Name: _____ **Date:** _____

Answer Key: Frozen 2: Elsa's Kingdom Heat Transfer Quest for 2nd Grade

Molecular movement, insulation design, and energy flow — high-level synthesis challenges requiring students to predict and create solutions for thermal energy problems.

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1. You are building a winter coat for a penguin. Which material would be the BEST choice to keep the penguin's body heat from escaping into the cold air?

Answer: B) Thick, fluffy wool with lots of trapped air

Fluffy materials like wool trap air, which is a poor conductor of heat. This creates 'insulation' that slows down the flow of thermal energy from the body to the outside.

2. Imagine you have two cups of cocoa. Cup A is very hot, and Cup B is lukewarm. If you pour them into one big bowl, the thermal energy will move from ____.

Answer: C) The hot cocoa into the lukewarm cocoa

In thermodynamics, heat always moves naturally from the object with more thermal energy (hot) to the object with less thermal energy (cold) until they even out.

3. True or False: If you leave a metal slide in the sun, it gets hotter than a plastic slide because metal lets heat travel through it more easily.

Answer: A) True

Metal is a conductor, meaning its particles pass thermal energy along very quickly compared to plastic, which is an insulator.

4. If you hold a cold ice cube in your hand, your hand starts to feel very cold. What is actually happening to the energy?

Answer: B) Heat energy is leaving your hand and moving into the ice

We feel 'cold' when we lose heat. The thermal energy from your warm hand is being transferred to the colder ice cube to try to melt it.

5. You are designing a 'Cool Box' for a picnic. To keep the drinks cold for the longest time, the inside of the box should be lined with ____.

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Answer: A) Styrofoam or thick foam

Styrofoam is an excellent insulator. It prevents the heat from the outside air from moving into the box and warming up the cold drinks.

6. True or False: Rubbing your hands together very fast creates heat because the friction makes the tiny particles in your skin move faster.

Answer: A) True

Heat is actually the movement of tiny particles. When you use friction (rubbing) to make particles move faster, the temperature goes up.

7. A scientist finds a way to make the particles in a block of wood stop moving completely. What would the temperature of that wood be?

Answer: C) As cold as it can possibly be

According to the laws of thermodynamics, if all molecular motion stops, the object reaches 'absolute zero,' the coldest possible temperature.

8. On a sunny day, why does a black t-shirt feel much hotter than a white t-shirt? It is because the black color ____.

Answer: B) Absorbs more light energy and turns it into heat

Dark colors absorb more light radiation from the sun. That light energy is then transformed into thermal energy, making the fabric hot.

9. You see steam rising from a puddle of water on a hot sidewalk. What is happening to the energy in this system?

Answer: C) Heat from the sidewalk is moving into the water particles

The hot sidewalk transfers thermal energy to the water. This added energy makes the water particles move so fast that they turn into gas (steam).

10. True or False: If you put a hot potato in a cold room, the potato will eventually become the exact same temperature as the air in the room.

Answer: A) True

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Heat will continue to flow from the potato to the room until they reach 'thermal equilibrium,' which means they are the same temperature.