

# Close Encounters of the Polymer Kind Lesson – Close Encounters Worksheet – Answers

## Directions

Please answer the questions below using complete sentences.

## Polymers

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

Answers will vary.

They are lighter weight and for instance in a car they would be more energy efficient. They can be made stronger or flexible depending on the applications. Thermoplastics can be recycled and thermosets can provide very strong materials.

## Weissenberg Effect

2. What did you observe in the Weissenberg Demo?

The polymer goes up in the Weissenberg Demo.

## Entropy and Enthalpy

3. In your own words describe entropy and enthalpy?

Answers will vary.

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

Entropic interactions between objects are the inherent desire for disorder in the system.

Enthalpic interactions are attractive and repulsive interactions between neighboring objects.

5. Does nature want to maximize or minimize entropy?

Entropy should be maximized in the Weissenberg Demo.

## 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?

A chain that is free to move has more entropy available to them.

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

Water is roughly linear and only bent slightly. Therefore its state of entropy is roughly the same in the die as out of the die so it does not swell appreciably.

## Kaye Effect

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

**Answers will vary.**

8. Explain shear thinning?

**When a polymer shear thins it acts like a lubricant and shears or slips or skips off the surface.**

9. Explain shear thickening?

**When solid particles in solution align under shear they give ordered structured that restricts the flow of fluid.**

## Thermosets

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

**A thermoplastic is a polymer system that consists of a collection of linear or nearly linear polymer chains that can be reshaped with sufficient heat.**

**A thermoset is a polymer that has been cured (heated) and cannot be changed back into its original form. The thermoset is set in its final form.**

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

**You cannot change the shape of a thermoset material as it is set.**

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

**A thermoset with fewer connections will be more flexible.**

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

**A thermoset with more connections will be more stiff.**

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

**Thermosets cross links are due to covalent bonds.**

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