AP BIOLOGY • EXERCISE SHEET

5.2 Meiosis and Genetic Diversity

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

Objective

Build the skills to answer exam questions on **meiosis and genetic diversity**.

You must be able to:

- explain **crossing over** 交叉互换 and **independent assortment** 自由组合
- explain how **random fertilization** adds variation
- link these to the diversity of offspring

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.

Three sources of variation

Meiosis and reproduction create genetic diversity by:

1. **Crossing over** —homologous chromosomes swap segments, making new gene combinations.
2. **Independent assortment** —homologous pairs line up randomly, so chromosomes are sorted into gametes in many combinations.
3. **Random fertilization** —any sperm can fertilize any egg.

Crossing over

During meiosis I, homologous chromosomes exchange pieces, so a chromosome ends up with a **new mix** of alleles from both parents.

Independent assortment

Each homologous pair lines up independently, so with n pairs there are 2^n possible gamete combinations from assortment alone.

A worked count

Humans have 23 pairs, giving 2^{23} (over 8 million) combinations from independent assortment —before crossing over and random fertilization add even more.

2 Practice

Now apply the methods above.

2.1 Name the process where homologous chromosomes swap segments. [1]

2.2 What does independent assortment describe? [1]

2.3 For an organism with 3 chromosome pairs, how many gamete combinations arise from independent assortment? [2]

3 Exam-style questions

3.1 Crossing over increases variation by [1]

- **A** copying DNA exactly
- **B** exchanging segments between homologous chromosomes
- **C** removing chromosomes
- **D** joining two gametes

3.2 A student lists sources of genetic variation.

(a) Name three sources from meiosis and reproduction. [3]

(b) Explain how independent assortment creates variation. [2]

3.3 Explain why sexual reproduction produces more genetic variation than asexual re-

production. [2]

4 Go further

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

- work through the **5.2 Meiosis and Genetic Diversity** lesson on the **Learn** page;
- read the **Meiosis and Genetic Diversity** section of the AP Biology handout on the **Know** page.

Solutions

2.1 Crossing over.

2.2 Homologous pairs line up randomly, so chromosomes sort into gametes in many combinations.

2.3 $2^3 = 8$ combinations.

3.1 B —exchanging segments between homologous chromosomes.

3.2 (a) Crossing over, independent assortment, random fertilization. (b) Each homologous pair aligns independently, so the maternal and paternal chromosomes are mixed into gametes in many different combinations.

3.3 Sexual reproduction combines crossing over, independent assortment, and random fertilization to mix alleles from two parents, whereas asexual reproduction copies one parent's genome, giving little variation.