Answer Key & CER Rubric

Please use the following answer key for the Explain Activity. CER rubric should be printed/posted for students.

Activity 2:

Part A: Chopping an Onion (Enzyme-Driven Reaction)

1. S-1-propenyl-L-cysteine sulfoxide + **alliinase** → **syn-Propanethial-S-oxide** → You cry

- *Enzyme alliinase catalyzes the reaction, forming the volatile compound that irritates your eyes.*

Part B: Cooking an Onion (Thermal Decomposition)

2. Sulfur compounds + **heat** → new **odor molecules** + color/smell changes

- *Thermal energy breaks down larger sulfur-containing molecules into smaller, flavorful and aromatic compounds.*

3. *Heat provides the additional energy needed to break bonds in the original compounds. This allows the atoms to rearrange and form new substances. (Encourage students to use activation energy if previously covered)*

Part C: Molecular Changes in Onions

4. The reaction starts only when onion cells are broken.
5. This indicates that enzymes and sulfur compounds are stored in separate compartments in the cells, and only interact when cell walls are damaged.

Activity 3:

1. ***Claim:***
   Enzymes play a key role in triggering the chemical reaction that leads to eye irritation.
   Evidence:
   The enzyme alliinase converts sulfoxides into other sulfur compounds, and another enzyme, LF synthase, helps produce syn-Propanethial-S-oxide, the compound that causes tears.
   Reasoning:
   Enzymes act as catalysts, speeding up chemical reactions. Alliinase begins the reaction, and LF synthase completes it. Without these enzymes, the compounds that irritate the eyes would not form quickly or at all.
2. ***Claim:***
   Determining the structure of LF synthase was essential to understanding the complete tear-inducing reaction in onions.

Evidence:

Scientists used X-ray crystallography to map the 3D structure of LF synthase and combined it with previous findings to model how the enzyme works.

Reasoning:

Understanding the structure of an enzyme helps explain how it functions in a reaction. This discovery provided the missing link in the decades-long puzzle of how onions produce the lachrymatory factor.

3. ***Claim:***

Chopping a raw onion makes you cry because it releases a gas that irritates the eyes, but cooking it does not cause tears.

Evidence:

When an onion is chopped, enzymes convert stable molecules into volatile sulfur-containing compounds that vaporize and react with the eyes. Heat, however, denatures the enzymes.

Reasoning:

Enzymes are sensitive to temperature. When onions are cooked, the enzymes responsible for producing the tear-inducing chemical are deactivated by heat, preventing the reaction.

<u>Rubric (Optional)</u>

Criteria	***4 – Excellent***	***3 – Proficient***	***2 – Developing***	***1 – Beginning***
Claim	*Clear, concise, and directly answers the question*	*Addresses the question clearly*	*Vague or partially addresses the question*	*Missing or unrelated to the prompt*
Evidence	*Strong, accurate evidence from the article*	*Adequate evidence, mostly accurate*	*Limited or somewhat unclear evidence*	*No evidence or mostly inaccurate evidence*
Reasoning	*Thorough explanation connects evidence to the claim with correct vocabulary*	*Reasonable explanation, minor vocabulary gaps*	*Weak connection between evidence and claim*	*No reasoning or major misconceptions*

Scientific Vocabulary	*Uses multiple relevant terms (e.g., enzyme, LF synthase, reaction, structure)*	*Uses some scientific terms correctly*	*Minimal or inconsistent use of vocabulary*	*Little or no scientific vocabulary used*
Mechanics & Clarity	*Well-organized, clear, and mostly error-free writing*	*Mostly clear, few errors*	*Some unclear sentences or grammar issues*	*Difficult to read due to errors or poor structure*

<u>Activity 3:</u>

When the onion is cut, an enzyme called *alliinase* ***reacts with*** *sulfur compounds* ***to produce*** *syn-Propanethial-S-oxide.*

Cooking the onion causes a chemical change because *heat breaks down sulfur compounds into new substances with different smells and colors.*

We can tell a chemical change happened because *the onion smells different, looks different, and produces new substances.*