Target Performances for *Systems and Scale* Activities

All *Carbon TIME units* are organized around a common purpose: *assessing and scaffolding students' three-dimensional engagement with phenomena.* Every *Carbon TIME* activity has its specific expectation for students' three-dimensional engagement with phenomena, what we call its **target performance**. Each activity also includes tools and strategies that teachers can use to asses and scaffold the target performance in rigorous and responsive ways.

The target performances for each activity in the *Systems and Scale* unit are listed in the table below.

Activity	***Target Performance***
Lesson 1 – Pretest and Expressing Ideas (students as questioners)	
Activity 1.1: Systems and Scale Unit Pretest	Students show their initial proficiencies for the overall unit goal: Questioning, investigating, and explaining how matter and energy changed during combustion of organic materials.
Activity 1.2: Expressing Ideas about Ethanol Burning (40 min)	Students ask and record specific questions about changes in matter and energy in response to the unit driving question: What happens when ethanol burns?
Lesson 2 – Foundations: Powers of Ten and Investigation Tools (students developing foundational knowledge and practice)	
Activity 2.1: Powers of Ten Video and Discussion (30 min)	Students discuss how all systems can be analyzed by "zooming in" and "zooming out" through a hierarchy of systems at different scales.
(Optional) Activity 2.2: From Big to Small (30 min)	Students organize images to "zoom in" and "zoom out" of six different systems at four different scales: atomic-molecular, microscopic, macroscopic, and large scales.
Activity 2.3: Zooming into Air (30 min)	Students describe air at atomic-molecular, microscopic, macroscopic, and large scales, identifying specific molecules in air.
Activity 2.4: Atoms and Molecules Quiz and Discussion (30 min)	Students apply the principle of matter conservation to atoms and molecules in different phenomena.
Activity 2.5: Using a Digital Balance and BTB (30 min)	Students (a) practice using two key tools for investigation—digital balances and BTB—with accuracy and precision and (b) describe how they can use these tools to detect matter movement and matter change.

Activity	***Target Performance***
(Optional) Lesson 3 – Investigating and Explaining Soda Water Fizzing (students as investigators and explainers)	
Activity 3.1: Predictions about Soda Water Fizzing (20 min)	Students develop hypotheses about how matter moves and changes when soda water loses its fizz and make predictions about how they can use their investigation tools—digital balances and BTB—to detect movements and changes in matter.
Activity 3.2: Observing Soda Water Fizzing (30 min)	Students record data about changes in mass and BTB when soda water fizzes and reach consensus about patterns in their data.
Activity 3.3: Evidence-Based Arguments about Soda Water Fizzing (45 min)	Students (a) use data from their investigations to develop evidence-based arguments about matter movements and matter and energy changes when soda water fizzes, and (b) identify unanswered questions about matter and energy movement and matter change that the data are insufficient to address.
Activity 3.4: Molecular Models for Soda Water Fizzing (45 min)	Students use molecular models to explain how carbon, oxygen, and hydrogen atoms are rearranged into new molecules during the decomposition of carbonic acid (the chemical change that happens when soda water fizzes).
Activity 3.5: Explaining Soda Water Fizzing (40 min)	Students explain how matter moves and changes when soda water loses its fizz (connecting macroscopic observations with atomic-molecular models and using the principle of conservation of matter).
Lesson 4 – Investigating and Explaining Ethanol Burning (students as explainers)	
Activity 4.1: Predictions about Ethanol Burning (30 min)	Students develop hypotheses about how matter moves and changes when ethanol burns and make predictions about how they can use their investigation tools—digital balances and BTB—to detect movements and changes in matter.
Activity 4.2: Observing Ethanol Burning (30 min)	Students record data about changes in mass and BTB when ethanol burns and reach consensus about patterns in their data.
Activity 4.3: Evidence-Based Arguments about Ethanol Burning (50 min)	Students (a) use data from their investigations to develop evidence-based arguments about matter movements, matter changes, and energy changes when ethanol burns; and (b) identify unanswered questions about matter movement, matter change, and energy change that the data are insufficient to address.

Activity	***Target Performance***
Activity 4.4: Molecular Models for Ethanol Burning (50 min)	Students use molecular models to explain how carbon, oxygen, and hydrogen atoms are rearranged into new molecules during the oxidation of ethanol (the chemical change that happens when ethanol burns).
Activity 4.5: Explaining Ethanol Burning (40 min)	Students explain how matter moves and changes and how energy changes when ethanol burns (connecting macroscopic observations with atomic-molecular models and using the principles of conservation of matter and energy).
Lesson 5 – Other Examples of Combustion (students as explainers)	
(Optional) Activity 5.1: Molecular Models for Methane Burning (40 min)	Students use molecular models to explain how carbon, oxygen, and hydrogen atoms are rearranged into new molecules during the oxidation of methane (the chemical change that happens when methane burns).
(Optional) Activity 5.2: Explaining Methane Burning (40 min)	Students explain how matter moves and changes and how energy changes when methane burns (connecting macroscopic observations with atomic-molecular models and using the principles of conservation of matter and energy).
Activity 5.3: Preparing for Future Units: Organic vs. Inorganic (40 min)	Students distinguish between organic and inorganic materials on the basis of both their functions (organic materials include foods, fuels, and the bodies of living things) and the chemical structure of their molecules (organic materials contain high-energy C-C and C-H bonds).
Activity 5.4: Explaining Other Examples of Combustion (50 min)	Students explain how matter moves and changes and how energy changes when other organic fuels burn, including (a) wood burning in a fireplace, (b) propane burning in a gas grill, and (c) octane burning in an internal combustion engine.
Activity 5.5: Systems and Scale Unit Posttest (40 min)	Students show their end-of-unit proficiencies for the overall unit goal: Questioning, investigating, and explaining how matter and energy changed during combustion of organic materials.