What makes chocolate snap?

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Experimenting with Chocolate

In this activity we will look at how chocolate can change when we heat and cool it and we will learn about a concept called polymorphism which will help us to understand why chocolate can sometimes loose its snap.

So, what is polymorphism? Let us imagine we have a crystal made up of smaller molecules A and B. If molecules A and B can be arranged in different repeating patterns inside our crystal this is called polymorphism and although the crystals contain the same molecules the different arrangements of the molecules can mean the crystals have different properties. Chocolate is a compound that exhibits polymorphism because cocoa butter molecules can arrange themselves in at least 6 different ways in a crystal. There are a couple of methods we can use to change cocoa butter from one polymorph to another. In this activity, we will melt chocolate to see how this process changes some observable properties such as texture.

What you will need

Ingredients:

A piece of chocolate

Utensils/tools:

- Plate
- Radiator/heating element
- Refrigerator

You can download and print the activity worksheet or follow along on a device. You will need internet access to watch the video of the results.

Learning Outcomes

In this activity, you will:

- Learn about properties of chocolate.
- Learn about polymorphism.

Recommended Age

This activity is suitable for ages 8+ years with adult supervision and guidance.

Health & Safety

These activities are carried out at your own risk. Please read these health and safety guidelines to reduce risks.

- Any access to the internet for minors should be done under adult supervision.
- Heating is required for this activity and should be done with an adult to reduce the risk of burns.
- Some people are allergic to the ingredients found in a chocolate bar, before eating the chocolate please check it is ok to do so with an adult.

Steps

Step 1: Grab a piece of chocolate bar and break the bar in half. Note the sound produced when the bar breaks. Put aside half of the chocolate bar, we will use this piece later to compare with what we make.

- *How would you describe the sound of the chocolate breaking?*
- *How easy or hard was it to break the piece of chocolate?*

Step 2: Take the other piece of chocolate and place it on a plate ready to melt. Put the plate with chocolate on a radiator or in the sunshine. If you want to melt the chocolate using a heating element instead, ask an adult to help you.

- *What do you think needs to happen physically for the chocolate to melt*?
- *What happens to the appearance of the chocolate as it starts to melt?*
- *Would you describe the melted chocolate as shiny or dull?*

Step 3: Once the piece of chocolate has melted, we need to cool the chocolate. Place the plate of melted chocolate somewhere cool like a refrigerator for a few hours. You can check on the chocolate as it resolidifies.

- *How would you describe the changes to the appearance of the chocolate as it resolidifies*?

Step 4: Once the chocolate has become solid again, take it out of the refrigerator and place next to the piece that was not melted.

- *Do the two pieces of chocolate look different?*

Allow the melted chocolate to come back to room temperature, *i.e.* not cold to touch. When the chocolate is no longer cold, try to break the piece of chocolate and you can also try tasting the two pieces of chocolate.

- *Was it easier or harder to break the piece that was not melted?*
- *How would you describe the sound when you break the piece that we melted?*
- *Did the two pieces of chocolate taste different or did they feel different on your tongue?*

Explanation

In this activity, we melted a piece of chocolate to observe some of the changes in property that can reflect polymorphism. Heating the chocolate caused the molecules inside the chocolate bar to move around more changing it from a solid to a liquid when the chocolate melted. When we cooled the chocolate down again the molecules stopped moving around and the chocolate re-solidified.

How the cocoa molecules pack together when it re-solidifies can cause some physical observations that can signify a new polymorph has formed such as a change in colour and appearance. You may have found the piece of chocolate that was melted was lighter in colour than the un-melted piece. This change is referred to as blooming. You may also be able to feel the difference in texture between the un-melted and melted piece of chocolate. Or perhaps when you tried to break the previously melted piece of chocolate you missed hearing the snap that we heard when breaking the un-melted piece. Your melted piece of chocolate may also have felt more crumbly or grainy on your tongue. If you did notice a difference

in your chocolate, then you have probably made a different polymorph and the cocoa butter molecules are packed together in a different arrangement.

We learnt earlier that there are at least 6 different ways cocoa butter molecules can arrange themselves in a crystal so you could try to heat the chocolate up or cool the chocolate down at different rates to see what happens and if you observe different properties. To do this why not repeat this experiment but this time try putting your chocolate in the freezer instead of the refrigerator and see if you spot any differences?