Lesson 1. Food chains and food webs

Lesson objectives

By the end of the lesson, students should able to:

1. Draw and interpret food chains and food webs.
2. Give reasons for identifying organisms as carnivores, consumers, herbivores, omnivores, predators, prey, producers.
3. Explain how changes in a population or community in an ecosystem affect other populations, and predict these changes using food webs.

1. Introduction — 5 mins

- Ask students what is meant by a food chain and what does the arrow represent? Take a selection of answers, lead students towards the idea of energy flow.

2. Food chains (LOs 1 and 2) — 15 mins

- Students should read the section **Food chains**.
- They should write definitions of the following key words and phrases:
  - carnivore
  - food chain
  - herbivore
  - predator*
  - prey*
  - primary consumer
  - producer
  - secondary consumer
  - tertiary consumer
  - trophic levels

  (* these words should be known from primary school work)
- Finally, they should write down two different food chains and annotate them with any extra information. For example: grass → chicken → fox, students could then label the grass as a producer, the chicken as a herbivore.
- Check objectives have been met.

3. Food webs (LOs 1 and 3) — 20 mins

- Students should read the section **Food webs**.

1. They should write out the longest food chain in food web C.
2. They should then choose one or more of these words for each organism in their food chain: carnivore, consumer, herbivore, omnivore, producers, top predator, and explain their choices.
3. Ask students, why are goshawks and wolverines in competition with each other?
4. Finally, students should use food web C to predict what would happen to the vole population if: a) the snowshoe hares all died; b) there was no rain for a long time.

4. More complex food webs (LOs 1, 2 and 3) — 15 mins

- Students should look at the **More complex food webs** and use it to work all the possible permutations if the leech population were to decline through disease.
- Discuss answers with students.
- Students should then write an additional label (e.g. predator, prey, carnivore) for each organism in the food web. It is possible for some organisms to have more than one additional label.

5. Reflect — 5 mins

- Ask questions to check objectives have been met.
- Ask students to write a question about the food web in section 3 and to design a mark scheme for the answer. Encourage students to think up questions that are worth more than two marks. Then allow students to swap questions for others to try out.

Lesson 2. Ecological pyramids

Lesson objectives

By the end of the lesson, students should able to:

1. Interpret and draw pyramids of numbers.
2. Compare models of energy transfer in food chains (pyramids of number, biomass).

1. Introduction — 5 mins

- Show students a food web that they are already familiar with or used in the last lesson (e.g. **Food web C: a food web in northern Canada**). Ask students how many of each organism they think there might be in the habitat, just in general terms of lots, a few, one, etc.
- Ask students if they can see a pattern (e.g. the further up the food web you go, the less numerous the animals are).
- Ask students to sketch a diagram or flowchart to represent the number of organisms at each stage of the food web. They can discuss their ideas in small groups if possible, opening up interest in learning about pyramids later.

2. What are pyramids of numbers? (LO 1) — 15 mins

- The numbers of organisms usually decrease through a food chain. There are normally lots of producers and far fewer primary consumers, fewer still secondary consumers, and so on. The reason for this is the loss of energy at each level. So much energy is lost that there is very little left to support vast numbers of top predators. This relationship is shown as a pyramid of numbers.
- Students should read the section **What are pyramids of numbers?** and look again at the food web from the introduction. Get students to write out three food chains from the food web, starting with grass.
- For each food chain, students should sketch a pyramid of numbers for this food chain. They do not need to use a ruler to measure anything.
- If possible, they should swap over their work with another student to peer assess. If they struggle with coming up with statements, they should stick to What Went Well (WWW)/Even Better If (EBI).

3. Constructing pyramids of numbers (LO 1) — 15 mins

- Students should read the section **Constructing pyramids of numbers**.
- Students are provided with three food chains with numbers. They should draw a pyramid of numbers for each food chain, but this time using a ruler (and graph paper) to draw it accurately.
- Students should then compare the shapes of the three pyramids of numbers so they can see that not all pyramids of numbers are pyramid shaped. They can check their answers using the mark scheme.

4. Pyramids of biomass (LO 2) — 20 mins

- Most students appreciate that the bars in a pyramid of numbers get smaller as you go upwards because the size of each successive organism is bigger. Big animals need to eat a lot of smaller ones. Pyramids of numbers can look odd if the producer is particularly large. Pyramids of biomass are always pyramid shaped because they show the total mass of living material at each level, rather than just the numbers of individuals. The amount of energy available is the main factor controlling the amount of mass of all the organisms at one feeding level (trophic level).
- Students should read the section **Pyramids of biomass** and then answer the following questions:

1. What does the word 'biomass' mean?

2. Sketch pyramids of biomass for each of the pyramid of numbers. You do not need to add any figures, just draw the shapes.

3. To work out a pyramid of biomass, the dry masses of the organisms are used. Why?

4. The biomass of an oak tree changes during the course of a year. Why is this?

5. Describe the advantages and disadvantages of using pyramids of biomass compared with pyramids of numbers.

- A mark scheme is provided for students to self-assess, but as this is a challenging idea, it might be an idea to mark as a class going through each question to check levels of understanding.

5. Reflect — 5 mins

- Ask students to think of one new thing they have now remembered or learnt today. They can talk to another student about it before feeding back to the class.

Lesson 3. Energy flow in ecosystems

Lesson objectives
By the end of the lesson, students should able to: 1. Explain the gains and losses of energy from living organisms. 2. Compare models of energy transfer in food chains (pyramids of number, biomass).

1. Introduction	5 mins
• Recap last lesson by getting students to look at Diagram D. They need to explain why it is not pyramid shaped.	
2. Energy flow in a food chain (LO 1)	**15 mins**
• The numbers of organisms usually decrease through a food chain. There are normally lots of producers and far fewer primary consumers, fewer still secondary consumers, and so on. The reason for this is the loss of energy at each level. So much energy is lost that there is very little left to support vast numbers of top predators. Students may have trouble with the concept of energy loss and may have been given the simpler explanation that as you go up a food chain the organisms become bigger. • Students should read the section **Energy flow through a food chain** and answer the following questions: **1.** Why do organisms respire? **2.** What does the red arrow on the left of diagram A show? **3.** Why does the fox not get all the energy that was in the lettuces eaten by the rabbit?	
3. The flow of energy through ecosystems (LOs 1 and 2)	**15 mins**
• Students should read the section **The flow of energy through ecosystems**. • Students should then make notes about what they have just read. A simple way to start would be to base it around the diagram and annotating it.	
4. Energy flow calculations (LO 1)	**20 mins**
• It is possible to assign values for the energy losses from an organism. With these values it is possible to work out the efficiency of energy transfer by an organism using the equation: $$\frac{\textit{energy transferred to biomass}}{\textit{total energy supplied to organism}}$$ • Explain to students how to use the equation. Efficiencies are usually on a scale of 0 to 1 but can be converted to percentages by multiplying by 100. • Students should then complete calculation questions based on the cow diagram.	
5. Reflect	**5 mins**
• Get students to identify what is easy and difficult about this topic. They could do this in small groups before feeding back to the class. Get students to come up with some ideas about what they can do about topics they are finding difficult.	

Lesson 4. Applying your knowledge

Lesson objectives
By the end of the lesson, students should able to: 1. Describe the sources and effects of some pesticides. 2. Explain the effects of some persistent pesticides on ecosystems. 3. Apply knowledge of food chains and food webs to unfamiliar situations and/or real-world issues.

1. Introduction	5 mins
• Students need to look at the diagram in this section, which shows a pyramid of biomass for a field. The units are g/m^2. They need to describe what this pyramid tells them in as much detail as they can.	
2. Poisons and food chains (LO 1)	**15 mins**
• Students should read the section **Poisons and f food chains** and answer the following questions. **1.** What effect did removing cats from Macquarie Island have? **2.** Why did it have this effect? **3.** Suggest what has happened to the populations of bird on Macquarie Island since 2011. Explain your reasoning.	
3. Bioaccumulation (LOs 1, 2 and 3)	**20 mins**
• Explain to students that there are many examples of toxins entering the food chain; the most famous being DDT. This is the example used here. DDT is fatal to large birds in high doses. It also came to light in Britain in the early 1960s that DDT caused birds of prey, like peregrine falcons, to lay eggs with very thin shells. The eggs were subsequently crushed as the birds tried to incubate them. DDT has effects in other animals too. Bats, for instance, are highly sensitive to it. Levels of about 10 mg/kg body mass in humans cause nausea, tremors, vomiting and confusion. • Explain to students that bioaccumulation is when toxins build up – or accumulate – in a food chain. The animals which are at the top of the food chain are most affected. Tell students the pyramid of numbers in this section shows this clearly. • Students should then read the section **Bioaccumulation** and use this information to answer the following questions. **1.** Look at diagram F and read the text that is with it. Explain why the peregrine falcon population in the UK decreased in the 1960s and 1970s. **2.** Look at the food web in diagram C and read the text that is with it. Beetles can kill aspen trees. To save the aspens in an area it has been suggested that the beetles be poisoned. Suggest a problem with using poison. **3.** Predict the effects of the poison on the thrush and aspen populations. • Students can then self-assess their answers using the mark scheme.	
4. IG exam question (LO 3)	**15 mins**
• Students should be led through an IG exam style question which links together all the topics they have studied in these lessons but at IG level.	
5. Reflect	**5 mins**
• Get students to RAG their feeling on the topics recapped in these intervention lessons. They could simply hold up a red-amber-green card when you read out a topic. Red – I'm still not sure, Amber – some doubts, and Green – no problems. Students could be asked to explain their responses.	