

Case Study: Grade 5 Exemplar

Related NGSS Performance Expectation:

5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Transcript

Part I

Mr. Rodgers' 5th grade class is learning about chemical reactions as part of a unit about the structure and properties of matter. The students have been keeping a chart of the investigations they are doing and classifying them as producing chemical reactions or not. Before beginning the next investigation Mr. Rodgers wants to review what they have learned so far.

Mr. Rodgers: Let's take out our charts and use our data to remind ourselves about chemical reactions. Adam?

Adam: In a chemical reaction, new materials are made. Like when we did the experiment yesterday with the baking soda, sugar, road salt, and that red liquid. When they all mixed together, it made a gas. We didn't have a gas before we started.

Lila: That was cool. The plastic baggie got really big. I thought it might explode. But I have a question, how do we know we didn't have something that was the gas but it was just a liquid or a solid before?

Drew: I'm confused. If we put two things together and they make a gas then we made something new.

Lila: Probably, but remember the experiment we did with boiling water? The water turned into water vapor, which is a gas, but it's still H₂O. It's not new stuff.

Adam: Well, the bag also got hot. That is also a sign of a chemical reaction.

The class continues to discuss their observations. Then, Mr. Rodgers tells the students that they will be repeating the experiment with the salt, sugar, baking soda and red liquid (really called phenol red). However, instead of just putting the materials together in a bag to see what happens, they will be experimenting to figure out what combination of 3 substances actually causes the chemical reaction. He first asks the students to work in groups to plan how to conduct the investigation and then create a data table where they can record their observations. Mr. Rodgers listens in as one group discusses their table.

Amelia: Okay, we need to plan how we will do this investigation.

Ethan: We can only change one thing at a time so let's write down all the different combinations we should try.

The students make a list of all the different combinations, making sure that they only change one substance at a time.

Amelia: Now we can make the data table.

Jeff: So I will write down which 3 substances we are trying. We need to make a space to write down what happens too, right?

Ethan: You mean, how will we know if a chemical reaction happened?

Amelia: Oh, the stuff in the bag will bubble.

Ethan: So maybe the second column could be yes or no, whether there are bubbles or not.

Amelia: What about the temperature? That will change if there is a chemical reaction.

The students continue their work.

Mr. Rodgers: I am seeing different types of data tables that you are using. Let's put up a few of them around the room and see how they compare. I'm going to give you sticky notes to write questions for the students who designed the data tables. It is important that if you write a question, it is one that asks about a specific part of the data table or about something you do not understand. For example, I might ask Amelia, Jeff and Ethan why their data table has a column for Yes or No -- Yes or No for what?

The students move in small groups around the room. Using sticky notes they ask questions about the data tables. Afterwards, Mr. Rodgers gives the groups time to read the questions and make changes to their tables. The students then collect their data.

Part II

The next day the students conduct their experiment. The following day Mr. Rodgers starts class by having the students take out their data tables and talk to their groups to remind each other what they learned from the experiment.

Amanda: We saw that when the baking soda, salt, and red liquid were mixed together, a chemical reaction happened.

Eliza: Well, we saw that there were bubbles. So that means a chemical reaction happened.

Amanda: Right. That was the combination that made something new, which was the gas. The bag got hot too.

Justin: So, what about the sugar? I mean, it turned into something red when we added the red liquid.

Eliza: I don't think that's a chemical reaction. It just changed colors.

Justin: Oh, I get it. It's like the melting ice. It turns into water, but it is still the same stuff. H₂O.

Mr. Rodgers explains that each student will be writing their own scientific explanation to answer the question: What 3 substances caused the chemical reaction? He shows the students a graphic organizer that has 3 parts: Claim, Evidence, and Reasoning.

Mr. Rodgers: Can someone remind me what a claim is?

Justin: The answer to the question.

Mr. Rodgers: Right. So the first thing you will do is write a sentence that answers our question, What 3 substances caused the chemical reaction?

Eliza: And then we use our data tables for the next part?

Mr. Rodgers: Right. Your data becomes your evidence when you use it to explain your claim. But remember, we are not going to just copy our data tables in there. We are going to write down in sentences the data that makes sense to include.

Amanda: So maybe not everything we tried?

Mr. Rodgers: Probably not. But you will have to decide what to include.

Ethan: Oh, I remember the last part, the reasoning. That's the science idea.

Jeff: So for this one what would we write? What a chemical reaction is?

Mr. Rodgers: You are going to have to make that decision, but don't forget that the science idea should show why your evidence explains the claim. Why does the data you used help explain your answer to the question? Remember, scientific explanations always explain how or why something happens. Today you will have a chance to do your writing. Tomorrow we will have some time to read each other's explanations to help make everyone's explanations even better.

Part III

The following day the students each read another student's scientific explanation. He asks students to first highlight in yellow their classmate's claim, highlight in green their evidence, and highlight in pink their reasoning. These colors correspond to a chart on the wall that defines claim, evidence, and reasoning. After they highlight each other's explanations, Mr. Rodgers provides the students with a series of sentences starters to help them offer each other constructive feedback about their explanations.

Adam: I agree with your claim, that the salt, baking soda, and red liquid caused the chemical reaction.

Brad: I have a question. How come you used way more evidence than me?

Adam: I decided that I should write what happened for every combination of the materials.

Brad: I think we don't need to write that much. I think you could just give an example of when you mixed stuff and it bubbled and when you mixed stuff and it didn't bubble.

Adam: Maybe give two examples, just to really show that those 3 substances are important for the reaction?

Brad: That might be okay.

Adam: I have a question about your reasoning, Brad. After your evidence, you wrote "This evidence shows that the salt, the red liquid, and the baking soda caused a chemical reaction."

Brad: Right. That's my reasoning.

Adam: But it is the same as your claim. Remember, we talked about we have to explain why a chemical reaction happened. See what I wrote? For my reasoning I said "The evidence shows a chemical reaction happened because something new was made. The gas was new. Chemical reactions happen when new substances are made." I think you need to say why a chemical reaction happened.

Mr. Rodgers tells students that their homework that night is to rewrite their explanations using the feedback from their partners. Tomorrow, he will collect them and students will get his feedback so they can edit them again over the weekend.