

Substitute Guide: Energy Flow in Ecosystems

Course: Biology (Grades 9–12) Subject: Science Time: ~50 min standard • ~90 min block

SCIENCE

Learning goal (plain language)

Students learn how **energy flows through an ecosystem** — from the Sun to **producers**, then up through **trophic levels** of consumers — and that only about **10% of the energy passes to each next level** (the "10% rule"), which is why an **energy pyramid** is wide at the bottom and narrow at the top. Working alone with a pencil, students read a short passage, study a labeled energy-pyramid diagram and a data table, do simple 10%-rule calculations, and write an evidence-based explanation (CER). **You do not need a science background to run this.** Everything students need is printed in their packet. This is a **paper** activity — no lab, no materials, no hazards.

Standards alignment

Framework: 19 TAC §112.42 (Biology). Knowledge & skills on **energy flow, trophic levels, and ecosystem relationships**.

- **Provisional — energy flow / trophic levels:** analyze the flow of energy through trophic levels and interpret energy pyramids, including the ~10% transfer of energy between levels.
- **Provisional — ecosystem relationships:** describe the roles of producers, consumers, and decomposers and predict how changes at one trophic level affect the others.

Provisional — pending educator verification against the current official TAC source. Codes and letters are placeholders until confirmed.

(Standards are paraphrased here, not quoted. Please confirm codes and wording against your official source. This packet does not claim formal alignment to the TEKS.)

SETUP Before class (5 min)

- Count and hand out one **student packet** per student.
- Confirm each student has a **pencil**. No calculators, computers, or lab items are needed (the 10%-rule numbers are $\times 0.10$, easy to do by hand).
- Write the date on the board and remind students to fill in the name line.
- Keep the **answer key** with you — it is a separate file and is **not** in the student packet.

MATERIALS
What's needed

- Printed student packet (4–6 pages) per student.
- Pencil per student.
- This guide and the separate answer key (teacher only).
- No technology, no calculator, no lab equipment, no safety hazards.

TIMING
Suggested pacing — standard vs. block

Segment	Standard (~50 min)	Block (~90 min)	What students do
Start — Notice & Wonder	5 min	5 min	Q1–Q2 warm-up
Build — Read the science	8–12 min	12 min	Read passage, word bank, energy pyramid; Q3
Apply — Use the data	20–25 min	25 min	Table 1; Q4–Q9 (classify, 10%-rule calculations, percent transfer, predict)
Explain — CER	7–10 min	10 min	Q10 explanation (claim/evidence/reasoning)
Close — ACE	5 min	5 min	Articulate / Connect / Extend
Continue — early finishers	optional	+30 min	Design a pyramid; block adds the multi-step ocean energy-loss calculation

On a standard ~50-minute period, the core stops after the CER (Q10) and ACE; the early-finisher pyramid is optional. On a ~90-minute block, everyone also completes the block extension — a multi-step energy-loss chain that applies the 10% rule five times and computes the percent of original energy reaching the top predator.

SCRIPT**Read aloud to start**

"Today's assignment is a paper science investigation called *Energy Flow in Ecosystems*. You will work by yourself with just a pencil — no computers or calculators, and nothing to build or mix. First read the short passage and study the energy-pyramid diagram and the data table. Then answer the questions in order; if one is tricky, skip it and come back. There are a few easy math steps where you take 10% of a number — that just means multiply by 0.10, or drop a zero. Write in complete sentences where it asks you to explain. You may quietly read the passage aloud to yourself. Put your name, class period, and date at the top now. You have about 50 minutes (or the full block); raise your hand if you need help understanding a word."

SUPPORT**When students ask for help**

- **You may read any part aloud** to a student or the class.
- If they are stuck on "which trophic level," point them to the **trophic levels** box and **Figure 1** — each band is one level.
- For the 10%-rule items (Q5–Q6), remind them "10% of a number" = multiply by 0.10 (for example $10,000 \times 0.10 = 1,000$). They do not need a calculator.
- Encourage the printed **sentence stems** for the CER (Q10) and ACE sections.
- Do **not** give answers; prompt with "What does the data show?" or "Which band is above which?"
- It is fine if a student cannot finish the optional early-finisher or block task.

ACCESS**Accommodations & language support**

- **Read-aloud** of any passage or question is allowed for all students.
- Point students to the **sentence stems** and the **Word Bank** (definitions provided).
- Extended time is fine; the core can stop after Q10 if time runs short.
- Students may answer in phrases if writing full sentences is a barrier, as long as the idea is clear. Showing the $\times 0.10$ step is enough for Q5–Q6.
- The packet is grayscale-safe — it prints and reads clearly in black and white; the pyramid uses patterns and labels, not color.

TOOLS Allowed & not allowed

Allowed: pencil, the printed packet, quiet self-read-aloud. **Not needed / not allowed:** calculator (the math is taking 10% of a number), phones, computers, lab materials.

Collect at the end:

Collect every packet, whether finished or not, with names on them. Stack them for the teacher. Note on a sticky how far most students got and any questions that caused confusion.

Answer key:

The **answer key is a separate file** (answerkey.html) and is for the teacher only. Please do not hand it to students.

Teacher follow-up (for the returning teacher)

Watch for two high-value misconceptions: students thinking *energy is recycled like matter*, and thinking *bigger animals have more energy available*. A quick next-day discussion contrasting the one-way flow of energy with the cycling of matter, and tying the pyramid shape to the 10% rule, would reinforce this well. The 10%-rule calculations (Q5–Q6) and the "remove a trophic level" prediction (Q9) show who can reason with the data; the CER (Q10) responses show who can cite specific energy values as evidence.