AP BIOLOGY • EXERCISE SHEET

2.10 The Origins of Cell Compartmentalization

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

Objective

Build the skills to answer exam questions on the **origins of cell compartmentalization** —the endosymbiotic theory.

You must be able to:

- state the **endosymbiotic theory** 内共生学说
- give the evidence (own DNA, double membrane, own ribosomes, binary fission)
- identify which organelles it explains

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 endosymbiotic theory

Mitochondria and **chloroplasts** are thought to have originated when a larger cell **engulfed** a free-living prokaryote, which then lived inside it (**endosymbiosis**) rather than being digested.

The evidence

- they have their **own DNA** (circular, like bacteria);
- they have their **own ribosomes**;
- they are surrounded by a **double membrane**;
- they reproduce by **binary fission**, like bacteria.

Which organelles

The theory explains **mitochondria** (from an aerobic bacterium) and **chloroplasts** (from a photosynthetic bacterium) —both double-membraned, DNA-containing organelles.

A worked reasoning

A mitochondrion's own circular DNA and ability to divide independently are strong signs it descended from a once free-living bacterium.

2 Practice

Now apply the methods above.

2.1 Which two organelles does the endosymbiotic theory explain? [2]

2.2 State one piece of evidence for the theory. [1]

2.3 How do mitochondria reproduce? [1]

3 Exam-style questions

3.1 Evidence that mitochondria were once free-living bacteria includes that they have [1]

- **A** no DNA
- **B** their own circular DNA and ribosomes
- **C** a single membrane only
- **D** the same DNA as the nucleus

3.2 A student examines a chloroplast.

(a) State two features that support the endosymbiotic theory. [2]

(b) Explain what the theory proposes about the chloroplast's origin. [2]

3.3 Explain why having its own DNA and dividing by binary fission suggests a mitochon-

drion had a bacterial ancestor. [2]

4 Go further

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

- work through the **2.10 The Origins of Cell Compartmentalization** lesson on the **Learn** page;
- read the **The Origins of Cell Compartmentalization** section of the AP Biology handout on the **Know** page.

Solutions

2.1 Mitochondria and chloroplasts.

2.2 Any one: own (circular) DNA, own ribosomes, double membrane, reproduce by binary fission.

2.3 By binary fission (dividing like bacteria).

3.1 B —their own circular DNA and ribosomes.

3.2 (a) Any two: own DNA, own ribosomes, double membrane, binary fission. (b) It proposes the chloroplast arose when a cell engulfed a photosynthetic bacterium that survived and lived inside it.

3.3 These are bacterial traits —free-living bacteria have their own DNA and reproduce by binary fission —so their presence in mitochondria points to a bacterial ancestor.