Ecosystems Instructional Model & Storyline Chart

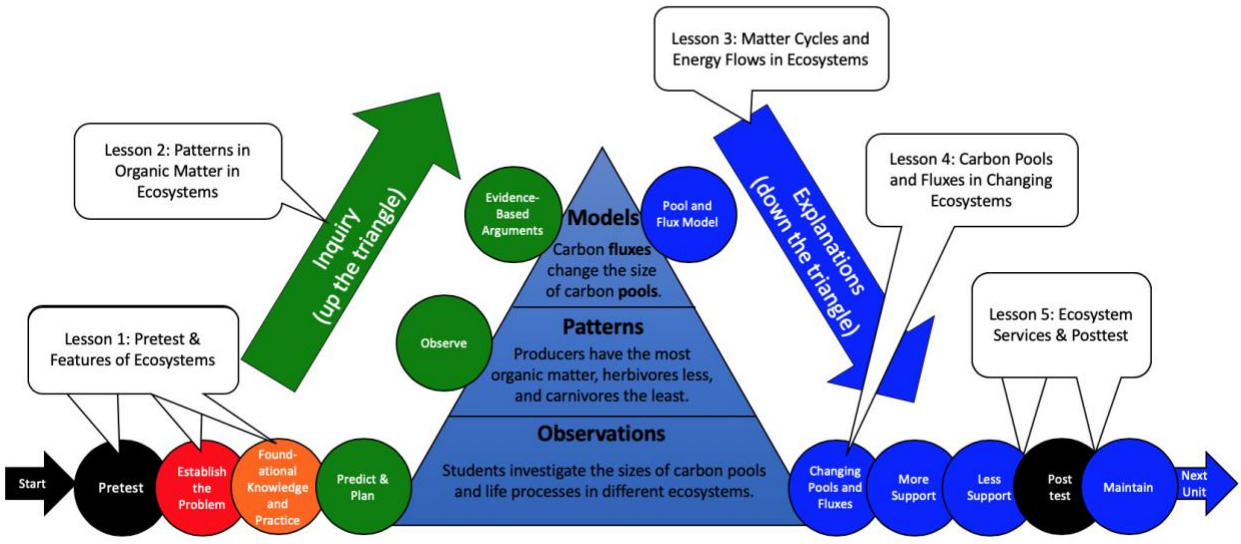
Here, we present two ways to think about how lessons are sequenced in the *Ecosystems* Unit. The Instructional Model, immediately below, emphasizes how students take on roles of questioner, investigator, and explainer to learn and apply scientific models they can use to answer the driving question. Further below, the Unit Storyline Chart highlights the central question, activity, and answer that students engage with in each lesson of the *Ecosystems* Unit.

Instructional Model

Like all *Carbon TIME* units, this unit follows an Instructional Model (IM) designed to support teaching that helps students achieve mastery at answering the driving question through use of disciplinary content, science practices, and crosscutting concepts. To learn more about this design, see the *Carbon TIME* Instructional Model.

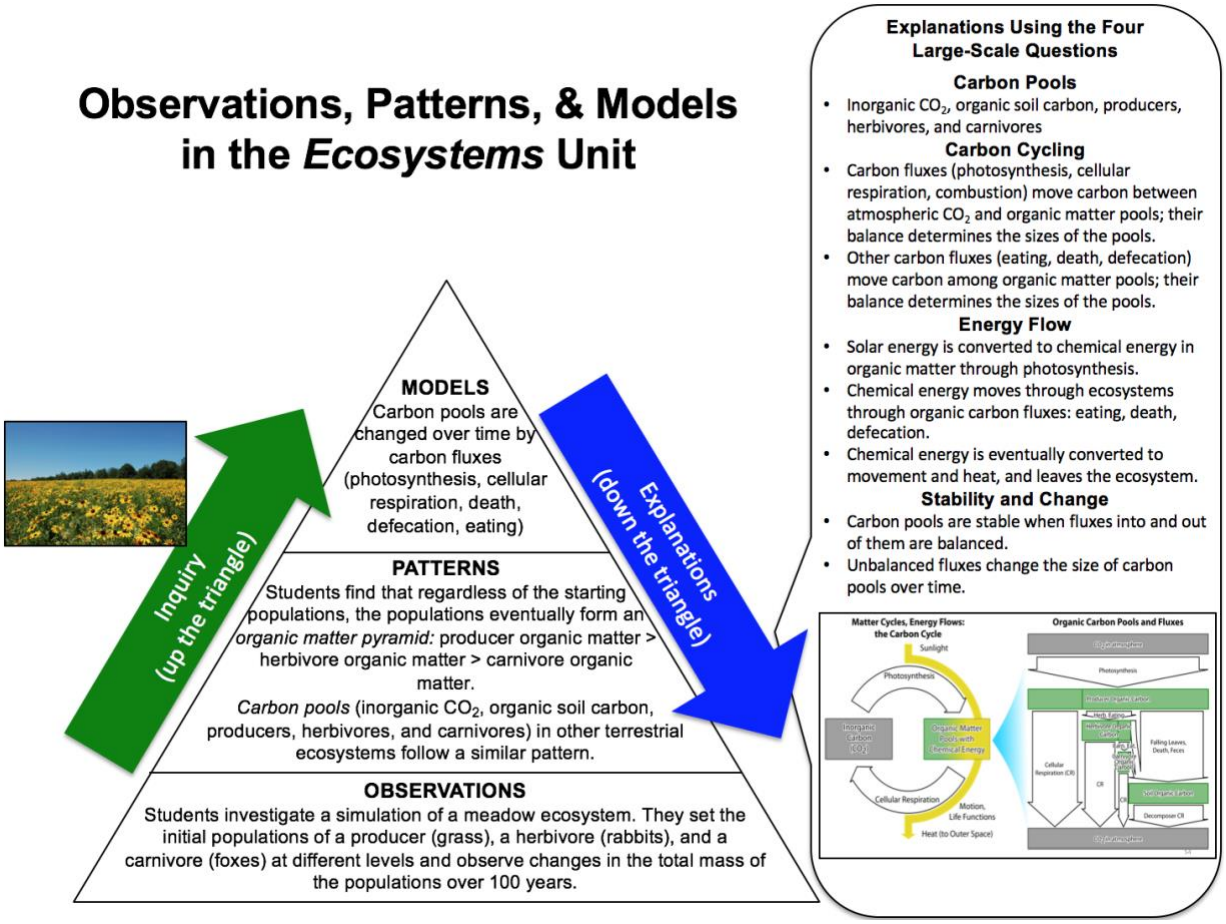
During the inquiry portion of the unit (Lesson 2), the students move from making observations of a simulated meadow ecosystem to identifying patterns, eventually using these patterns to make evidence-based arguments. During the explanation portion of the unit (Lessons 3, 4, and 5), students makes connections across scales (from atomic-molecular scale to ecosystem scale) to explain patterns and changes in ecosystems. Across the unit, classroom discourse is a necessary part of three-dimensional *Carbon TIME* learning. The *Carbon TIME* Discourse Routine document provides guidance for scaffolding this discourse in lessons.

The *Ecosystems* Unit



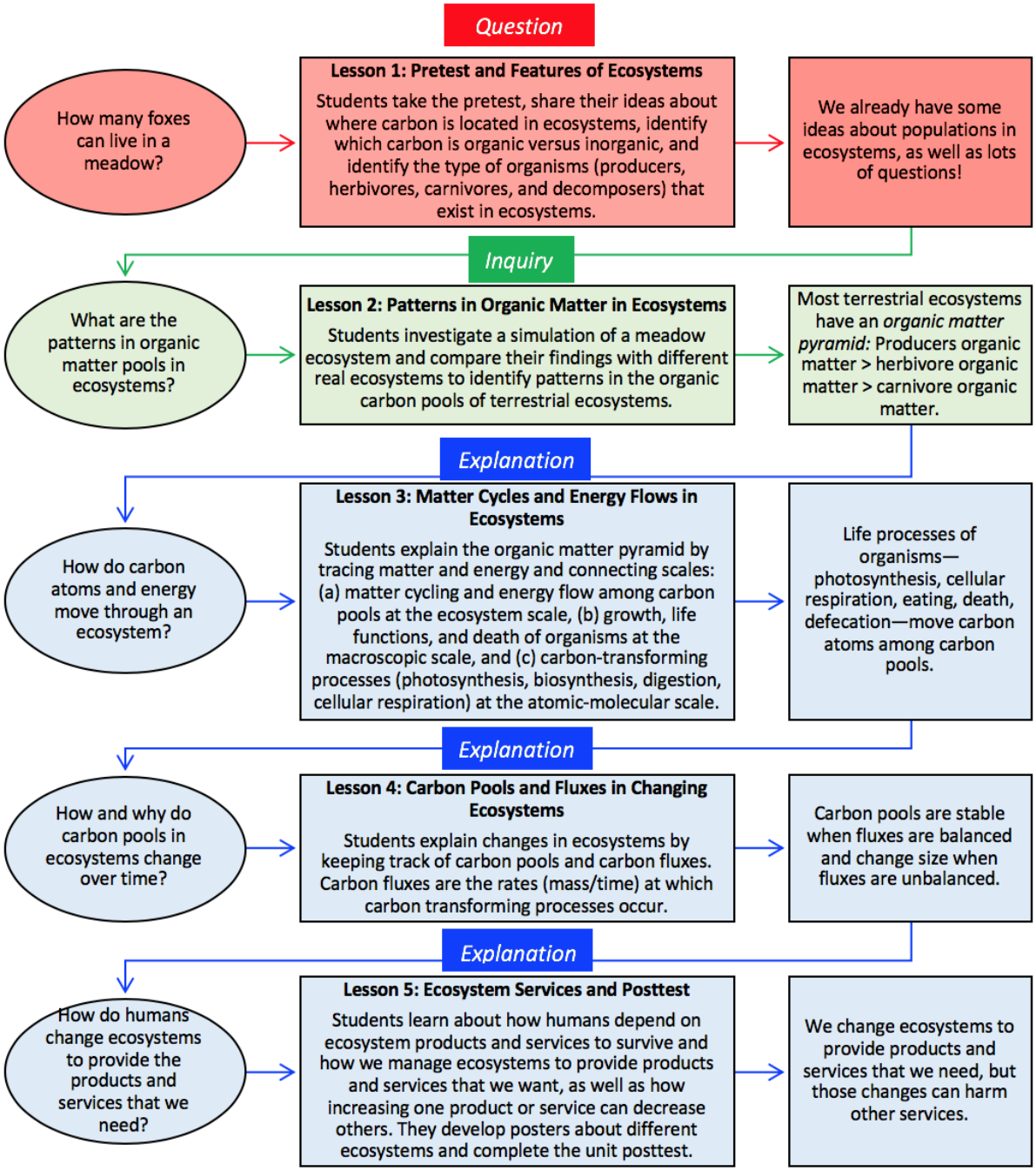
The core of the *Carbon TIME* IM is the Observation, Patterns, Models (OPM) triangle, which summarizes key aspects to be attended to as the class engages in unit inquiry and explanation. The OPM triangle for the *Ecosystems* Unit, shown below, articulates the key observations students make during the unit investigation, the key patterns they identify through analyzing their investigation data, and the central scientific model that can be used to answer the unit's driving question.

Observations, Patterns, Models, and Explanations in the Ecosystems Unit



Unit Storyline Chart

Another way to familiarize yourself with the sequence of lessons in the *Ecosystems* Unit is with the Unit Storyline Chart depicted below. The Unit Storyline Chart summarizes a unit phenomenon-based driving question associated with each lesson, what classes will do in each lesson to address the question, what conclusions they will come to, and how they will transition to a subsequent lesson.


Question
How many foxes can live in a meadow?
Lesson 1: Pretest and Features of Ecosystems
Students take the pretest, share their ideas about where carbon is located in ecosystems, identify which carbon is organic versus inorganic, and identify the type of organisms (producers, herbivores, carnivores, and decomposers) that exist in ecosystems.
We already have some ideas about populations in ecosystems, as well as lots of questions!
Inquiry
What are the patterns in organic matter pools in ecosystems?
Lesson 2: Patterns in Organic Matter in Ecosystems
Students investigate a simulation of a meadow ecosystem and compare their findings with different real ecosystems to identify patterns in the organic carbon pools of terrestrial ecosystems.
Most terrestrial ecosystems have an organic matter pyramid: Producers organic matter > herbivore organic matter > carnivore organic matter.
Explanation
How do carbon atoms and energy move through an ecosystem?
Lesson 3: Matter Cycles and Energy Flows in Ecosystems
Students explain the organic matter pyramid by tracing matter and energy and connecting scales: (a) matter cycling and energy flow among carbon pools at the ecosystem scale, (b) growth, life functions, and death of organisms at the macroscopic scale, and (c) carbon-transforming processes (photosynthesis, biosynthesis, digestion, cellular respiration) at the atomic-molecular scale.
Life processes of organisms—photosynthesis, cellular respiration, eating, death, defecation—move carbon atoms among carbon pools.
Explanation
How and why do carbon pools in ecosystems change over time?
Lesson 4: Carbon Pools and Fluxes in Changing Ecosystems
Students explain changes in ecosystems by keeping track of carbon pools and carbon fluxes. Carbon fluxes are the rates (mass/time) at which carbon transforming processes occur.
Carbon pools are stable when fluxes are balanced and change size when fluxes are unbalanced.
Explanation
How do humans change ecosystems to provide the products and services that we need?
Lesson 5: Ecosystem Services and Posttest
Students learn about how humans depend on ecosystem products and services to survive and how we manage ecosystems to provide products and services that we want, as well as how increasing one product or service can decrease others. They develop posters about different ecosystems and complete the unit posttest.
We change ecosystems to provide products and services that we need, but those changes can harm other services.