360Storylines: Fireworks

Lab 1: Elements, Compounds, and Mixtures

IP: Can we break down matter? Write a possible explanation of this phenomenon.	**AP:** Can matter form new substances when combined? 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 might provide a few examples on how matter can be broken down by physical means before they begin the lab. Students experiment with what happens when a piece of charcoal (carbon), for example, is broken into smaller pieces. Does the carbon change into anything different, is it broken down further? Students also perform a chemical reaction and witness substances combining to form new ones, where matter is conserved. At this point students might not know the term chemical reaction. However, the driving point is to have students witness different forms of matter.	In this lab students witness that matter cannot be changed into something different by physical means. Students should conclude that no matter how much a pure element is broken by physical means, the element's identity remains. When the chemicals were combined, new substances were formed where conservation of mass was proven.
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 might have been under the impression at the beginning of the experiment that when matter is broken down by physical means, it can "change" into something else. This experiment provided a great introduction into matter and the particles of matter. However, for example, students should conclude that no matter how much a pure element is broken by physical means, the element's identity remains.	

Lab 2: Bean Bag Isotopes

IP: Are all atoms of an element the same? What particles make up the atom? 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 colors in fireworks?
Students learn about isotopes with dried food items. Students may not fully grasp that all elements have isotopes. At this point students may provide an answer, such as all atoms are made up of a nucleus containing protons and neutrons, and surrounding the nucleus are the electrons.	Students start to make connections between atomic structure, in other words the particles involved in atomic structure and why fireworks display different vibrant colors in the sky.
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 colors in fireworks.
The student revision to the IP should be that they fully grasp that an isotope is an atom of the same element, where it has the same number of protons but different number of neutrons. After performing the experiment, students witnessed that the different food types were isotopes in element Bg.	After performing labs 1 and 2, students’ knowledge begins to evolve regarding atomic structure. When students are brought back to examine the Anchoring Phenomenon of fireworks, lab 1 provides experience at simply observing types of matter and its properties. Lab 2 solidifies the differing particles of the atom that results in isotopes.

Lab 3: Evaluate Atomic Spectra

IP: Do all atoms in a gas filled spectrum tube display the same emission spectrum when viewed through a spectroscope? Write a possible explanation of this phenomenon.	**AP:** What happens to the particles in an atom to produce unique colors in the visible region of the electromagnetic spectrum? 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 fireworks?
Although students may not understand that the emission spectrum of every gas filled spectrum tube will be different due to the different electron configurations of the gases, students should have an idea that the emission spectrum of each spectrum tube will not be the same. Their discoveries in the previous experiments will lead the students to this conclusion before experimentation.	When students observe the visible colors of the emission spectra, they begin to make connections to fireworks; the colors are very similar. During the lab the students are also brought back to atomic structure. Students should reach an understanding that as electrons relax back down to the ground state, particles called photons are released. The colors of the photons are in the visible region of the electromagnetic spectrum.
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 fireworks.
Students fully grasp the IP when re-explored. While it is possible that students did not initially understand why the emission spectra are unique, after performing the lab they should conclude that the emission spectra are due to the electronic structures of the various elements in the tubes.	Labs 1, 2, and 3 serve as atomic structure building blocks for students. In labs 1 and 2, students evaluated matter and the particles of matter. By lab 3, students apply this knowledge to spectrum tubes and witness colors of emission spectra. In lab 3 they learn about the photon particle. Students compare similarities between the emission spectra of spectrum tubes and fireworks.

Lab 4: Evaluate the Bohr Model of the Atom

IP: Can we know the precise location of an electron around the nucleus of an atom? Write a possible explanation of this phenomenon.	**AP:** What is the probability of finding an electron as its distance from the nucleus increases? 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 fireworks?
When students are presented with this IP they may provide the inaccurate answer of: yes, the precise location of an electron is known. Resources used in chemistry, such as the periodic table, show us electron configurations of each element. In addition, rules listed in textbooks discuss allowed number of electrons in orbitals. There is a common misconception that if we know how many electrons there are in the orbitals, we also know their exact location.	The simulated experiment shows students how the probability of finding an electron about the nucleus decreases the farther away the election is from the nucleus. Students begin to rethink their initial hypothesis and start making connections to fireworks, since electrons can "jump" energy states or orbitals, they relax back down to their ground states and release photons along the way.
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 fireworks.
After performing the lab, students understand that we can only know the probability of where to find the electron, and not its exact location. Students also explore the probability of finding electrons near the nucleus, versus farther away.	At this point we have solidified that electrons play a major role in the colors of fireworks displays. Students have extensive experience and knowledge about the particles of atoms and their involvements in the Anchoring Phenomenon of fireworks.

Lab 5: Model Electron Configuration

IP: Do all atoms have the same number of electrons in all of the atomic orbitals? Write a possible explanation of this phenomenon.	**AP:** Do all atoms have the exact same electron configuration? 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 fireworks?
While students may understand that there are only a certain amount of electrons allowed in the various atomic orbitals, they may not be familiar with the atomic orbital filling rules. This concert chart seating analogy solidifies this concept.	By lab 5 of this Anchoring Phenomenon, students fully grasp and connect electron configuration to fireworks. They learn the rules of electron filling orders and witness the various electrons in the orbitals of atoms of the elements, the elements do not have the same electron configuration.
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 1–5 to formulate an explanation of fireworks.
Students delved deeper into assigning electron configuration to each element. Their initial knowledge involved knowing the filling rules based on the Aufbau principle, Pauli exclusion principle, and Hund's rule. These principles were applied to the concert chart seating analogy.	Students make the connection that the colors of fireworks are different because the electron configurations of the metal ions in the firework materials are unique. An important concept that students connect in this lab is that the colors of fireworks results from excitation and relaxation of electrons where photons, visible to the naked eye from the visible region, are witnessed. This ties back to lab 3.

Lab 6: Evaluate Atomic Structure with Flame Tests

IP: Why do burned metal ion samples display brightly lit colors? Write a possible explanation of this phenomenon.	**AP:** Why do burned metal ion samples display different colors? What happens to the particles in the metal ion samples that cause the different display of colors? 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 fireworks?
By lab 6 students should have a deep grasp of electron configuration of metal ions and their excitation, relaxation, and photon emission (the colors witnessed when burned). Students may not yet understand that energy needs to be applied in order to witness the color.	This lab is the most relatable to the Anchoring Phenomenon of fireworks. When the metal ion samples are burned, unique colors are observed. Students should conclude that the colors are emission of photons of each metal ion burned. The colors range from green, to yellow, to red of the visible region. The colors are unique to each metal ion since each metal ion has a unique electron configuration.
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 1–6 to formulate an explanation of fireworks.
Students come to understand that for fireworks to function, applied energy is needed. In this lab a Bunsen burner supplying a flame was needed to excite the electrons and witness the colors of the various dipped metal ion wood splints.	The labs developed the students' ability to look at how fireworks function and why they function. The first few labs focused on the elementary topics of simply exploring the particles that make up atoms. Then students explored how these particles can be manipulated in the atom with supplied energy and cause an amazing phenomenon to occur—fireworks.