THE STANDARD

Temperature & Energy

Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

DCI
DISCIPLINARY CORE IDEA

PS3.A · Definitions of Energy

> *Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.*

Temperature measures how fast particles are moving on average. But how much energy it takes to change that temperature depends on what the substance is and how much of it you have. Water needs a lot of energy to warm up by one degree. Metal needs much less. **A big pot takes longer to heat than a small one.**

SEP
SCIENCE & ENGINEERING PRACTICE

Planning and Carrying Out Investigations

> *Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.*

Students aren't running a recipe lab where the procedure is handed to them. They're planning the investigation themselves. They pick the variables, decide what to control, choose the tools, and decide how much data they need. **The teacher's job is to keep them honest, not to hand them a worksheet.**

CCC
CROSSCUTTING CONCEPT

Scale, Proportion, and Quantity

> *Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.*

This standard runs on proportional reasoning. Double the mass, you roughly need double the energy for the same temperature change. Swap water for sand, and a small amount of energy moves the temperature a lot more. **Students reason about ratios between energy in, mass, and temperature change without doing the formal calculations.**