

Unit 2: Cells, Development, Biodiversity and Conservation

WBI12 · Issue 2 · Topics 3-4 · cells, meiosis, mitosis, stem cells, plants,
biodiversity · sheets 2.1-2.8

From one cell to a living world

Unit 2 runs from one fertilised egg to the variety of all life: divide, specialise, count and defend.

A eukaryotic cell is a set of compartments

Structure	Function
Nucleus 细胞核	stores DNA behind a double membrane
Rough ER 粗面内质网	folds and transports proteins from its ribosomes
Golgi 高尔基体	modifies, packages and exports proteins
Mitochondrion 线粒体	aerobic respiration and ATP

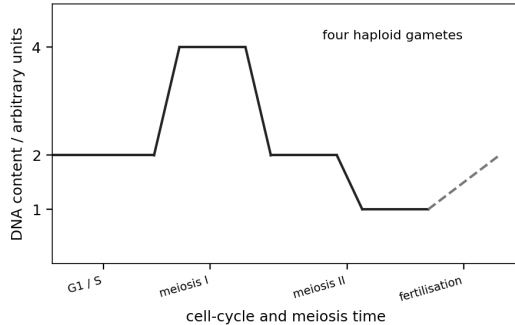
Magnification and resolution

- 1 **Convert 转换** 36 mm on a photograph at x600: convert to 36 000 micrometres first
- 2 **Divide 相除** $36\,000 / 600 = 60$ micrometres actual width
- 3 **Judge 判断** a nuclear double membrane sits closer than 200 nm - electron microscope needed

Two divisions, four cells

Meiosis halves the chromosome number and shuffles the genes: independent assortment and crossing over are the two sources of variation.

DNA content through meiosis



Read the graph: doubling once in S phase, halving twice through the two divisions, restored at fertilisation.

Gametes are specialised for delivery or provisioning

Sperm 精子

Acrosome with digestive enzymes to penetrate the egg coats;
mitochondria-packed midpiece drives the flagellum.

Egg 卵子

Supplies nearly all the cytoplasm of the zygote; after one sperm enters, the cortical reaction blocks the rest.

Mitosis makes two identical cells

Prophase 前期: chromosomes condense, spindle forms



Metaphase 中期: chromosomes line up on the equator



Anaphase 后期: chromatids pulled to opposite poles

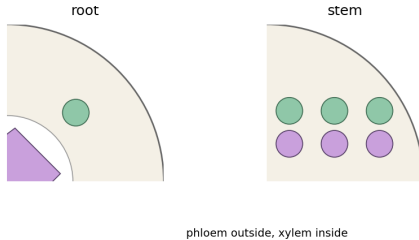


Telophase 末期: nuclear membranes reform

Same genes, different proteins

Every cell keeps the whole genome; differentiation is transcription factors choosing which genes to read.

Two polysaccharides, two tissues



xylem star, phloem between arms

In the root xylem forms the central star with phloem between its arms; in the stem phloem sits outside xylem in a ring.

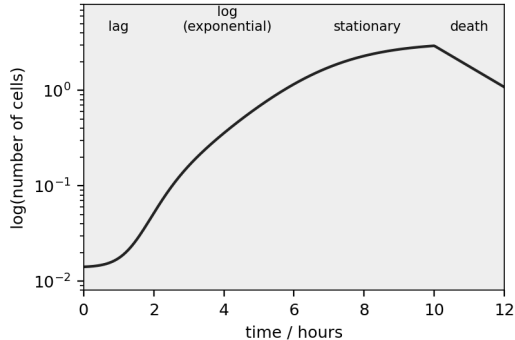
Counting variety two ways

- 1 **Data 数据** habitat A counts 40, 35, 25; habitat B counts 90, 6, 4
- 2 **Compute 计算** A: $9900 / 3350 = 2.96$ - B: $9900 / 8052 = 1.23$
- 3 **Interpret 解释** same richness, but B is dominated by one species - D sees what richness cannot

Hardy-Weinberg tracks alleles

- 1 **Phenotype 表型** 45 of 500 foxes show the recessive coat: $q^2 = 0.09$
- 2 **Alleles 等位基因** $q = 0.3$, so $p = 0.7$
- 3 **Carriers 携带者** $2pq = 0.42$, about 210 of the 500 foxes

Aseptic technique and the growth curve



Aseptic technique protects you and the culture; the growth curve reads as lag, then exponential doubling, then balance, then death.

Check yourself

Your turn

A pond sample has counts 60, 20, 15 and 5. What is the index of diversity?

- ☐ A. $N(N-1)$ over the sum of $n(n-1)$: 9900 over $4150 = 2.39$
- ☐ B. add the species counts first, then divide by four
- ☐ C. the largest count over the smallest count
- ☐ D. species richness times total individuals