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| **Target Grade:** 9-11 | **Title:** *Homeostasis is adapted from Sweating Alcohol at ScienceNspired.com found at* [*https://bit.ly/2Idivys*](https://bit.ly/2Idivys)  **Developed by: Jeff Lukens** |
| **Topic:** *Homeostasis* |
| **Three Dimensions Color Coding Key**   * Disciplinary Core Ideas – Red Text * Crosscutting Concepts – Green Text * Science & Engineering Practices – Blue Text | |
| **Performance Expectation(s) (Standard) from State Standards or NGSS:**  *HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.*  *[Clarification statement: Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels.]* | |
| **Lesson Objectives:**   * Ss carry out an investigation to examine the cooling an evaporation rates of three different liquids. * Ss construct explanations of the evaporative cooling in the living world. * Ss use models to develop understanding of the process of evaporation and its relationship to the rate of cooling. | |
| ***Teacher Notes*:** Monitor student progress by running the Navigator system and by checking in with the groups.  Provide the materials and tools for the students:   * TI-Nspire CX or CXII handhelds * EasyTemp Probes * 3 small beakers or small plastic cups (**but don’t put acetone in plastic cups!**) * Isopropyl (rubbing) alcohol, * room temperature water * acetone | |
| **Phenomenon:**  Perspiration on the skin’s surface has a cooling effect. | |
| **What the Teacher Will Do:** | **What the Students Wil Do** |
| **Gathering Information**  Ts should look for evidence of the following when students are collecting data :   * Make careful observations that generate evidence * Recognize patterns in observations and data * Discuss and compare observations with others observing the same events. | ***Gathering Information***   * In groups of 2 or 3 and using the procedure found in the Three Liquids Student Handout, Ss will collect data to obtain information on the cooling rates of various liquids: (Water, isopropyl alcohol, acetone) |
| **Reasoning**  Ts should look for evidence of the following when students are analyzing and interpreting data:   * Compare data to make sense of and explain phenomena and use comparisons as evidence * Use graphical displays to analyze data in order to identify linear and nonlinear relationships * Determine function fits to data, including slope, intercept, and correlation coefficient for linear fits. | **Reasoning**   * Ss analyze data from the investigation to determine relationship between evaporation and cooling rates of the three liquids. |
| Ts should look for evidence of the following when students are using mathematical thinking:   * Use of mathematical expressions to represent phenomena to support explanations * Look for patterns in simple data sets that suggest relationships * Use statistical and mathematical techniques (data displays, tables, and/or graphs to find patterns in data | * Ss use mathematical thinking to derive the line of best fit within data sets. |
| Ts should look for evidence of the following when students are developing and using models   * Develop models to describe mechanisms at unobservable scales * Use model to explain about phenomenon in a natural system | * Ss develop and use a model using evidence from their investigation to explain the phenomena of how liquids evaporate. |
| Suggested Questions to Stimulate Class Discussion   * How is energy flowing and matter changing in the system of each liquid? * For each liquid, how did the energy leaving the system cause changes in the system overall? * For each liquid, what causes the matter to move into and/or out of the system? * How can you use a model to show how energy is flowing into or out of the system? * What patterns in the rate of cooling did you observe? * What patterns exist between the rate of cooling and the rate of evaporation in the three liquids? * How did the patterns of how each liquid cooled or evaporated caused the liquid change? * Given enough time, will the pattern change or be stable over time? * How are patterns similar across multiple systems in the three liquids? * What are the patterns you observed between the matter and energy in the system? * At what point in time will the system for each liquid become more stable? | |
| **Communicating**  Ts should look for evidence of the following when students are constructing an explanation:   * Explain science observations using evidence * Use patterns as evidence to support explanations. * Reflect on the best evidence to support a specific explanation. | **Communicating**   * Ss individually develop an explanation from evidence for why different liquids evaporate cool at different rates |

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| **Assessment of Student Learning**   * SCORE 4 – Student identifies that, given a standard temperature, the strength of the bonds and the energy required to break the bonds between the molecules of a liquid determine how quickly a liquid evaporates * SCORE 3 – Student identifies that the rate of evaporation of a liquid is dependent on the amount of energy introduced to the system and whether the molecule is polar or non-polar. * SCORE 2 – Student identifies that liquids evaporate at different rates as a result of their bulk properties. * SCORE 1 – With assistance, student could achieve either 2 or 3. |
| *(Extension of learning: Ss can build upon this lesson to draw conclusions, based on experimental evidence, about the water’s role in the homeostatic process of perspiring and how temperature regulation is critical to maintaining homeostasis).* |