AP ENVIRONMENTAL SCIENCE • EXERCISE SHEET

1.10 Energy Flow and the 10% Rule

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **energy flow and the 10% rule**.

You must be able to:

- apply the **10% rule** 十分之一定律
- calculate energy at each trophic level
- explain why energy is lost between levels

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

The 10% rule

Only about **10%** of the energy at one trophic level is passed to the next. The other ~90% is lost as **heat** and used for the organism's own life processes (movement, respiration).

Calculating up the levels

Multiply by 0.1 at each step. Producers with 10 000 units → primary consumers 1000 → secondary 100 → tertiary 10.

Why energy is lost

Energy is used for respiration, movement, and heat, and not all of an organism is eaten or digested —so most energy never reaches the next level.

A worked calculation

If producers store 50 000 kcal, the secondary consumers receive $50\,000 \times 0.1 \times 0.1 = 500$ kcal.

2 Practice

Now apply the methods above.

2.1 What percentage of energy passes to the next trophic level? [1]

2.2 Producers have 8000 kcal. How much reaches the primary consumers? [1]

2.3 Where does the ”lost” energy go? [1]

3 Exam-style questions

3.1 By the 10% rule, energy passed from producers to primary consumers is [1]

- **A** 1%
- **B** 10%
- **C** 90%
- **D** 100%

3.2 Producers in an ecosystem store 30 000 kcal/m^2/yr.

(a) Calculate the energy reaching the tertiary consumers. [3]

(b) Explain why so little reaches this level. [1]

3.3 Explain why energy flow limits the number of trophic levels an ecosystem can support. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **1.10 Energy Flow and the 10% Rule** lesson on the **Learn** page;
- read the **Energy Flow and the 10% Rule** section of the AP Environmental Science handout on the **Know** page.

Solutions

2.1 About 10%.

2.2 800 kcal.

2.3 Lost as heat and used in life processes (respiration, movement).

3.1 B —10%.

3.2 (a) primary = 3000; secondary = 300; tertiary = 30 kcal/m^2/yr. (b) About 90% of the energy is lost at each of the three transfers.

3.3 Because ~90% of energy is lost at each level, after a few levels there is too little energy left to support another, limiting the number of levels.