Unit	Stream Ecology
Lesson	1.2 Understanding energy flow
Essential question	How does energy flow through in an ecosystem?
Objective	Students will be able to model and interpret energy flow in an aquatic ecosystem in multiple ways.
Key words	Energy flow, photosynthesis, autotrophs/producers, heterotrophs/consumers, trophic level, primary consumer, secondary consumer, food chain, food web, cellular respiration, trophic pyramid
Related Standards	
NGSS standard	HS-LS2-4
AP Env Sci topic	1.9, 1.10, 1.11
IB Biology topic	C4.2
IB ESS topic	2.2
Suggested sequence of learning activities	Classroom-based lesson: 1. Starter quiz/prior knowledge check 2. Direct instruction (if traditional) or classroom discussion (if flipped). Slides here. 3. Energy flow analysis questions here. 4. Peer or teacher check. Answers by request. 5. Individual exit ticket/comprehension check
Assessment	Exit ticket/comprehension check
Possible modifications	• Give a keyword list (with or without definitions already included) to students before or during class • Be intentional about student groupings (eg. heterogeneous skill levels)
Resources required	• Hard copies of worksheet (students are required to construct diagrams which is better done on hard copy rather than

	computer)
Starter questions	1. Why do you think biodiversity is important? 2. How would you measure biodiversity?
Concepts covered in lesson	Most ecosystems rely on a supply of energy from the sun. Light energy is converted into chemical energy in organic carbon compounds (like glucose) through a chain of chemical reactions called **photosynthesis**. Organisms who synthesize their own organic compounds are called **autotrophs** or **producers**. Chemical energy in organic compounds flows through food chains through feeding. Organisms that get their organic compounds through feeding are called **heterotrophs** or **consumers**. Food chains describe a sequence of organisms feeding on each other. Each step in the sequence can be described as a **trophic level**, or role that an organism plays in a food chain, starting with producer, then **primary consumer**, **secondary consumer** and so on. A **food web** is a summary of all possible food chains in an ecosystem. The same organism can occupy different trophic levels in different food chains. All organisms (autotrophs and heterotrophs) convert chemical energy in organic compounds into adenosine triphosphate (ATP), a molecule used for cellular processes, through a series of chemical reactions called **cellular respiration**. Cellular respiration is not a completely efficient process as energy is lost as heat. As energy is lost during each step of the food chain, energy needs to be added to the system continuously. Another way to model energy in an ecosystem is a **trophic pyramid** which shows the amount of energy (or biomass) contained within each trophic level. As a rule of thumb, as much as 90% of energy is lost from one trophic level to another due to the following reasons: • Heat lost through respiration • Not all organisms are consumed by the next trophic level • Not all parts of an organism are consumed (ie. hair, bones) • Not all the energy of an consumed organism is used by the

	consuming organism (ie. fecal loss) When drawing a trophic pyramids of energy, it should have the following characteristics: ● Horizontal bar chart ● Drawn to scale and should be stepped, not triangular ● All bars should be labelled by trophic level (producer, primary consumer, etc) with producers at the bottom ● If given, must include units
Slide presentation	Link here
Activity	Analysis questions here for printing out (diagrams easier done hard copy rather than on a computer). Answer key by request.
Exit ticket questions	1. Why is a stonefly an useful species to indicate stream health? 2. If you do not find any alderflies in your stream, does that mean the stream is polluted? Answers: *1. Because it is intolerant to pollution so its presence indicates an unpolluted stream.* *2. Not necessarily, they might not be present for another reason besides the presence of pollution.*
Extension questions/activities/ resources	Good video on trophic pyramids and food webs here. Have students look into black smokers– ecosystems around deep ocean geothermal vents that rely on chemosynthesis rather than photosynthesis. Good intro video here.