THE STANDARD

States of Matter & Thermal Energy

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

DCI — DISCIPLINARY CORE IDEA

PS1.A · Structure and Properties of Matter

> *Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.*

A pure substance is made of particles in motion. In a solid, they vibrate in place. In a liquid, they slide past each other but stay in contact. In a gas, they zoom around with space between them. Add thermal energy and particles move faster. **Add enough, and the substance changes state.**

SEP — SCIENCE & ENGINEERING PRACTICE

Developing and Using Models

> *Develop a model to predict and/or describe phenomena.*

Students aren't memorizing the three states. They're building a particle-level model that predicts what happens when heat goes in or out. The model has to show motion, spacing, and state. If their drawing can predict what ice does on the counter, they're doing science. **If it just labels three boxes, they're not.**

CCC — CROSSCUTTING CONCEPT

Cause and Effect

> *Cause and effect relationships may be used to predict phenomena in natural or designed systems.*

This standard is built on cause and effect. Thermal energy in is the cause. Faster particle motion, a temperature rise, or a phase change is the effect. **Students use the model to predict: if I add this much heat, what happens to the particles, what happens to the temperature, what happens to the state?**