360Storylines: Forest Fires

Lab 1: Energy Densities of Organic Fuels

IP: What happens when fuels burn? Write a possible explanation of this phenomenon.	**AP:** Why are forest fires hard to extinguish? 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?
Students may note that when fuels burn the area around them gets hotter, or that fuels "go away" when they burn. At this point they may not be able to make claims about energy densities, or why different fuels contain different amounts of energy. They may note that different fuels are made of different types of "stuff," or they may make very broad statements such as "different fuels release varying amounts of energy because they are different."	Students should recognize that forests provide large reserves of fuel. The scale of a forest fire is many orders of magnitude greater than the scale at which their experiment takes place. They should also recognize that dry fuel burns more readily than wet fuel. This is evident when they try to burn a wet wood splint and compare the energy released by the wet wood splint to the dry wood splint. Students may also note that a forest fire needs some energy input, such as a match. This is evident by the fact that the wood splint must be lit with a lighter.
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 recognize that fuels are chemical compounds composed of atoms. When fuels with different numbers of atoms burn they release different amounts of energy. Students should observe that wood and ethanol have different chemical formulas and that when they burn they cause different temperature changes to water held in an adjacent calorimeter. These different temperature changes indicate the release of different amounts of energy.	

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Lab 2: Matter Transformation in Combustion

IP: What happens to the matter in a fuel source when the fuel source burns? 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 forest fires?
If students have been exposed to the Law of Conservation of Matter in a previous setting they may know that mass is not created or destroyed. Less experienced students may state that when matter in a fuel source burns it changes.	Students should now know that when trees or homes burn in a forest fire the atoms that compose them are not destroyed, but converted into other forms. Their pre-combustion and post-combustion data confirm this idea. Students may note, if they view the summary video, that some of the matter in combustion reactions is transformed into carbon dioxide and some into water.
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 forest fires.
Students should note that the pre and post-combustion masses of the samples are the same despite the pre and post-combustion appearances of the samples changing. This should lead students to note that matter is neither created nor destroyed during a chemical reaction, but it must be turned into something else, or a combination of things, some of which cannot be seen.	Students should at this point recognize that forests provide large fuel sources and that forest fires convert the atoms that compose plant life into carbon dioxide and water. They should note that forest fires do not start spontaneously, but need an initial energy input. They should also recognize that the energy from a forest fire derives from chemical reactions in which bonds between atoms break and reform as matter is transformed.

Lab 3: Measure Energy Flow in Chemical Reactions

IP: Where does the energy come from in a chemical reaction? Is energy always released? Write a possible explanation of this phenomenon.	**AP:** Where does the energy or heat given off in a forest fire come from? 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 forest fires?
Student answers at this point will likely be simple. They may reference “changes” or “rearrangements” related to atoms, but it is unlikely that they will know that some chemical reactions release energy while others absorb it, or have observable temperature decreases.	At this point students should recognize that the energy given off in a forest fire derives from chemical reactions, specifically the combustion of trees with excess atmospheric oxygen. They see in this experiment that when compounds interact there can be associated energy changes. Specifically, they should note that in a fire the bonds between the atoms that compose trees are broken as are the bonds in oxygen molecules. The atoms reform into carbon dioxide and water and there is a net release of energy macroscopically observable as a temperature change.
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 forest fires.
Students should note that compounds composed of atoms of different elements can have very different energies associated with them. For example, they should note that the reaction with ammonium thiocyanate leads to a temperature decrease. They should thus reason that the energy derives from an association with the types of atoms and the fact that they have different connectivities. They may note that in a chemical reaction bonds break and reform and it is the balance of energy associated with these processes that results in a temperature increase (release of energy) or a temperature decrease (absorption of energy).	Students should note that the energy given off by a forest fire derives from the breaking and reforming of the bonds that connect the atoms in trees as well as the bonds in oxygen molecules. Students will know that forest fires are not spontaneous, but that once they start they are difficult to extinguish because trees are usually densely packed and forest fires often occur in dry climates, where wood burns more readily. Students will know that the material burned in a forest fire is not destroyed but is converted to carbon dioxide, water, and other minor products

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Lab 4: Climate Change and the Carbon Cycle

IP: Do trees remove carbon dioxide from the atmosphere? Write a possible explanation of this phenomenon.	**AP:** What role do forest fires play in the carbon cycle? Do they result in a net increase in atmospheric CO_2? 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 forest fires?
Students may know from the information they consume daily that trees process CO_2 into energy. They may also know as much from a previous science course. Some students may note a simple "yes" or "no." It is important that students gather evidence to support whatever position they take.	Students should note that forest fires, or deforestation, removes carbon dioxide recyclers from the Earth system as well as directly vents carbon dioxide into the atmosphere. These things together lead forest fires to be net increasers of carbon dioxide.
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 forest fires.
Students should note that plant life is able to remove carbon dioxide from water, which implies that plant life is able to remove carbon dioxide from the atmosphere. In this lab, aqueous solutions of a plant sprig and acid-base indicator become less acidic (more basic) when exposed to light because plants are able to photosynthesize carbon dioxide into sugar. Students may note that plants also respire and thus give off carbon dioxide. They will not know without further research that the rate of photosynthesis exceeds the rate of respiration and that plants are therefore net carbon reducers.	Students should note that the energy associated with a forest fire derives from the potential energy in chemical bonds. They should note that forest fires are hard to put out because the atmosphere provides an excess of oxygen and the forest provides a large amount of closely packed fuel, i.e., each burning tree can supply the energy to burn another tree(s). Students should also note that forest fires are pronounced in dry climates because dry fuel burns more readily than wet fuel. Finally, students should note that forest fires put carbon dioxide directly into the atmosphere and remove organisms that are capable of converting carbon dioxide into sugar, from the earth system.