Have the team come up with a hypothesis to test:   For example:   * Both my pet and I will have a similar body temperature increase during exercise at the same ambient air temperature. * Both my pet and I have same range of body temperature throughout the day in similar conditions. * My pet will have a high body temperature difference when exercising than I will due to its fur.  1. Home Learning, Have each student learns a concept or word for review except for the student will collect the data on their hypothesis on themselves and their pet with the TI Sensor.   **Day 4 and 5 Time: 60 Minutes** (this could take less time depending on the class)  **Activities**   1. Have students teach the word or concept to the class for review. 2. Have students with their teams graph their data and complete their lab reports. 3. Have students make a poster about their hypothesis, data and findings using the criteria on the Rubric. 4. Have students share their research findings and posters with the class and/or invite other classes or parents to come to the presentation. Put the presentations in the library or somewhere on display for other students to read. 5. Extension:   Have students think of Field Research they would like to complete using any of the TI Sensors.  -Have student pick a One World One Health Issue and utilize the TI Sensors to collect data on the topic or create a hypothesis for them to solve.  -Have students look at a variety of Citizen Science Projects and participate in one either as a team or individually and present their experiences to the class at a later date.  -The following sites can be used to find a Citizen Science Project:  “ Top Citizen Science Projects in 2014” <http://blogs.discovermagazine.com/citizen-science-salon/2015/01/05/scistarters-top-fourteen-citizen-science-projects-2014/#.V5TUQPnF-So>  or  “ National Geographic: Citizen Science”  <http://education.nationalgeographic.com/idea/citizen-science-projects/> |
| Assessments | Students will be assessed by:  -Daily teaching of word and content  -Student brainstorming and teacher checking for understanding  -Graphs and data Sheets  -Lab report  -Poster and presentation rubric |
| Modifications | This lesson utilizes multiple intelligences and can be completed by students of all abilities.  Some specific supports related to this lesson for English Language Learners and students with Special Needs are:  -Use of song and video  -Vocabulary Maps can be done for each word: They include:  <http://www.readingquest.org/pdf/wordmap.pdf>  -Mindful group pairing with a strong peers  -Read Aloud of Texts  -Frequent praise and recognition of success  -Teaching homework and repetition of vocabulary daily  -Modified Lab Report  -Extra Time for completion  -Hypothesis given to the student to test or better yet, support from teacher, or think pair share  -One on one direct assistance in utilizing the sensor  -Frequent praise and recognition of success |
| References | About NCSU Assist Center:  <https://www.youtube.com/watch?v=8_ZUZRZLyQo>  One World One Health:  <http://www.onehealthinitiative.com/>  Hyperthermia and Hypothermia <http://emergency.cdc.gov/disasters/winter/staysafe/hypothermia.asp>  <http://emergency.cdc.gov/disasters/extremeheat/index.asp>  Statistics on Hyperthermia and Hypothermia :  <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5529a2.htm>  <http://www.cdc.gov/nchs/data/nhsr/nhsr076.pdf>  <http://healthresearchfunding.org/17-shocking-heat-exhaustion-statistics/>  Greenhouse Effect and Hyperthermia:  <http://www.nrdc.org/globalwarming/killer-heat/files/killer-summer-heat-report.pdf>  Thermoregulation in Humans:  <http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel/responses_to_environment/homeostasisrev3.shtml>  <http://academickids.com/encyclopedia/index.php/Body_temperature>  Endotherms and Ectotherms:  <https://www.biog1445.org/demo/04/bodytempregulation.html>  <http://www.ehow.com/how_7722875_teach-difference-between-endotherm-ectotherm.html>  TI Sensor Tag  <http://www.ti.com/tool/cc2650stk> |
| Comments | This lesson can be shortened or made longer depending on the teacher’s needs. |
| Graphic Organizer | Supplementary Science Material |
| Vocabulary Map | *ReadingQuest.org* Making Sense in Social Studies  ReadingQuest.org http://www.readingquest.org  Permission Granted for Classroom Use Only. All Others Inquire at rjones@virginia.edu. Copyright ©Raymond C. Jones. All Rights Reserved.  [**http://www.readingquest.org/pdf/wordmap.pdf**](http://www.readingquest.org/pdf/wordmap.pdf) |
| Modified Lab Report | Use Modified Lab Sheet or one usually used. |

**Thermoregulation Graphic Organizers:**



<http://cnx.org/resources/1bb98a5a2e4fd6dc7cd30e7a5c181938ffbbce9b/Figure_33_03_04.png>



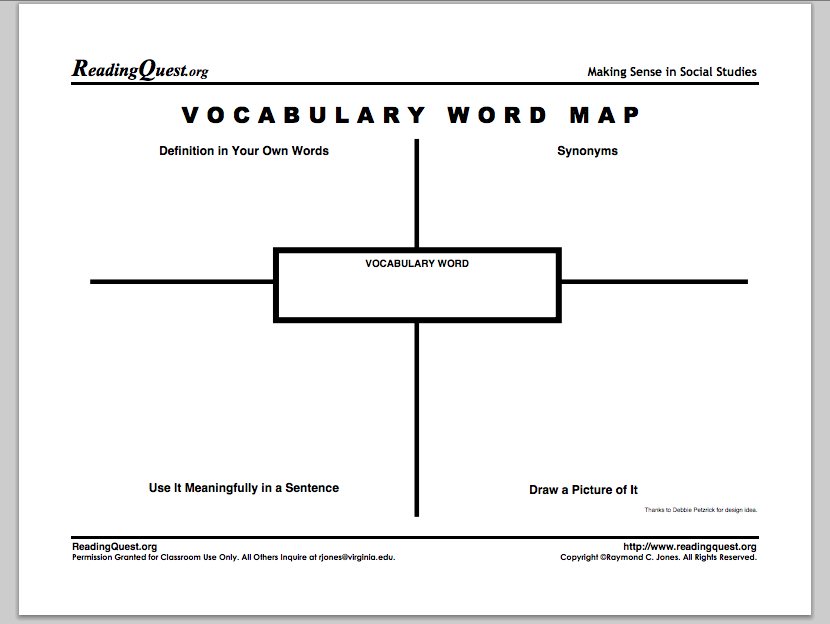
<http://schoolworkhelper.net/wp-content/uploads/2010/07/thermoregulation-feedback.jpg>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Endothermic Versus  Ectothermic | |  |  | | --- | --- | | **Endothermic**   * Animals generate their own body heat. * This heat comes from animal metabolism, chemical reactions within the body. * Produce Heat | **Ectothermic**   * **Animals which have no metabolic method of regulating their body temperature.** * Ectotherms use behavior to control their body temperature by; altering the amount of heat they are gaining or losing by convection, conduction and radiation. For example: Radiation form the sun   Gain Heat. | | |
| **Homoeothermic** Maintain their body temperature within a narrow range | * Most Birds and Mammals * Humans * Dogs * Elephants | * Some tropical reptiles * Some organisms occurring deep in the ocean or even in deep lakes * mudpuppy |
| **Poikilothermic**  Can tolerate a wide variation in internal body temperature, usually because of environmental variation. | * Some birds and mammals * Bats * Humming Birds * Squirrels * Bear | * Most fish, amphibians, and reptiles as well as most invertebrates * Frogs * Snakes * Lizard |

Modified From: <https://www.biog1445.org/demo/04/bodytempregulation.html>



<http://learn.mindset.co.za/sites/files/LXL2013/LXL_Gr12LifeSciences_17_Thermoregulation_05June.pdf>

[](http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0CAcQjRw&url=http://www.myeasybee.com/blog/the-best-free-vocabulary-graphic-organizers/&ei=WGuhVaycEIWdygTChYTwAg&bvm=bv.97653015,d.aWw&psig=AFQjCNE_gSHpjb1OmfihSj8Ow7zySX381g&ust=1436728535438310)

**Modified Lab Report:**

|  |  |
| --- | --- |
| **What was done in a few sentences:** | **Data in a Simple Graph Form** |
| **What was done using a pictures** | **Conclusion in a few sentences** |

**Lab Report:**

**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Lab Title:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Hypothesis:** If\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
Then\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Data:**

Inside:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ambient Air Temperature When Sitting | IR Temperature  When Sitting | Ambient Air Temperature  When Walking | IR Temperature  When Walking | Ambient Air Temperature  When Running | IR Temperature  When Running |
|  |  |  |  |  |  |

Outside:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ambient Air Temperature  When Sitting | IR Temperature  When Sitting | Ambient Air Temperature When Walking | IR Temperature  When Walking | Ambient Air Temperature  When Running | IR Temperature  When Running |
|  |  |  |  |  |  |

**Graph your results on Graph Paper.**

**Conclusion:**

My hypothesis was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| |  | | --- | | **Rubric for Field Research Poster and Presentation**  Student Name:     \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CATEGORY | **4** | **3** | **2** | **1** |
| **Use of Class Time** | Used time well during each class period. Focused on getting the project done. Never distracted others. | Used time well during each class period. Usually focused on getting the project done and never distracted others. | Used some of the time well during each class period. There was some focus on getting the project done but occasionally distracted others. | Did not use class time to focus on the project OR often distracted others. |
| **Graphics -Clarity** | Graphics are all in focus and the content easily viewed and identified from 6 ft. away. | Most graphics are in focus and the content easily viewed and identified from 6 ft. away. | Most graphics are in focus and the content is easily viewed and identified from 4 ft. away. | Many graphics are not clear or are too small. |
| **Graphics - Relevance** | All graphics are related to the topic and make it easier to understand. All borrowed graphics have a source citation including a graph of data accurately labeled. | All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation including a graph of data accurately labeled. | All graphics relate to the topic. Most borrowed graphics have a source citation including a graph of data accurately labeled. | Graphics do not relate to the topic OR several borrowed graphics do not have a source citation including a graph of data accurately labeled. |
| **Required Elements** | The poster includes all required elements as well as additional information -background information on hyperthermia or hypothermia in humans and cats or dogs depending on the hypothesis chosen -hypothesis -data in graph form -conclusion including why or why not the hypothesis was correct -how this data can be used to prevent hyperthermia or hypothermia -ways the TI Sensor can be utilized to prevent hyperthermia or hypothermia | All required elements are included on the poster. -background information on hyperthermia or hypothermia in humans and cats or dogs depending on the hypothesis chosen -hypothesis -data in graph form -conclusion including why or why not the hypothesis was correct | All but 1 of the required elements are included on the poster. -background information on hyperthermia or hypothermia in humans and cats or dogs depending on the hypothesis chosen -hypothesis -data in graph form -conclusion including why or why not the hypothesis was correct | Several required elements were missing. -background information on hyperthermia or hypothermia in humans and cats or dogs depending on the hypothesis chosen -hypothesis -data in graph form -conclusion including why or why not the hypothesis was correct |
| **Content - Accuracy** | At least 7 accurate facts are displayed on the poster. | 5-6 accurate facts are displayed on the poster. | 3-4 accurate facts are displayed on the poster. | Less than 3 accurate facts are displayed on the poster. |
| **Knowledge Gained** | Student can accurately answer all questions related to facts in the poster and processes used to create the poster. | Student can accurately answer most questions related to facts in the poster and processes used to create the poster. | Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster. | Student appears to have insufficient knowledge about the facts or processes used in the poster. |
| **Mechanics** | Capitalization and punctuation are correct throughout the poster. | There is 1 error in capitalization or punctuation. | There are 2 errors in capitalization or punctuation. | There are more than 2 errors in capitalization or punctuation. |
| **Presentation and Participation** | Student participated greatly in the presentation and making of the poster. | Student participated mostly in the presentation and making of the poster. | Students participated somewhat in the presentation and making of the poster. | Student barely participated in the presentation and making of the poster. |
| **Total Points** |  |  |  |  |

Supplemental Material:

Homeostasis means same safe state and refers to the process of keeping the internal body environment in a steady state when the external environment changes. Humans are endotherms, which is an organism that maintains its body at a metabolically favorable temperature; largely by the use of heat set free by its internal bodily functions instead of relying almost purely on ambient heat. Other endotherms are birds. Endotherms normally maintain their body temperature between 35-40◦C. Endotherms are typically called warm blooded animals. Other living things are ectotherms, which are animals that are dependent on external sources of body heat. These include fish, amphibians, and most invertebrates. Ectotherms can have a warm blood during the day when they bask in the sun so at times are “warm blooded”. The main difference between the two are endotherms use internal corrective mechanisms to maintain their body temperature and ectotherms use behavior mechanisms such as lying in the sun when it is cold.

Another way to classify both endotherms and ectotherms is if they keep their body temperature more or less constant at all times. Some animals have their temperature vary during the day. Some animals reduce their body temperature on a regular basis to save energy, especially in small animals with high metabolic rates such as bats which cool off part of the day. Other animals, such as bears lower their body temperature while hibernating. Those that maintain their temperature constant are called Homoeothermic. This includes ectothermic animals such as birds and mammals and also some tropical reptiles. Animals that body temperatures to vary a good extent on a regular basis are called poikilothermic. These include some birds and mammals, most fish, amphibians, and reptiles.

In human brains there is an area called the hypothalamus. This area is the thermoregulatory center and detects the temperature of your blood. There are also thermos-receptors in the skin to detect the temperature outside. This information allows the body to make the correct adjustments. There first are voluntary responses if we are too hot or too cold. We may take off or add more clothes, seek heat or shade. If these responses are not enough then the thermoregulation center is stimulated which is part of the autonomic, or involuntary, nervous system. The body has critical high and low temperatures. The low critical temperature is 27 ° C and metabolic rates change. The lower lethal temperature is about 25° C which causes the system to collapse and die. Thermoregulation is needed because there is a temperature range the enables cell to function efficiently. If we get too cold the heat conservation center of the hypothalamus is stimulated. If we get too hot the heat loss center of the hypothalamus is stimulated. When the body is too hot the body’s responses include vasodilation of surface capillaries, shunt (a blood vessel that links an artery directly to a vein) vessels constrict, there is an increase of sweating, decrease of metabolic rate, and hairs lie flat, so the body cools. Sweat glands secrete perspiration which is vaporized by body heat to help the body cool. When skin blood vessels dilate, capillaries become flushed with warm blood and heat radiates from skin surface. Shunt vessels constrict so more blood goes to the surface to help in cooling, and pilorelaxation occurs, where the muscles at the base of the hair cause them to relax and lie flat so less air is trapped near the skin and less insulating. Less Thyroxin is produces so metabolic rates lowers and the behavioral response, controlled by the cerebral cortex, becomes more inactive causing less respiration.

When the body is too cold, there is vasoconstriction of surface capillaries, shunt vessels dilate, decrease in sweating, increase metabolic rate, hairs stand on end, and shivering so the body heats up. When skin blood vessels constrict, blood is diverted from skin, capillaries withdraw to deeper tissues, and minimizes the overall loss of heat from the skin surface. Skeletal muscles activate when more heat must be generated and shivering begins. Shunt vessels dilate thereby cutting off the blood flow to the extremities and preventing heat loss. There is piloerection, muscles at the bottom of the hair to stand on end, insulating the layer of air, reducing heat loss and behavioral response of putting on more clothes. There is a hormone response of adrenaline is released which increases metabolic rate. If very cold, more thyroxine is produced, increasing metabolic rate. Thermoregulation is a negative feedback system: a corrective mechanism that opposes or negates a variation from normal limits in most mammals’ body temperature is normally maintained at 37.5° C +- .5° C. During a fever, body temperature is raised when pyrogens are released by white blood cells and the body temperature is increase 2-3 ° C to help kill bacterial when they are hot. Mammals that hibernate release a hormone that reduces their set point 10-15 Degrees lower depending on the animal, when they hibernate which reduces their metabolic rates so they conserve food. Some animals like bats and humming birds reduce their set point daily when they are inactive since they have such high surface volume ratios. It is interesting to note when a person is stretching out, it opens up their body and have a larger surface area and greater heat loss. When a person curls up their body it makes it smaller, so smaller surface area and reduce heat loss. Slender body shape helps the body keep cool, and a short broad body shapes helps retain heat good in cooler climates which can factor in when looking at general body types in various climate regions in the world.

When a person cannot regulate the heat level in their body, Heat Exhaustion occurs, when, perspiration decreases, and skin and body temperatures rise. Core body temperature typically rises to 98.6 °F or 37° C or above **.**Treatment for this is; to move to a cooler location, lie down and loosen the person’s clothes, apply cool wet clothes to as much of the body as possible, sip water and if vomiting is continuous, seek medical help.

Heat Stroke occurs when the body temperature is above 104° F or 40°C. The skin is red, hot dry or moist, the pulse is rapid and strong and person can be unconscious. Treatment includes, call 911, move the person to a cooler environment, reduce the person’s body temperature with cool clothes or bath and do not give fluids. Heat stroke can cause organ damage or death Heat stroke occurs when the core body temperature rises above 40.5°C and the body’s internal systems start to shut down. Normally, sweating helps maintain a healthy body temperature by increasing heat loss through evaporation. When a person becomes dehydrated, they do not sweat as much, their blood becomes concentrated and organ functioning is impaired. Many organs in the body suffer tissue damage and the body temperature must be reduced quickly. Most people will have profound central nervous system changes such as; delirium, coma and seizures. As well as effects on the nervous system, there can be liver, kidney, muscle and heart damage. Prevention includes: drinking more water than usual, drink 2-4 cups of water every hour of working or exercising, avoid alcohol or liquids with high sugar, stay in air conditioner, do not use a fan as your primary cooling device, avoid direct sunlight, wear light weight clothing, take cool showers and checking on at risk people (young children, elderly, those with chronic and acute illnesses) daily.

Hypothermia occurs when with long exposure to cold temperatures or water. With Hypothermia core temperature drops below 95° F and in severe hypothermia core body temperature can drop to below 82° F or lower. Hypothermia happens after cold temperature exposure without warm clothes, but can be also in milder environments based on a person’s age, body mass, body fat, health and length and time of exposure. Exposure can be outdoors but also in a very cold room. Symptoms include: shivering which may stop as hypothermia continues, slow shallow breathing, confusion and memory loss, drowsiness, slurred speech, loss of coordination, slow week pulse and in severe hypothermia a person may be unconscious without signs of breathing in pulse. Infants symptoms can include: being cold to the touch and usual low energy.

There is mild hypothermia measured by a body temperature; a body temperature between 89-95° F, moderate hypothermia is between 82-89° F and severe hypothermia lower than 82°F. Treatment includes: remove wet clothes, protect a person against cold with warm dry clothes, and move to a warm dry shelter, rewarming a person with extra blankets and clothes, offering warm liquids but avoid alcohol and caffeine but not giving fluids to an unconscious person. If a person is unconscious and has no pulse call 911 and start CPR. Advance hypothermia hospital treatment is required and may include warmed IV fluids, heated and humidified oxygen, peritoneal lavage (internal "washing" of the abdominal cavity), and other measures. Complications during recovery can include [pneumonia](http://www.webmd.com/lung/tc/pneumonia-topic-overview), heart arrhythmias, ventricular fibrillation (a dangerous "fluttering" rhythm of the heart), cardiac arrest (a sudden stopping of the heartbeat), and death.

On average, 675 people die from complications related to extreme heat each year in the United States more than all other weather events combined. Heat stroke is one of the leading three causes of death from exercise or sports, the highest for high school football players. More than 70% of heat stroke deaths occur in children younger than age 2. Three out of ten of those incidents occur when a child enters a hot location and cannot escape on their own without the caregiver’s knowledge. On average, 38 kids die every year in vehicles because they were forgotten about and left in the heat. Since 1998, that’s an average of 1 child dying every 9 days. The inside temperatures of a vehicle can easily reach 120°F on a hot day in just minutes.

During 2006–2010, 10,649 deaths of U.S. residents were attributed to weather-related causes of death. Exposure to excessive natural heat, heat stroke, sun stroke, or all were cited as either the underlying cause or a contributing cause of death for 3,332 (31%) of these deaths, and exposure to excessive natural cold, hypothermia, or both was cited for 6,660 (63%) of deaths. The remaining weather-related deaths were attributed to floods, storms, or lightning.

The National Resources Defense Council Reports in its issue brief, “Projected Death Toll from Rising Temperatures in America Due to Climate Change reports results of independent peer-reviewed scientific papers and presents the findings of increasing heat-related mortality due to global warming for the 40 largest U.S. cities. The conclusions were reached by determining the sensitivity of the populations of each city to extreme heat events and then applying that sensitivity to a projection for midcentury and end-of-century climate condition, indicate that rising temperatures driven by unabated climate change will increase the number of life-threatening excessive heat events, resulting in thousands of additional heat-related premature deaths each year, with a cumulative toll of approximately 33,000 additional heat-related deaths by midcentury in these cities, and more than 150,000 additional heat-related deaths by the century’s end, which would change percentage of people who dies from heat related deaths.”

Animals both domesticated and wild can also have hypothermia and hyperthermia usually by animals being exposed to unusually cold or hot temperatures, prolonged exposure in animals not used to cold water temperatures through accidents, flooding and other weather events, neglected pets. Animals can be treated with care similar to humans and by seeing a vet.

Typically a Thermometer is used to measure body temperature. Normal temperature taken orally is 97.8-99° F, rectally is .5-.7°F higher and under the arm is .3-.4 °F lower. Using infrared sensor measures heat or surface temperatures. Infrared sensors measure infrared light waves to measure heat or movement. The hotter the object, the shorter the movement. An article below explains this in detail which students can read. This activity will use infrared sensors, and students should be aware this is only surface body temperature not actual body temperature. Students will be looking for changes in surface temperatures based on setting and activities. This lesson will incorporate the science principals of thermoregulation, conducting research, utilizing sensors, comparing and contrasting results between humans and animals and application of this knowledge to help prevent a One World One Health issue. Students will learn briefly about One World One Health whose goal is to: “Recognizing that human health (including mental health via the human-animal bond phenomenon), animal health, and ecosystem health are inextricably linked, One Health seeks to promote, improve, and defend the health and well-being of all species by enhancing cooperation and collaboration between physicians, veterinarians, other scientific health and environmental professionals and by promoting strengths in leadership and management to achieve these goals.” (More can be read about this topic via the link listed within the lesson) and relate their findings to the One World One Health concept