[MUSIC PLAYING]

JESSICA HARROP: Hi, I'm Jessica and I'm going to be talking about a chemical demonstration today that I like to call "Death of a Gummy Bear." We eat these little guys all the time and our bodies break down the sugar in a series of chemical reactions. But what happens when you break down the sugar in a gummy bear outside of our bodies? Well, MIT'S Dr. John Dolhun is going to show us. Here he is at the Cambridge Science Festival at MIT.

JOHN DOLHUN: Now I'm going to actually be combusting a gummy candy. And my wife said, please don't tell them it's a bear. Guess what? It's a bear. And I'm going to eat one right now. And I'm eating a gummy candy. It's sugar. And I'm going to chew on it, and eat it, and what do you think's going to happen to it?

AUDIENCE: It's going to break down.

JOHN DOLHUN: It's going to break down into carbon dioxide. Tomorrow I'm going to be breathing out CO_2. I'm going to be perspiring. Water is going to be coming out. And I'm going to make a lot of energy, and I'm going to take that energy and store it up as ATP, and it's going to help me clean all these dishes tomorrow. I don't want to think about that but I'm going to need the energy.

And now I'm going to do this same reaction inside of a test tube. And I want you to compare what you just saw. You didn't see a lot of smoke and fire coming out of my mouth, did you? Not yet, OK. So Clifton, you can. Clifton's going to play a little rondo or music while I set this reaction up.

[MUSIC PLAYING]

JESSICA HARROP: So what is Dr. Dolhun doing? First, he put some solid potassium chlorate in a test tube and heated it up. The heat causes the solid to melt and become a liquid. So this little triangle means heat. It turned from a solid to a liquid. As it's being heated, the liquid potassium chlorate immediately starts breaking down into two products, potassium chloride and oxygen. Now potassium chloride is a solid and the oxygen is a gas. Looks like this. Now let's see what happens when Dr. Dolhun adds the gummy bear.

[MUSIC PLAYING]

So let's break down what just happened. The sugar from the gummy bear and oxygen reacted to produce carbon dioxide and water, releasing a lot of energy as heat and light. This is what that looks like, and I'm going to draw sucrose, or sugar, in red because it's from the gummy bear.

This reaction is probably familiar to you. It's a combustion reaction, which is when a fuel reacts with oxygen to produce carbon dioxide and water and at the same time, releasing a bunch of energy. So why is so much energy released and where does it come from? To show you, I'm going to draw the structures. Now, if you're unfamiliar with organic chemistry notation, each of the lines between the elements that I'm going to draw represents a covalent bond, which is the sharing of two electrons between two atoms. So let me draw those.

So here are the reactants and here are the products. Now by looking at the number of bonds and the type of bonds, so a carbon bonded to an oxygen, or a carbon bonded to a carbon, and a single bond versus a double bond, you can calculate the energy difference between the left side of the reaction, the reactants, and the right side, or the products. Now all combustion reactions have more energy stored in the reactants than the products, so as the reaction progresses, this energy has to go somewhere and it's released as heat and light.

Now the amount of energy released from this explosion is exactly the same as the amount of energy that would be released in my body when I eat this gummy bear. The difference is that proteins in my body are set up in pathways that extract the energy in small, manageable bundles. So I power my everyday activities like dancing and running, but I don't explode. Evolution has trained biological systems to efficiently extract energy from our environment. That's it for me today. I'll see you next time.

[MUSIC PLAYING]