

Name: _____ Date: _____

Close Encounters of the Polymer Kind Lesson – Close Encounters Worksheet

Directions

Please answer the questions below using complete sentences.

Polymers

Using chemical reactions, you can make many different types of polymers. Polymers are typically separated into two types: *thermosets*, such as tires and car bumpers, and *thermoplastics*, such as water bottles, which are often made out of polyethylene, as mentioned earlier.

1. While polymers have some negative environmental aspects to them, what are some reasons why polymers are so widely used?

Weissenberg Effect

The *Weissenberg Effect* is the instance where a polymer travels up a rod, in contrast to say water that moves away from the rod as it spins. By considering the differences between long chain polymers and water, we can figure out why this is the case.

2. What did you observe in the Weissenberg Demo?

Entropy and Enthalpy

Polymers are the same as people who are in close contact in a small room: they want plenty of room to stretch their arms and legs. Essentially, they want to increase *entropy*, or create disorder of the current system. If standing in the room next to an enemy, there would be an inclination to move. There is a *repulsion* between the two people—this is analogous to *enthalpy*.

3. In your own words describe entropy and enthalpy?

4. In your own words, describe what enthalpic and entropic *interactions* are?

5. Does nature want to maximize or minimize entropy?

Barus (Die Swell) Effect

The Barus Effect is similar to the Weissenberg Effect in that it can be explained by the balances of the entropic and enthalpic contributions. Think back to the YouTube video of the three effects. What happened in the Barus Effect? As the polymer exited the die (mold), it expanded and swelled.

6. Which has more entropy available: a chain that is forced to be straight or a chain that can freely move?

7. Explain why water does not swell after exiting the die?

Kaye Effect

Write down your observations of the Kaye effect, as seen in the lesson video.

The polymer appears to “skip” off the surface— possibly due to what is known as *shear thinning*. The polymer outside of the polymer stream shear thins and acts as a lubricant, allowing the stream to slide or skip off the surface.

Shear thickening is the exact opposite of what is happening in the Kaye Effect video. With shear thickening, a material gets stiffer as you run/move across it. In fact, the faster you move, the easier it is to cross the material. With shear thinning, the material gets softer as you run across it. The faster you run, the softer the material gets.

8. Explain shear thinning?

9. Explain shear thickening?

Thermosets

10. In your own words, what are a thermoplastic and a thermoset? List one of each.

11. Can you change the shape of a thermoset material?

12. If you want a *flexible* thermoset do you need a few or many connections?

13. If you want a *stiff* thermoset do you need a few or many connections?

14. Are the crosslinks in thermosets physical entanglements or covalent bonds?

15. When you have no loose ends, you have a _____ ratio of functional groups.