360Storylines: Hot & Cold Processes

Lab 1: The Thermodynamics of Hand Warmers

IP: How do hand warmers work? Write a possible explanation of this phenomenon.	**AP:** Why do some reactions release heat while others absorb it? Based on what you learned in this experiment, try to formulate an explanation to answer this question. What evidence did this experiment supply to aid in your understanding?
Depending on student knowledge, answers will vary. There are several types of hand warmers students can reference. There are air activated hand warmers and sodium acetate hand warmers available for purchase at stores. Students could state that when the hand warmer is activated, a chemical reaction occurs and releases heat.	At this point students' answers will be rather basic. But they should at least be able to recognize that the endo- or exothermic nature of a reaction is related to the chemicals involved.
Revised Explanation: After performing the experiment, what revisions need to be made to your explanation of the ***IP***? What observations did you make that led to these revisions? Write your new explanation.	
Students should note that the salt that worked best as a hand warmer was calcium chloride. They should have also observed that some of the salts decreased the temperature of the solution. This should give them the idea that certain processes involve heat being absorbed, while others release it.	

Lab 2: Hess's Law and the Combustion of a Metal

IP: What happens to energy during a chemical reaction? Write a possible explanation of this phenomenon.	**AP:** In what way(s) do you think this lab experiment relates back to the anchoring phenomenon? How does the evidence collected in this experiment add to your understanding of hot and cold processes?
Students may recall that energy is neither created nor destroyed, but can be transferred. They might reference using temperature changes to track this transfer of energy. This is a good time to discuss the differences between temperature and heat. Temperature is a measure of the average kinetic energy, while heat is the transfer of energy.	By completing this activity, students will now have an understanding of how scientists measure and quantify energy changes. The conservation of energy is a key concept in science and should be reinforced whenever possible.
Revised Explanation: After performing the lab experiment, what revisions need to be made to your explanation of the ***IP***? What observations did you make that led to these revisions? Write your new explanation below.	**Working Model:** Apply what you have learned in labs 1–2 to formulate an explanation of hot and cold processes.
Students should now realize that they can use the conservation of energy and Hess's law to calculate enthalpy changes for reactions that cannot be directly measured.	Students should now understand that hot and cold processes involve the transfer of energy. For example, when we burn wood, energy is released. These transfers of energy can be quantified using experimental techniques such as calorimetry.

Lab 3: The Heat of Melting Ice

IP: Where does energy go when ice melts? Write a possible explanation of this phenomenon.	**AP:** Are temperature changes only associated with chemical reactions? In what way(s) do you think this lab experiment relates back to the anchoring phenomenon? How does the evidence collected in this experiment add to your understanding of hot and cold processes?
Students answers can vary. Keep in mind students' misconceptions that could still occur, such as "cold" being transferred. Another example student answer could be "ice absorbs energy from its surroundings to change from a solid to a liquid state."	Students should know that a phase change is a physical, not chemical. change. Since they just determined that melting ice was an endothermic process, they should now be able to confidently state that temperature changes are not solely linked to chemical reactions.
Revised Explanation: After performing the lab experiment, what revisions need to be made to your explanation of the ***IP***? What observations did you make that led to these revisions? Write your new explanation below.	**Working Model:** Apply what you have learned in labs 1–3 to formulate an explanation of hot and cold processes.
Students should note that while ice is melting, energy is being absorbed, even though the temperature isn't changing. This provides them with direct hands-on evidence for the intermolecular forces that exist between water molecules that need to be overcome during the melting process.	Students should note that there are many different types of processes that have a temperature change associated with them. They should now have a good understanding of how we are able to quantify them and that the reasons for the temperature changes are linked to changes on the atomic level.

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Lab 4: Enthalpy of a Neutralization Reaction

IP: How can you quantify the energy of a reaction? Write a possible explanation of this phenomenon.	**AP:** How do chemical plants know how much energy their reactors will have to deal with? In what way(s) do you think this lab experiment relates back to the anchoring phenomenon? How does the evidence collected in this experiment add to your understanding of hot and cold processes?
Students should be able to answer this question well. They have used changes in temperature to measure an energy change several times already. What they might neglect to mention is the link to energy release per mole or per gram, which is needed to fully quantify an energy change.	Students should note that chemical plants mix specific quantities of reactants. Since the energy released by a reaction is related to its scale, they are able to predict how much energy will be released and ensure that they are able to cope with this amount of heat.
Revised Explanation: After performing the lab experiment, what revisions or additions need to be made to your explanation of the ***IP***? What observations did you make that led to these revisions? Write your new explanation below.	**Final Model:** Apply what you have learned in labs 1–4 to formulate an explanation of hot and cold processes.
Students should make minor corrections and revisions to the previous answer. Encourage them to think about experimental design and the limitations of an open system, when compared to a closed or isolated system.	Students should have come to understand that almost all processes involve either the release or the absorption of energy. Through careful measurement scientists can quantify these changes and through the application of certain scientific principles, such as the conservation of energy, the energy changes for processes that cannot be directly measured can still be predicted.