# Big Idea: Cells Come from Other Cells (Reproduction)

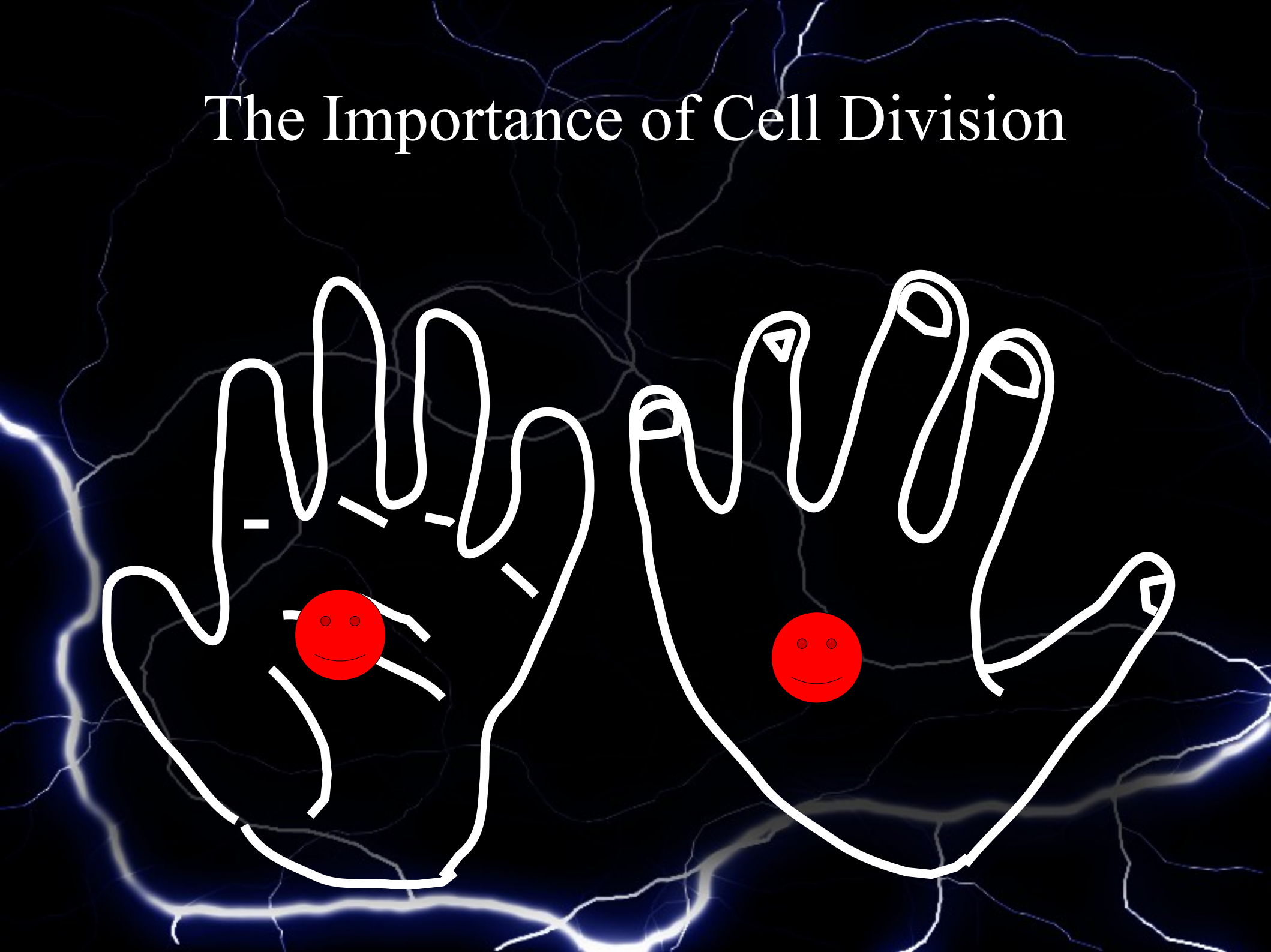
# The Importance of Cell Division

**Activity – Cell Replacement**

You will draw two identical symbols on your left hand (right hand if you're left handed), one on the palm and the other on the back.

Observe what happens to the symbol throughout the evening.

# The Importance of Cell Division



# The Importance of Cell Division

**Activity – Cell Replacement**

**Hypothesize** which stain will last longer.

ex. The stain on the pal of my hand will last longer *because* I always wipe the sweat from my head with the back of my hand.

# The Importance of Cell Division

1. **Cells continually die.** If we didn't replace them, there would be no cells left.
2. **Cells make more cells** through the process of cell division.
3. **Our bodies will continue to replace cells** until the day we die.

# The Importance of Cell Division

**Functions of Cell Division:**

1. **Growth –** Organisms grow by making more cells through the process called cell division.

2. **Repair –** Multicellular organisms repair damage by cell division.

3. **Reproduction –** Unicellular organisms reproduce through cell division.

# The Importance of Cell Division

Activity p. 37 – From One Cell to Trillions

1. Using chalk, copy the table onto the desk, up to 10 cell divisions.
2. **Without a calculator**, calculate the number of cells that are produced after each cell division.

Q. How many cells will there be after 20 cell divisions?

Q. Why are there not really that many cells in your body?

# Textbook Questions

Read pages 36 and 37.  Complete the following questions on page 38.

Q 1, 2, 4, 7, 8, 11, 14

# 2.2 Cell Structures

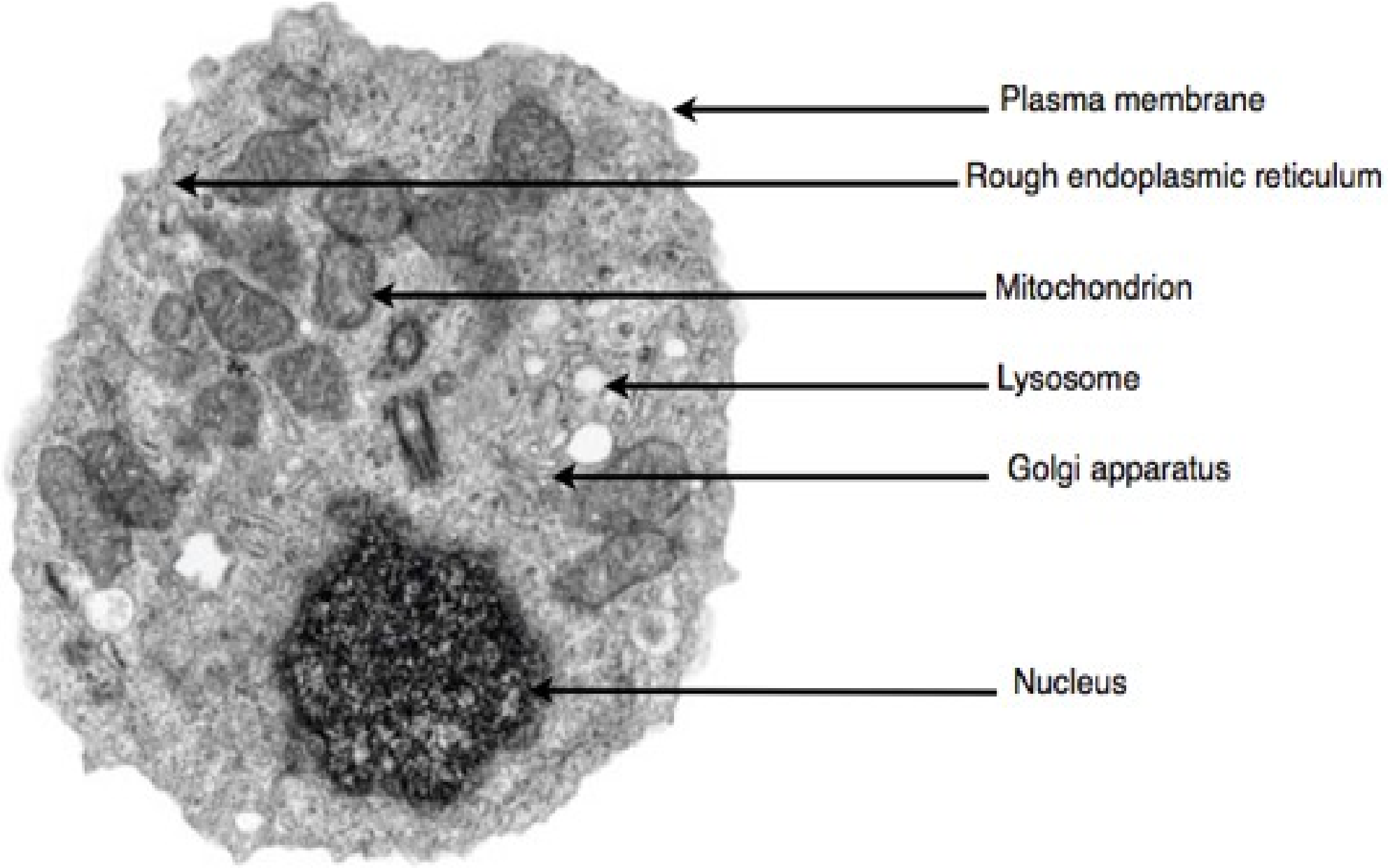
**All living things are made up of cells**. They can be unicellular (just 1 cell) or multicellular (more than 2 cells)

**Plants and animals are made up of different types of cells** with different organelles

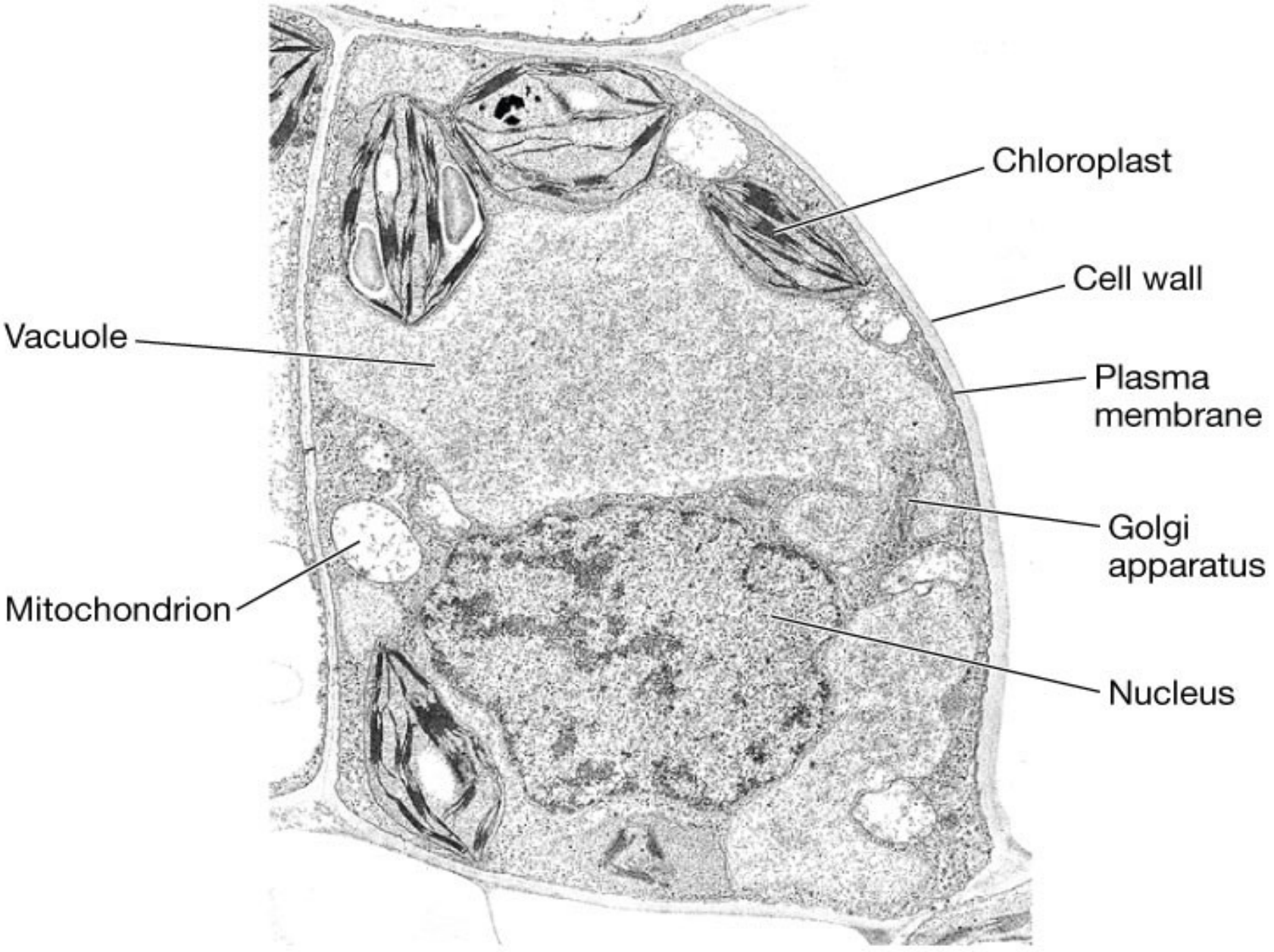
# 2.2 Cell Structures

Lets read page 39 – 40 together

# Micrograph of an Animal Cell



# Micrograph of a Plant Cell



# Cell Structures

**Activity**

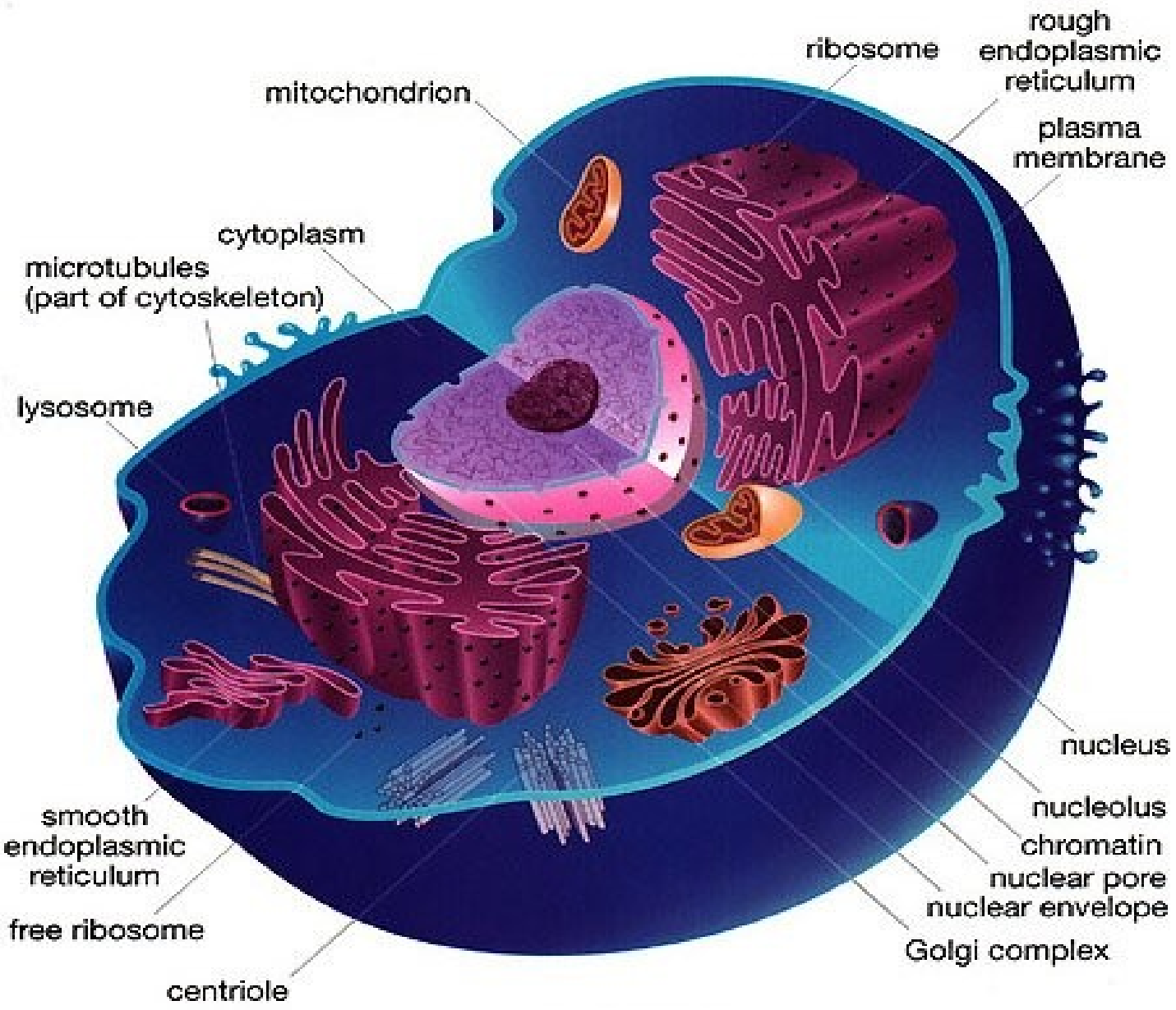
- Using your textbook pages 39 and 40, **label the diagrams of the animal and plant cell** on the given handout.
- Colour the 3 organelles found in a plant cell that are not found in an animal cell green
- Colour the 1 organelle found in an animal cell that are not found in a plant cell red

# Animal Cells and Plant Cells

Typical animal cell

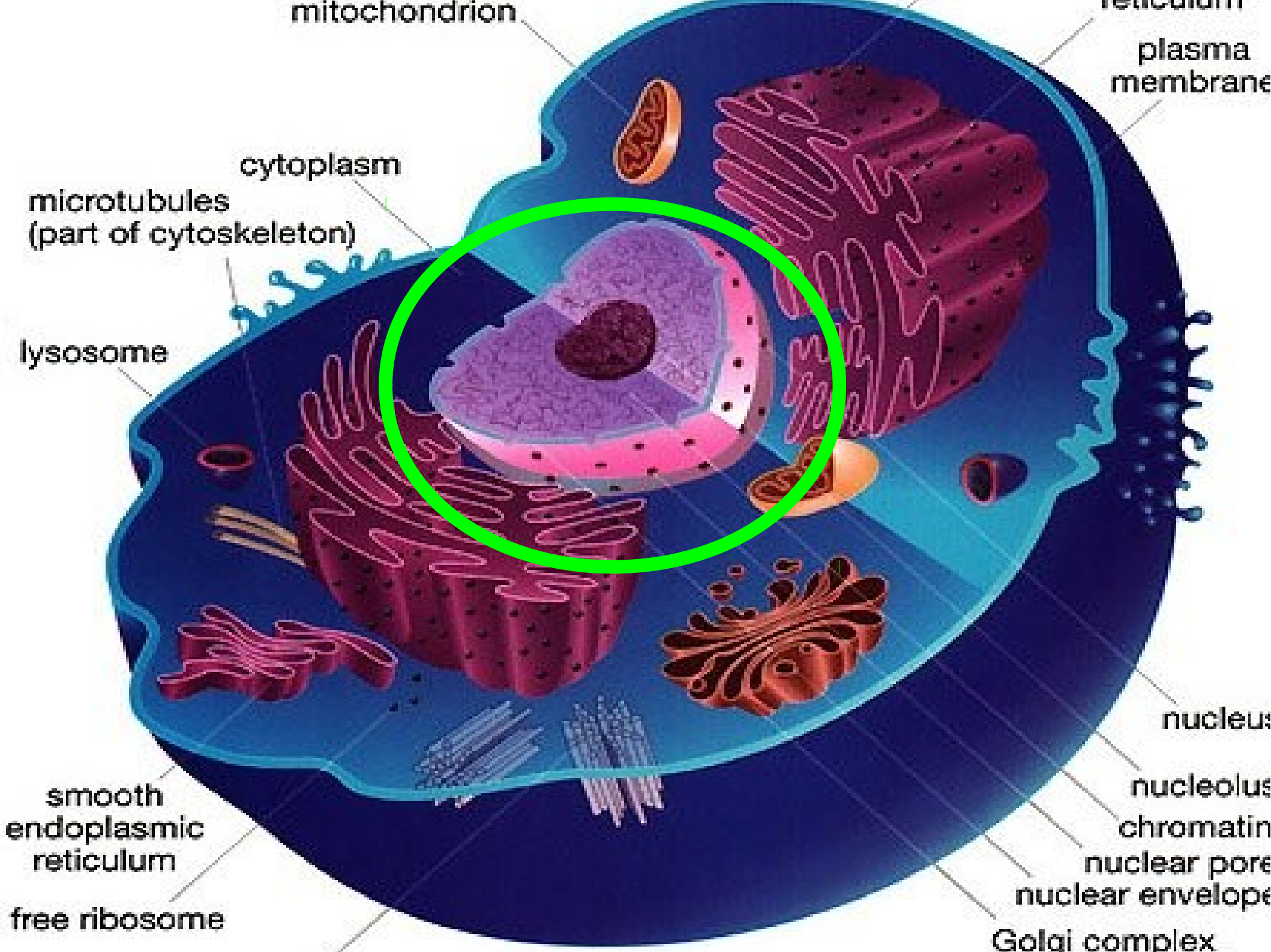
note the:

- nucleus
- nucleolus
- chromatin
- ribosomes
- endoplasmic reticulum
- cytoplasm



# The Nucleus

- **the control centre** of the cell (like a brain)
- surrounded by a nuclear membrane
- Tiny holes called pores that allow movement in and out of the cell


mitochondrion
plasma membrane
cytoplasm
microtubules (part of cytoskeleton)
lysosome
nucleus
nucleolus
chromatin
nuclear pore
nuclear envelope
smooth endoplasmic reticulum
free ribosome
Golgi complex

# Organelles

**The Nucleus**

- **The control centre** of the cell
- **Contains chromosomes** which are the instructions for all activities in the cell (growth, repair, reproduction)
- Humans have 23 pairs of chromosomes
- **Chromosomes are made of DNA**
- **Contains the nucleolus** – where ribosomes are made

# Ribosomes and Endoplasmic Reticulum

**Ribosomes** are tiny organelles that **make proteins**

They are either in the cytoplasm or attached to the endoplasmic reticulum (ER)

**Rough ER moves proteins** around the cell

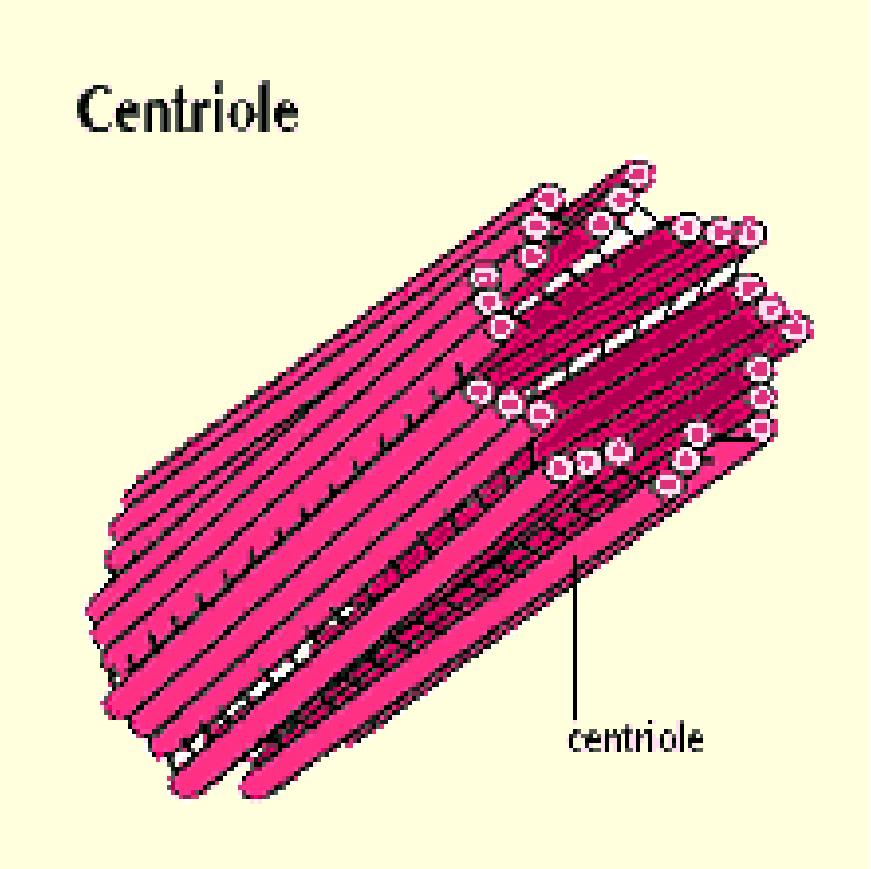
**Smooth ER** (has no ribosomes on it) **makes fats**

# Cytoplasm

**Cytoplasm is the fluid inside a cell**

It contains all the organelles, including centrioles (only found in animal cells)

Activities such as nutrient absorption, transport, and processing happens here



# Textbook Questions

Read page 39 – 40

P41 answer questions 1, 3 – 6, 8 – 12, 15 and 16

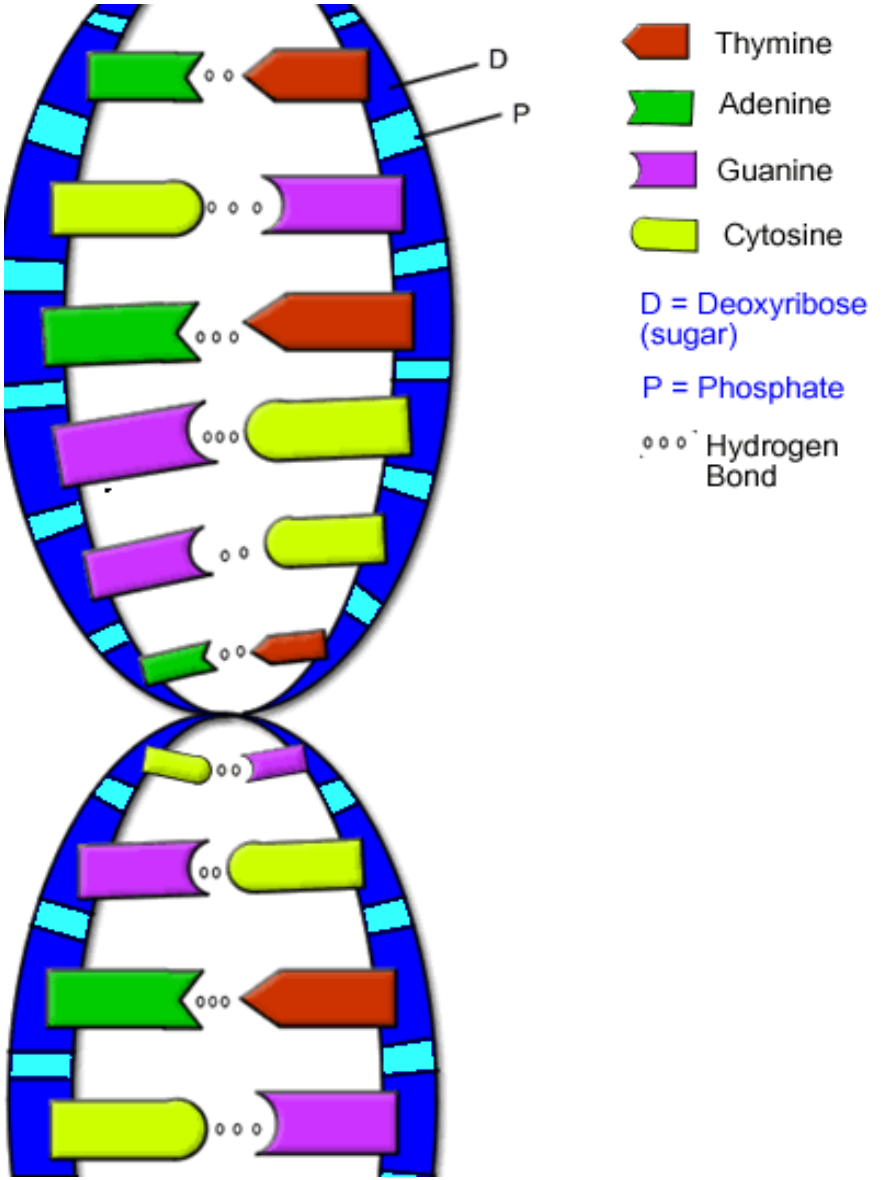
Extension questions 7, 13, 17

# Textbook

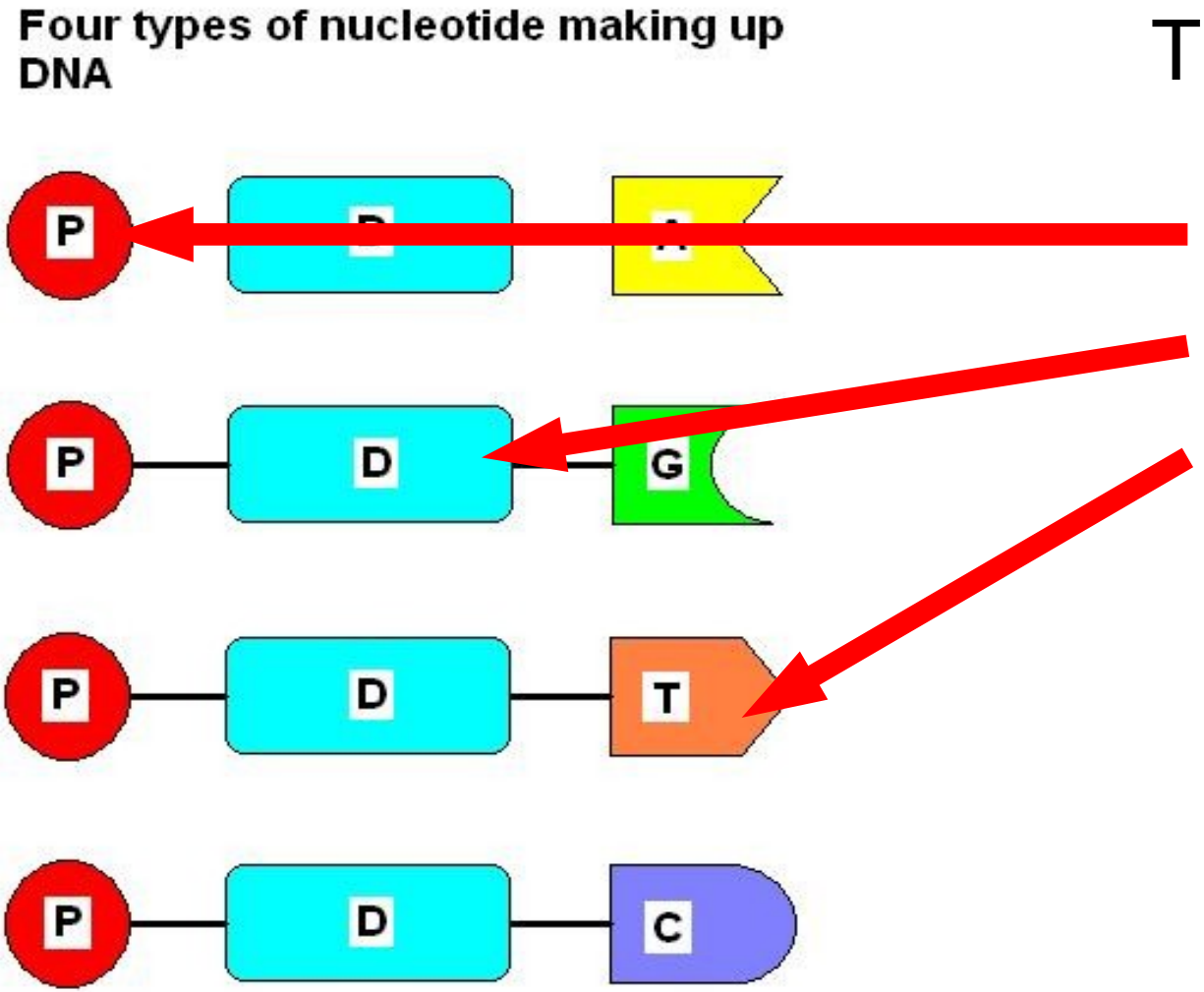
Read pages 42 – 46 – From DNA to Proteins

# DNA Structure

- **Chromosomes contain DNA** (deoxyribonucleic acid) formed as a double helix
- It is **made up of two strands** of nucleotides that fit together like a zipper



# DNA Structure




These **nucleotides are made up of**:

- **a phosphate**
- **a sugar**
- **a nitrogenous base**

# DNA Structure

The **nitrogenous bases** are:

**adenine**

**thymine**

**cytosine**

**guanine**

Adenine always pairs with thymine **(A – T)**

cytosine always pairs with guanine **(C – G)**

# DNA Structure

Activity – Formation of DNA

Do not eat anything until you are done!

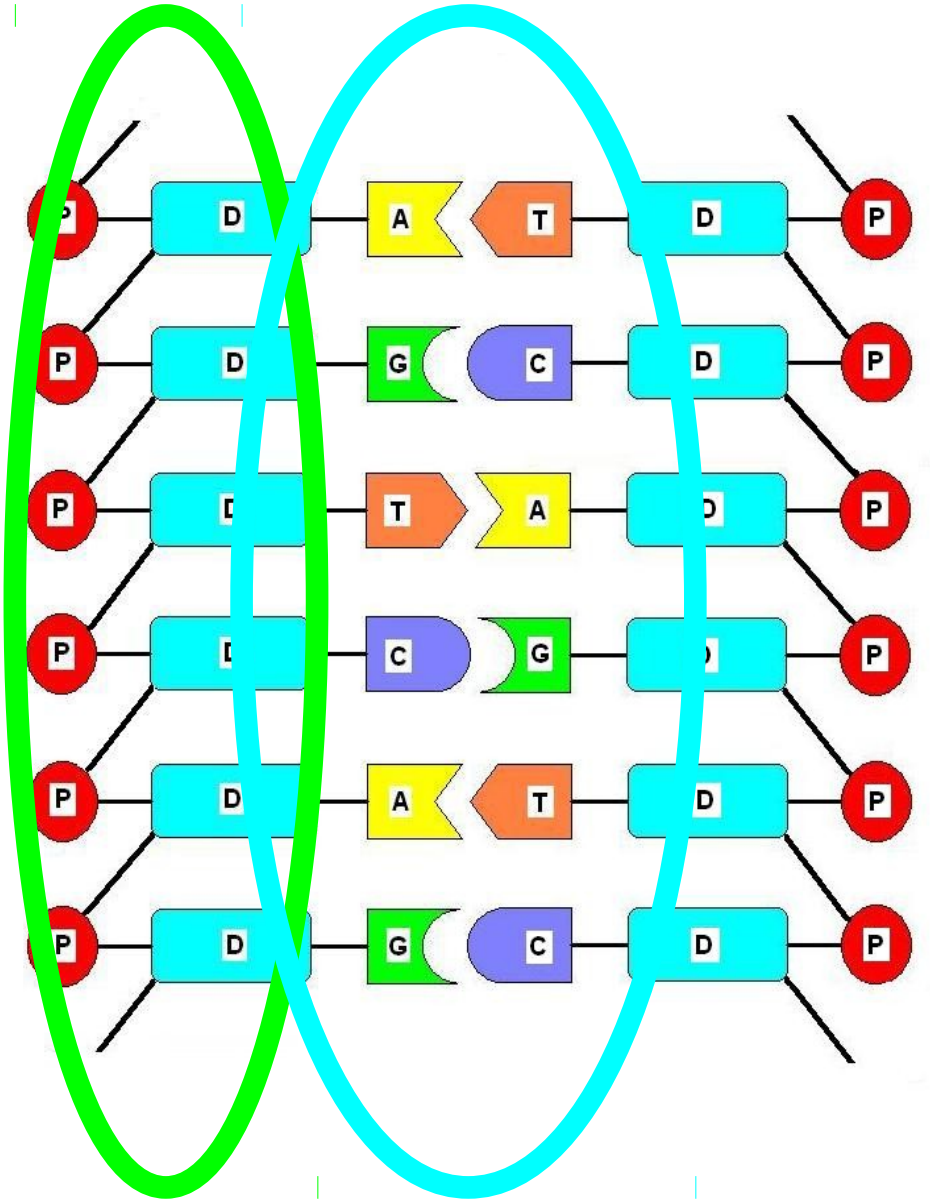
You will receive a mark for your completed model.

After I give you a mark, you may eat it.

# DNA Structure

The sides of the ladder are made up of sugar and phosphate molecules joined together

The rungs of the ladder are made from the pairs of nitrogenous bases

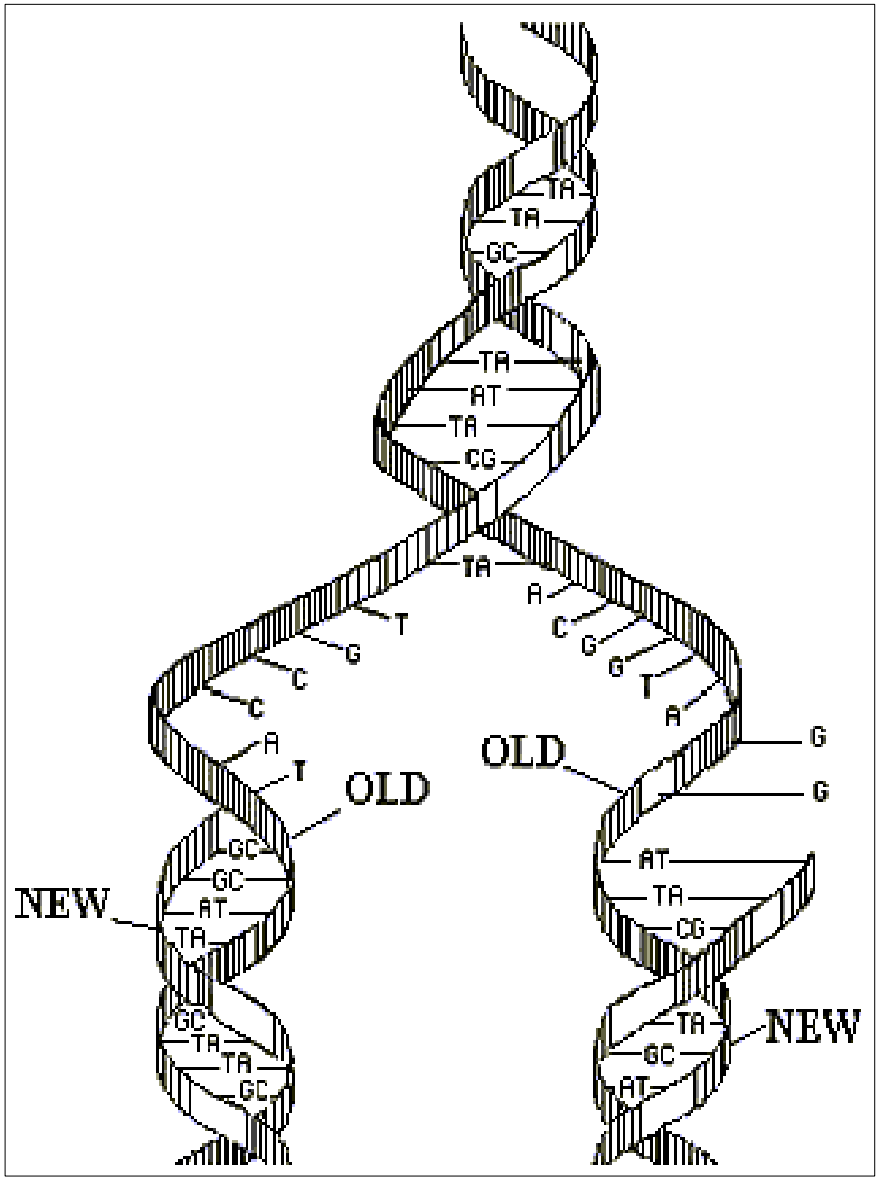


# DNA Structure

**DNA** is an amazing molecule because it is **able to replicate itself**

Before cell division can happen, each DNA molecule must copy itself

The DNA molecule splits like a zipper, and new nucleotides reform onto the 2 parts of the broken ladder



# The Genetic Code

DNA is a 4 – letter alphabet (A, T, C, G)

These 4 letters code for 20 different words (amino acids)

These 20 words can be used to make millions of different sentences (proteins)

It's these proteins made from the genetic code that make up all the different living things on our planet!

# DNA Sentences

- As a group of two or three, use the following words to make as many sentences as you can.

| | |
|---|---|
| The | Did |
| And | Its |
| Not | Say |
| You | Now |
| Can | She |
| Her | Too |
| One | Use |
| Are | See |
| Him | New |
| You | Cat |

# DNA Sentences

- The letters represent nitrogenous bases
- The word represent amino acids
- The sentences represent proteins

# From DNA to Genes

**Chromosomes are organized into smaller sections called genes**

Each gene codes for a specific protein

All the genes in an organism is called the genome

# A Taste of Genetics: Build Your Own DNA!

- See the handout
- Collect the materials you need
  - Two giant nibs
  - 20-26 marshmallows
  - 10-13 toothpicks
  - A clean sheet of paper to work on

| | T | C | A | G | |
|---|---|---|---|---|---|
| T | TTT, TTC — phe | TCT, TCC, TCA, TCG — ser | TAT, TAC — tyr | TGT, TGC — cys | T |
| | TTA, TTG — leu | | TAA — stop | TGA — stop | A |
| | | | TAG — stop | TGG — trp | G |
| C | CTT, CTC, CTA, CTG — leu | CCT, CCC, CCA, CCG — pro | CAT, CAC — his | CGT, CGC, CGA, CGG — arg | T |
| | | | CAA, CAG — gln | | C |
| | | | | | A |
| | | | | | G |
| A | ATT, ATC, ATA — ile | ACT, ACC, ACA, ACG — thr | AAT, AAC — asn | AGT, AGC — ser | T |
| | | | | | C |
| | ATG — met | | AAA, AAG — lys | AGA, AGG — arg | A |
| | | | | | G |
| G | GTT, GTC, GTA, GTG — val | GCT, GCC, GCA, GCG — ala | GAT, GAC — asp | GGT, GGC, GGA, GGG — gly | T |
| | | | | | C |
| | | | GAA, GAG — glu | | A |
| | | | | | G |

# From Genes to Proteins

**Proteins are made from DNA**

But first, the DNA is *translated* into another language called RNA (ribonucleic acid)

**RNA is a single strand** made from a DNA molecule

RNA then takes its information and leaves the nucleus to find a ribosome where proteins are made

# Function of Proteins

Lots of different functions:

- enzymes to make reactions happen faster
- hormones are messengers between cells
- acts to strengthen tissues

See page 45 table 1 for a list of common proteins and their functions

# Variation

**Variation means differences between things**

All humans have the same number of genes and they are almost all identical

The differences are caused by different versions of the same gene, called **traits**

Some traits are controlled by several genes

Examples of traits: red hair, brown eyes, hitch-hikers thumb

# Human Traits Survey

Activity – Textbook page 46

In this activity, we will survey the class to find out which of the following traits we have.

Copy the table on page 46 into your notes. Include room for the 6 traits given.

Record whether a trait is present in each of your classmates.

Calculate the **ratio** for each trait

(number with trait: number without trait)

# Human Traits Survey

Q. Do we see any pattern in the ratios?

Q. What trait was most common?

Q. What trait was least common?

Q. Do you think that the ratios would be the same in other classes in the school? In BC?

# Textbook Questions

Re-read pages 42 – 46

Answer Questions on page 47

1 – 3, 5 – 8, 12 – 16

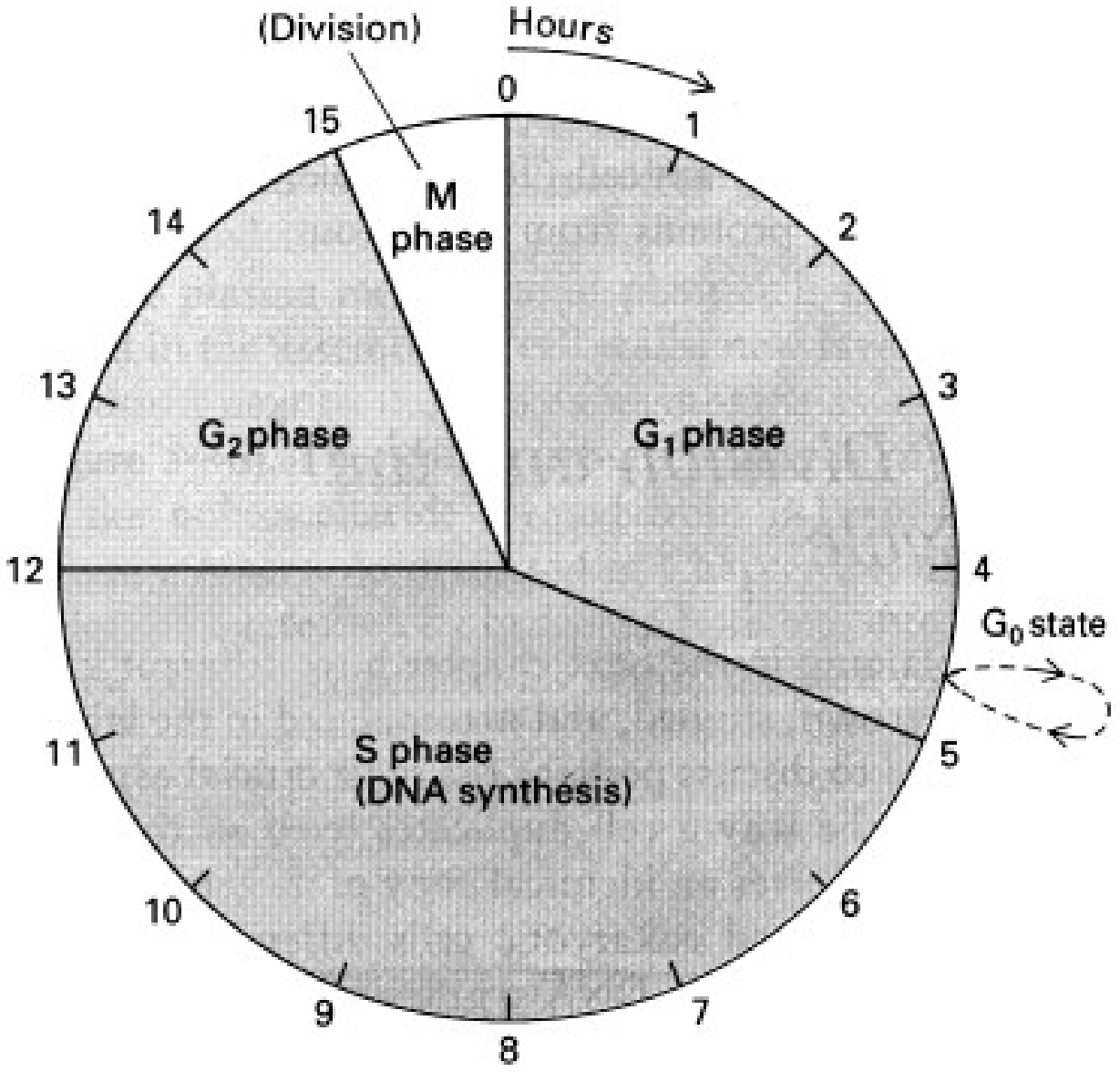
# Textbook Questions

Read pages 49 – 51

# The Cell Cycle

- The cell cycle is the **series of events from one cell division to another**
- Most of a cell's life cycle is called interphase
- The remainder of the time is called mitosis, or cell division

# The Cell Cycle




- Growth phase 1
- Synthesis phase (DNA duplicated)
- Growth phase 2
- Mitosis (cell division)

# The Cell Cycle

- **90% of the cell cycle is interphase**, where the cell grows by making more cytoplasm and more organelles, and the chromosomes are copied
- copied chromosomes are called **sister chromatids**, each with identical instructions
- During cell division, one copy of each chromosome will go into each of the two cells

# Cell Division

- Cell division is the process **where one cell splits evenly into two** equal-sized daughter cells
- It is **made up of two parts – mitosis and cytokinesis**
  - Mitosis is the process where nuclear material divide evenly forming sister chromatids
  - Cytokinesis is the process where the cytoplasm and organelles divide evenly
- Each equal-sized daughter cell is half the size of the parent cell

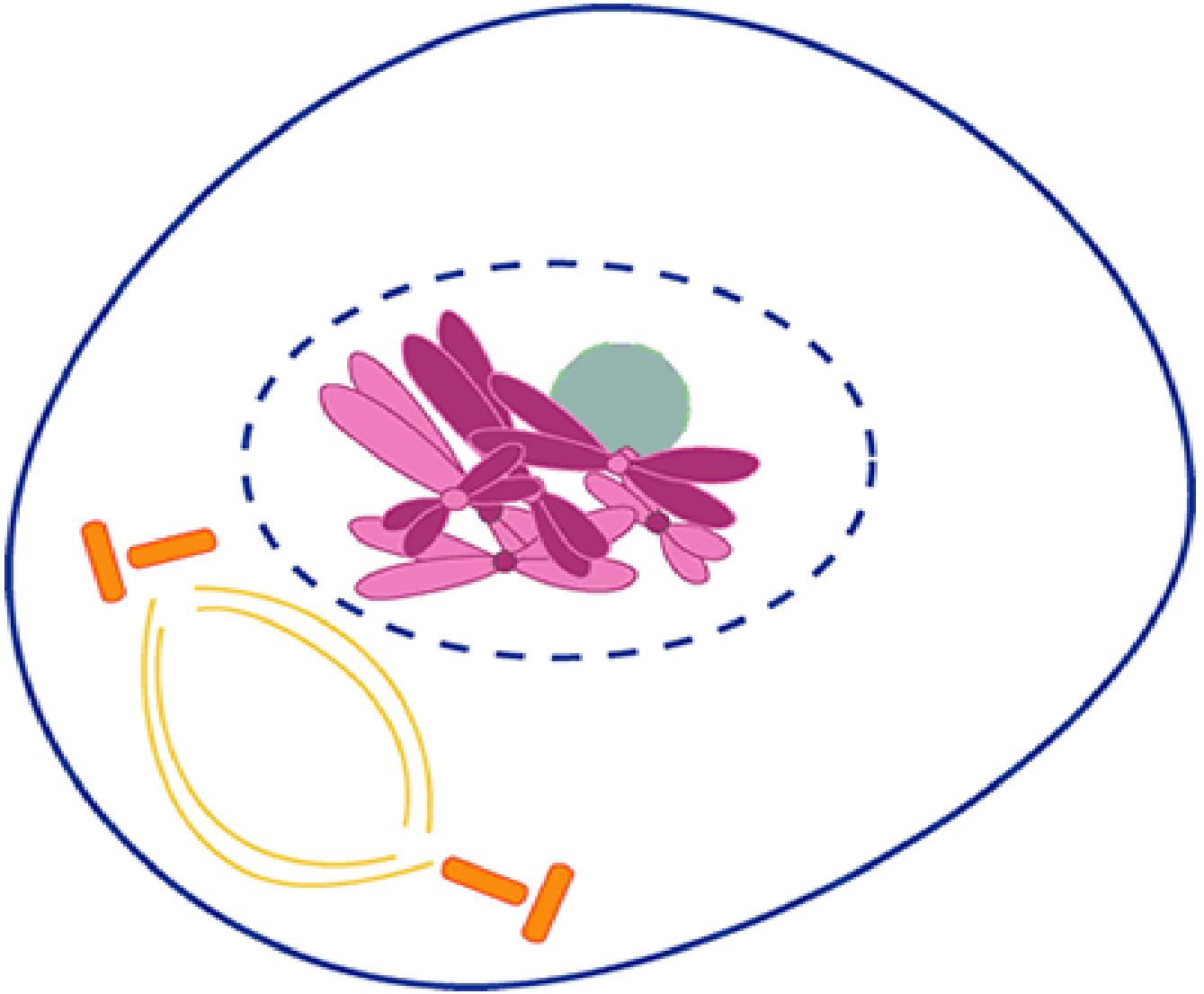
# Phases of Mitosis

There are 4 phases to mitosis

**Prophase**

- **sister chromatids** formed during interphase are **now visible** and appear as an X
- the **nucleolus** disappears **and** the **nuclear membrane disappear**
- **centrioles move to** the opposite **ends** of the cell and **spindle fibres grow** toward the chromosomes

# Prophase

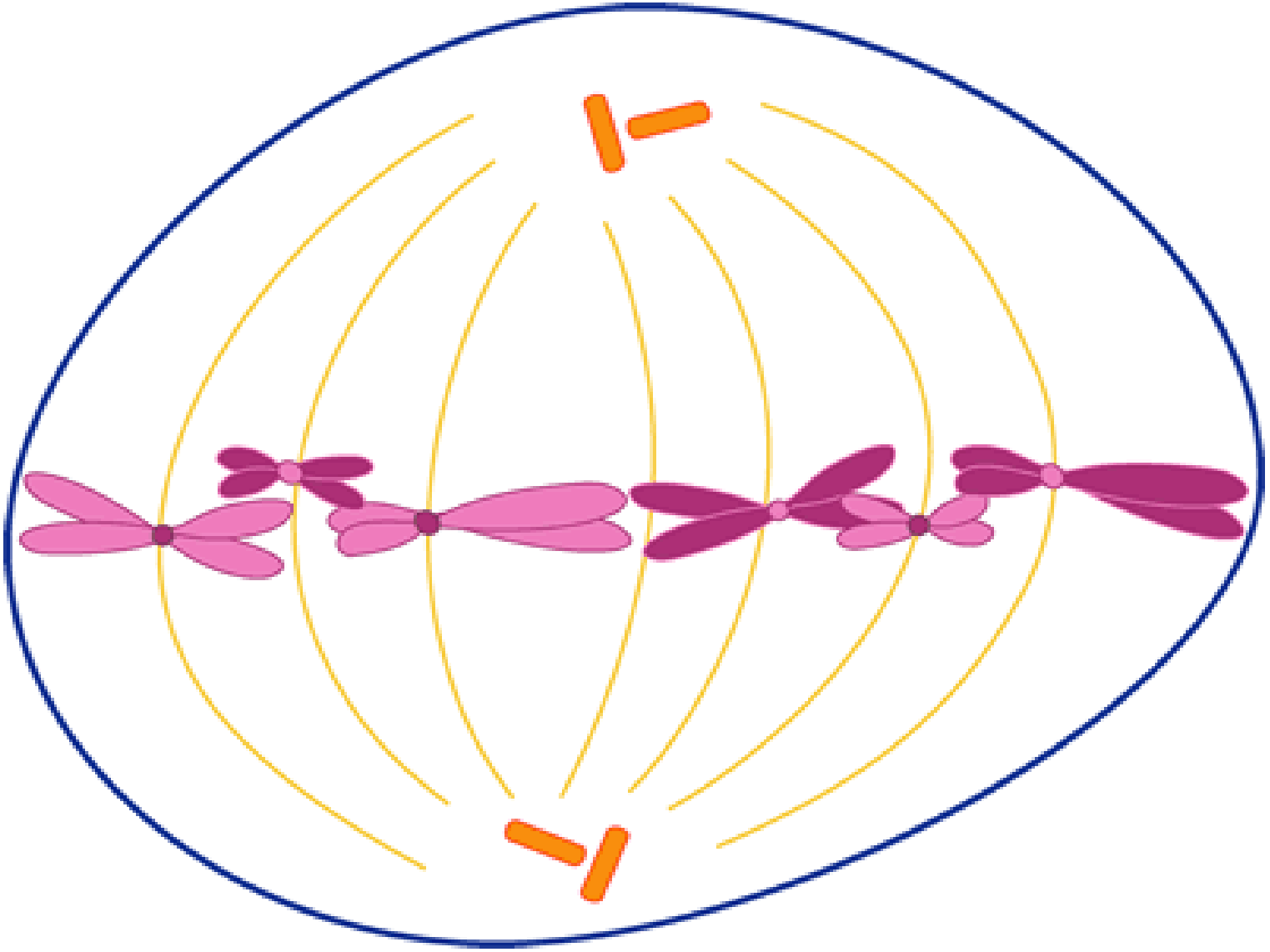


# Phases of Mitosis

**Metaphase**

- the spindle is completely formed and the sister chromatids attach to it
- The **sister chromatids line up in the middle** of the cell

# Metaphase

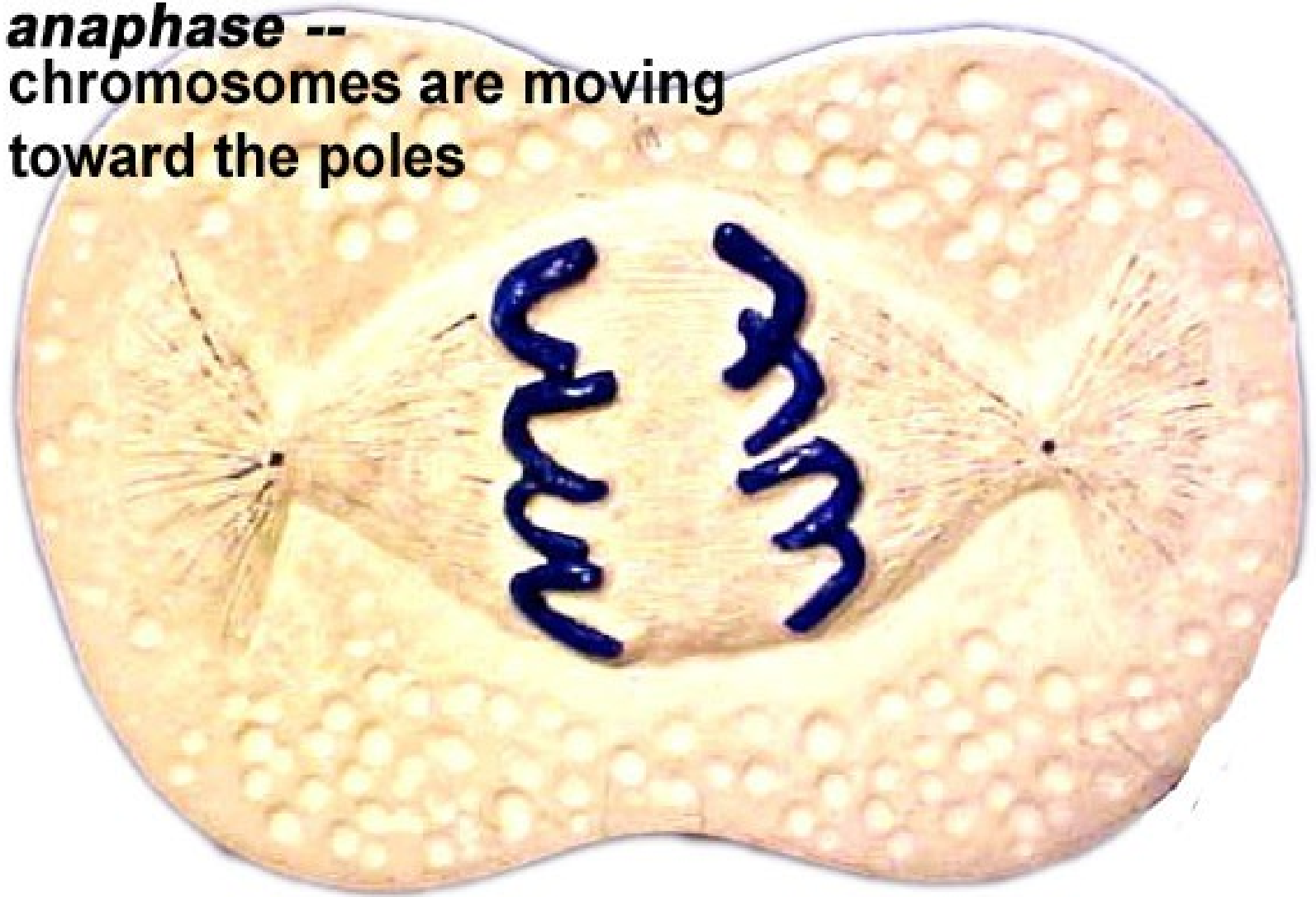


# Phases of Mitosis

**Anaphase**

- the **sister chromatids are pulled apart** by the spindle and move towards opposite sides of the the cell
- each half of the sister chromatids is called a chromosome again

# Anaphase

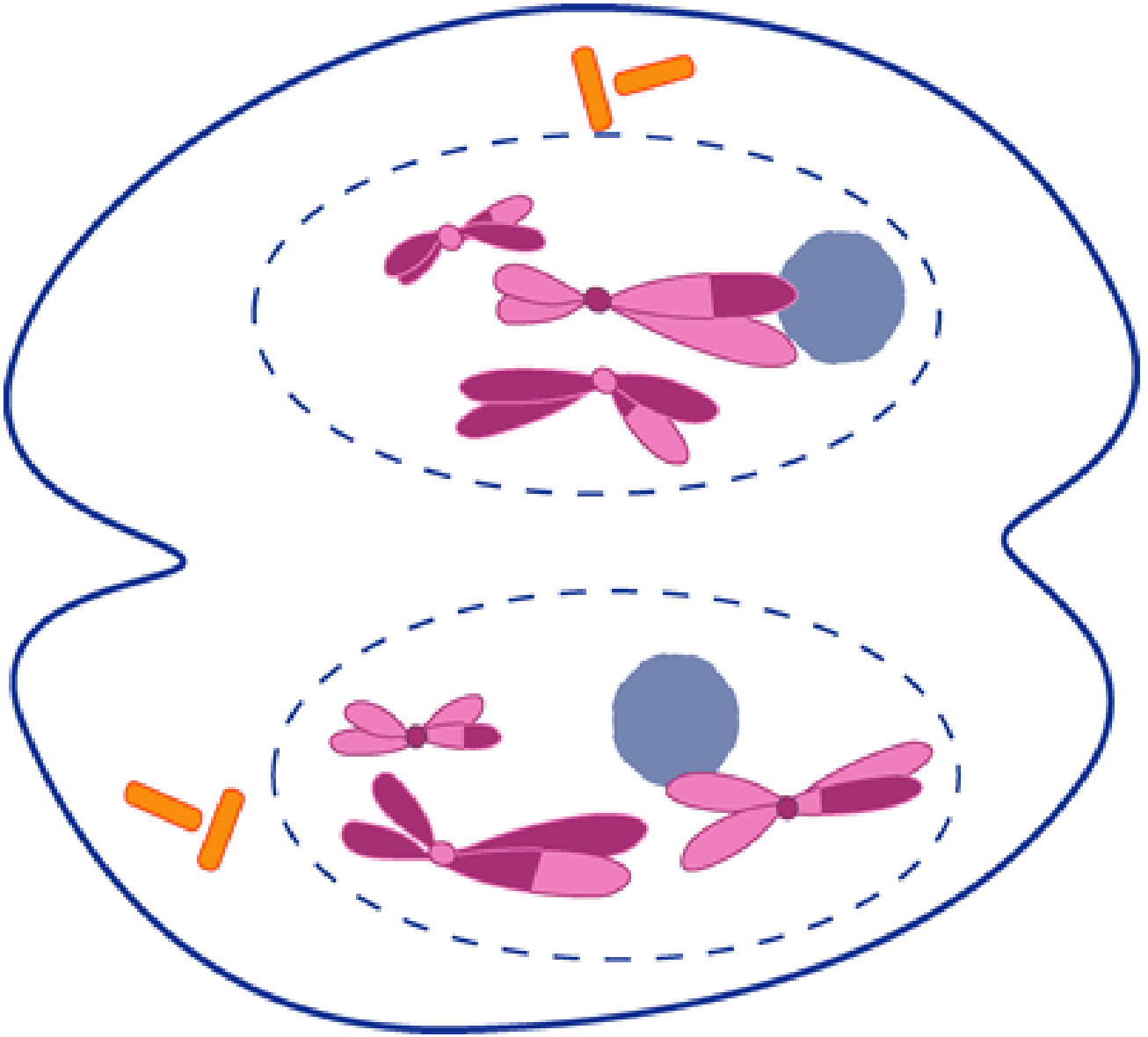


# Phases of Mitosis

**Telophase**

- the new chromosomes have reached opposite ends of the cell
- the nuclear membrane reforms
- the spindle disappears
- the chromosomes lengthen and become thinner
- the nucleolus reappears
- cytokinesis now occurs

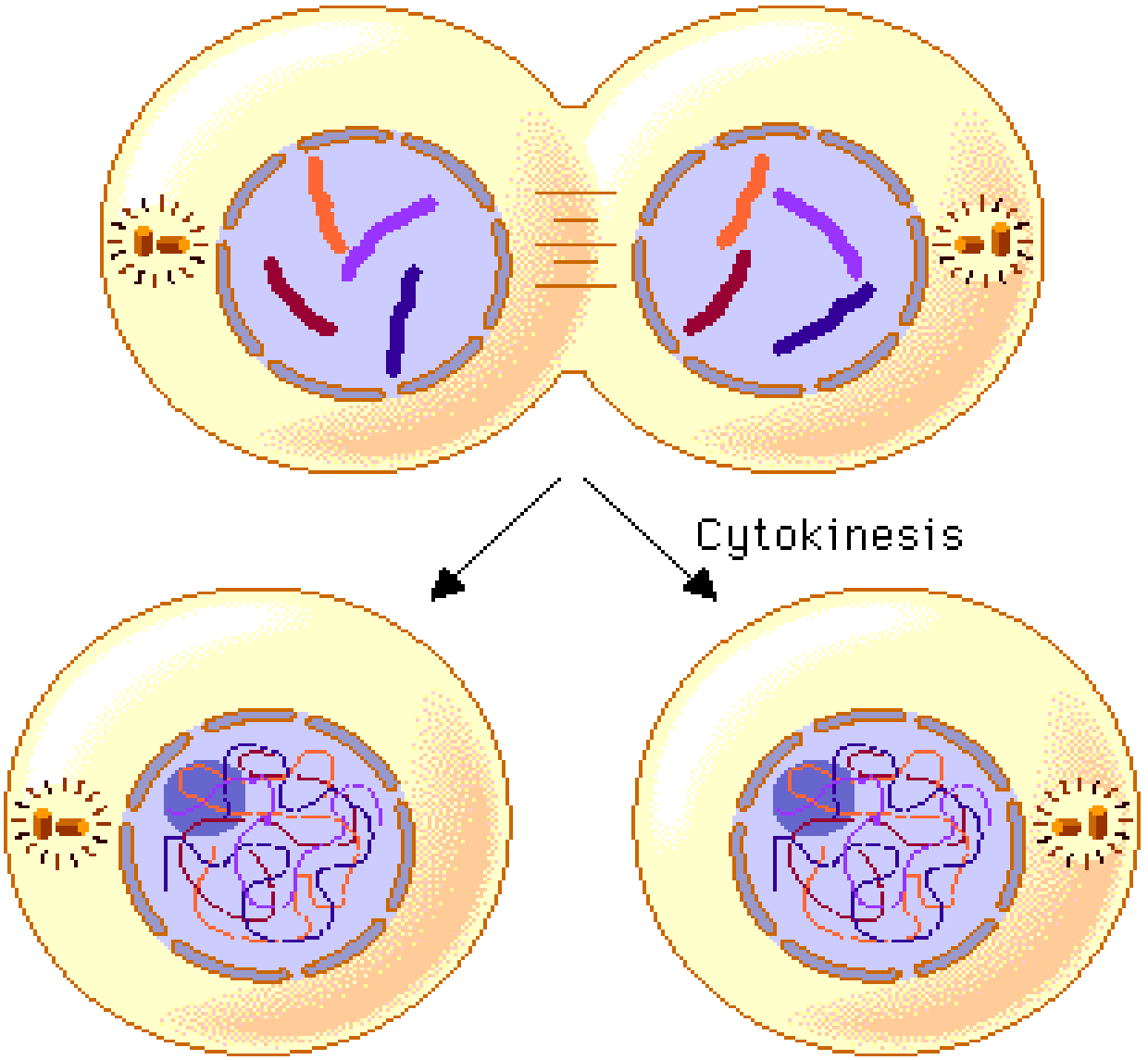
# Telophase



# Cytokinesis

- Cytokinesis occurs at the end of telophase
- It **divides the cytoplasm and all organelles** into two daughter cells
- In animal cells, the cell pinches between the two nuclei until it pinches right together, forming two different cells
- These two daughter cells now begin interphase

# Animal Cell Cytokinesis



# Cytokinesis

In plant cells, there is no indentation of the cell

Instead, a cell plate forms between the two nuclei

The cell plate grows until it reaches the edges of the cell membrane, separating the two nuclei

A new cell wall also forms between the two daughter cells

# Plant Cell Cytokinesis

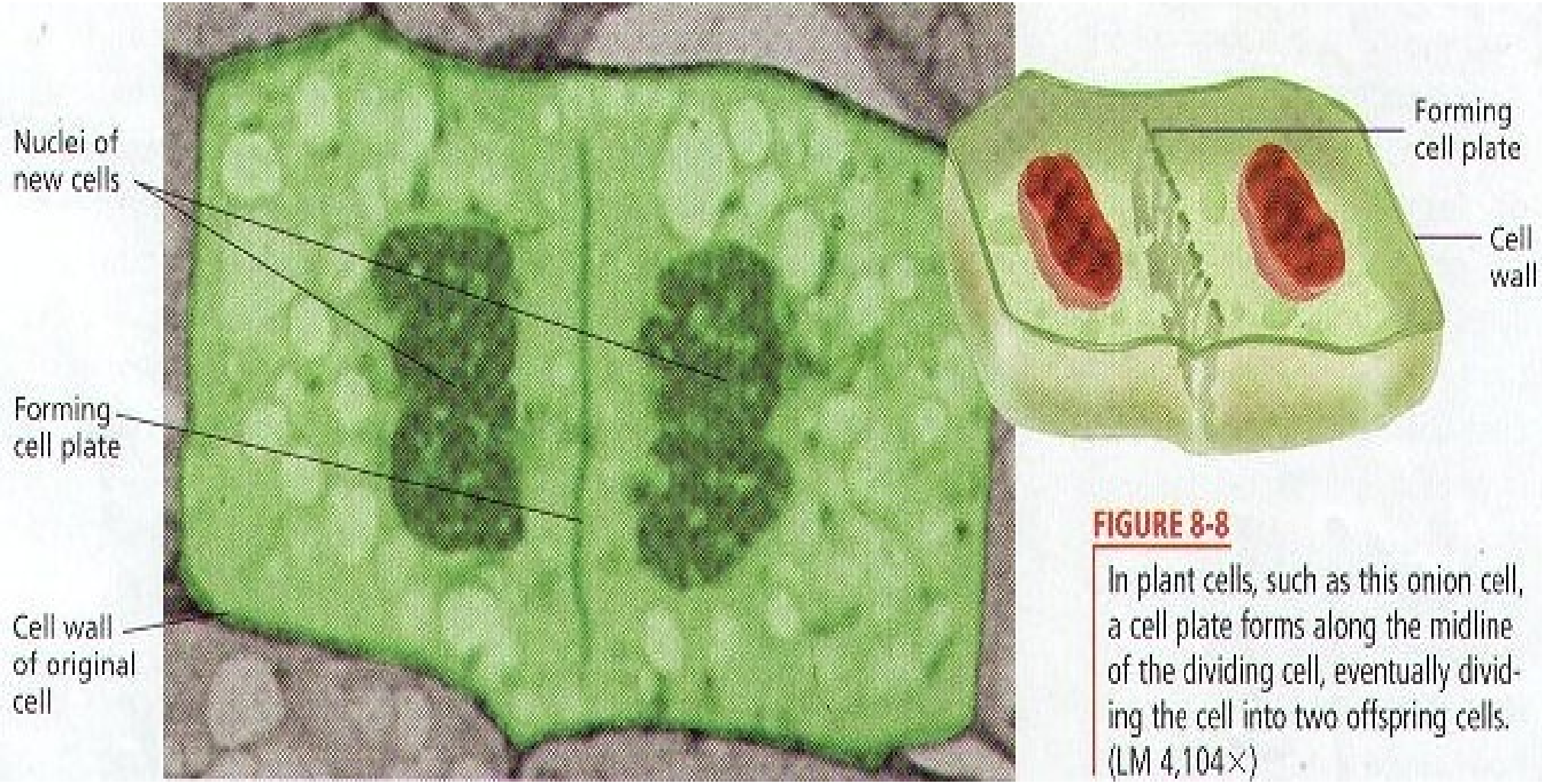
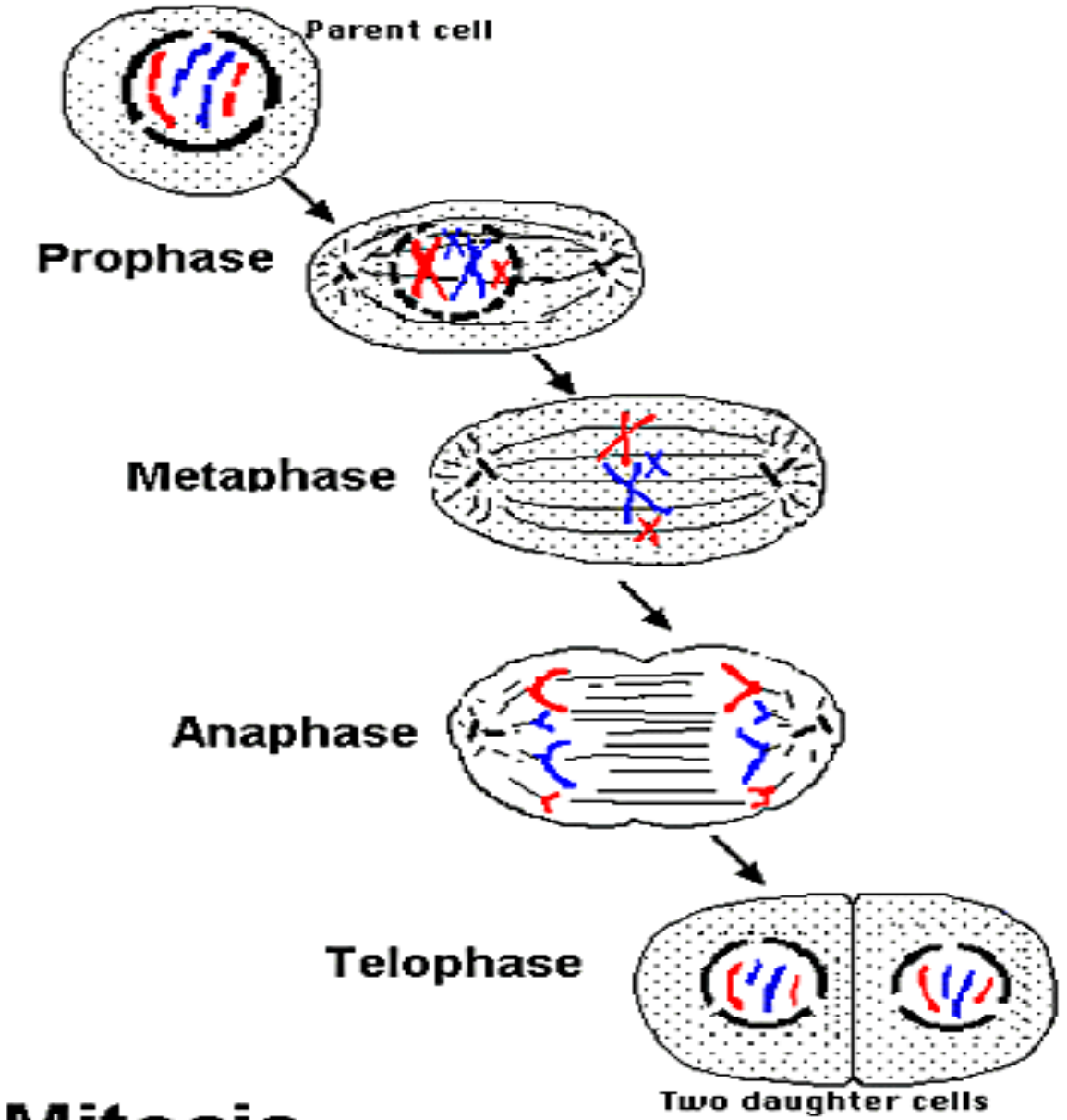



**FIGURE 8-8**

In plant cells, such as this onion cell, a cell plate forms along the midline of the dividing cell, eventually dividing the cell into two offspring cells. (LM 4,104×)

# Mitosis Summary



# Mitosis Animations

# Textbook Questions

Read pages 49 – 51

Answer questions 1 – 12, 17

Additional Questions because you can't stop talking:

# Textbook

Read pages 53-55 on Changes to a Cell's DNA

Write all the words in bold and their definitions.

# Changes to a Cell's DNA

A change in DNA is called a **mutation**

Mutations cause a change in the order of nucleotides, which change the order of amino acids, which change the protein

**Mutations can be either**:

1. **beneficial**
2. **neutral (causing no effect)**
3. **harmful**

# Changes to a Cell's DNA

**Harmful Mutations**

These cause genetic diseases such as:

cystic fibrosis

Duchenne muscular dystrophy

Turner syndrome

Down syndrome

Klinefelter syndrome

haemophilia

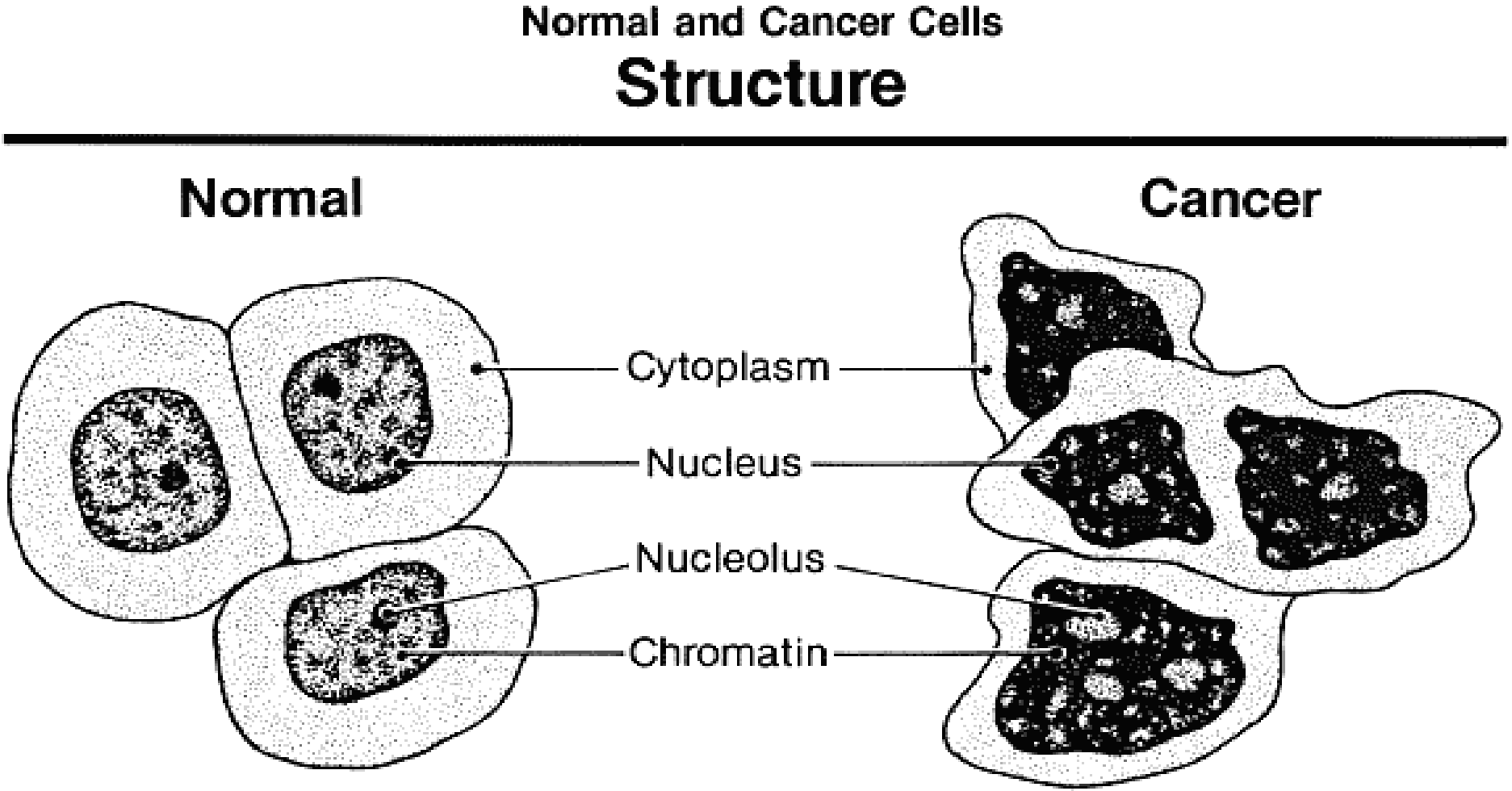
# Cancer

- Can be caused by **harmful mutations**
- Cancer affects the nucleus and **causes uncontrolled cell division**
- The DNA of cancer cells has mutated so that the cell does not know when to stop dividing

# Changes to a Cell's DNA

- Cancer cells develop into a mass called a tumour
- **Two types of tumours**:
  - **benign** (causes no damage to surround area)
  - **malignant** (causes damage to surround area)
- Cancer cells that move from one area to another is called **metastasis**

# Changes to a Cell's DNA



# Cancer Cells Vs Normal Cells

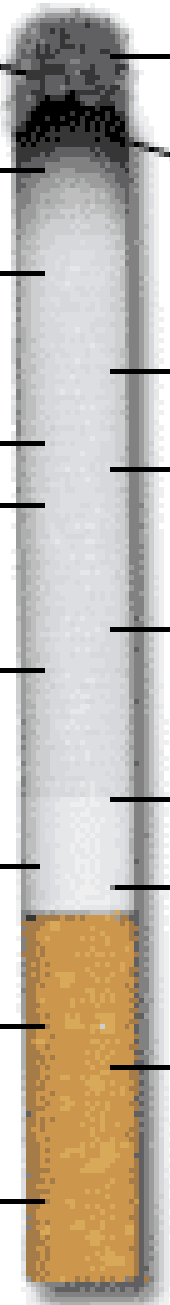
# Changes to a Cell's DNA

**Anything that causes cancer is called a carcinogen**

Known carcinogens are:

- tobacco
- viruses (HPV, Hepatitis)
- x-rays
- pesticides
- solar radiation
- trans fatty acids
- asbestos

# DANGER POISON !



**Acetone**
(solvent)

***Naphtylamine**

**Methanol**
(used as rocket fuel)

***Pyrene**

**Naphtalène**
(moth-repellent)

**Nicotine**
(used as a herbicide and insecticide)

***Cadmium**
(used in batteries)

**Carbon monoxide**
(found in exhaust fumes)

**Vinyl chloride**
(used in plastic materials)

**Cyanhydric acid**
(was used in the gas chambers)

**Ammoniac**
(détergent)

***Urethane**

**Toluene**
(industrial solvent)

**Arsenic**
(lethal poison)

***Dibenzacridine**

***Polonium 210**
(a radioactive element)

**DDT**
(insecticide)

*Known carcinogenic substances

# Treating Cancer

Surgery to remove tumours

Radiation to kill cancer cells

Chemotherapy uses drugs to stop cell division

Combination of these

# Textbook Questions

Read pages 53-55

Answer all questions on page 56

# Textbook

Read pages on methods of asexual reproduction 57 – 59

# Asexual Reproduction

**Asexual reproduction involves only one parent**

Offspring are genetically identical to the parent and are called **clones**

# Asexual Reproduction

There are **5 types** of asexual reproduction:

Binary Fission

Budding

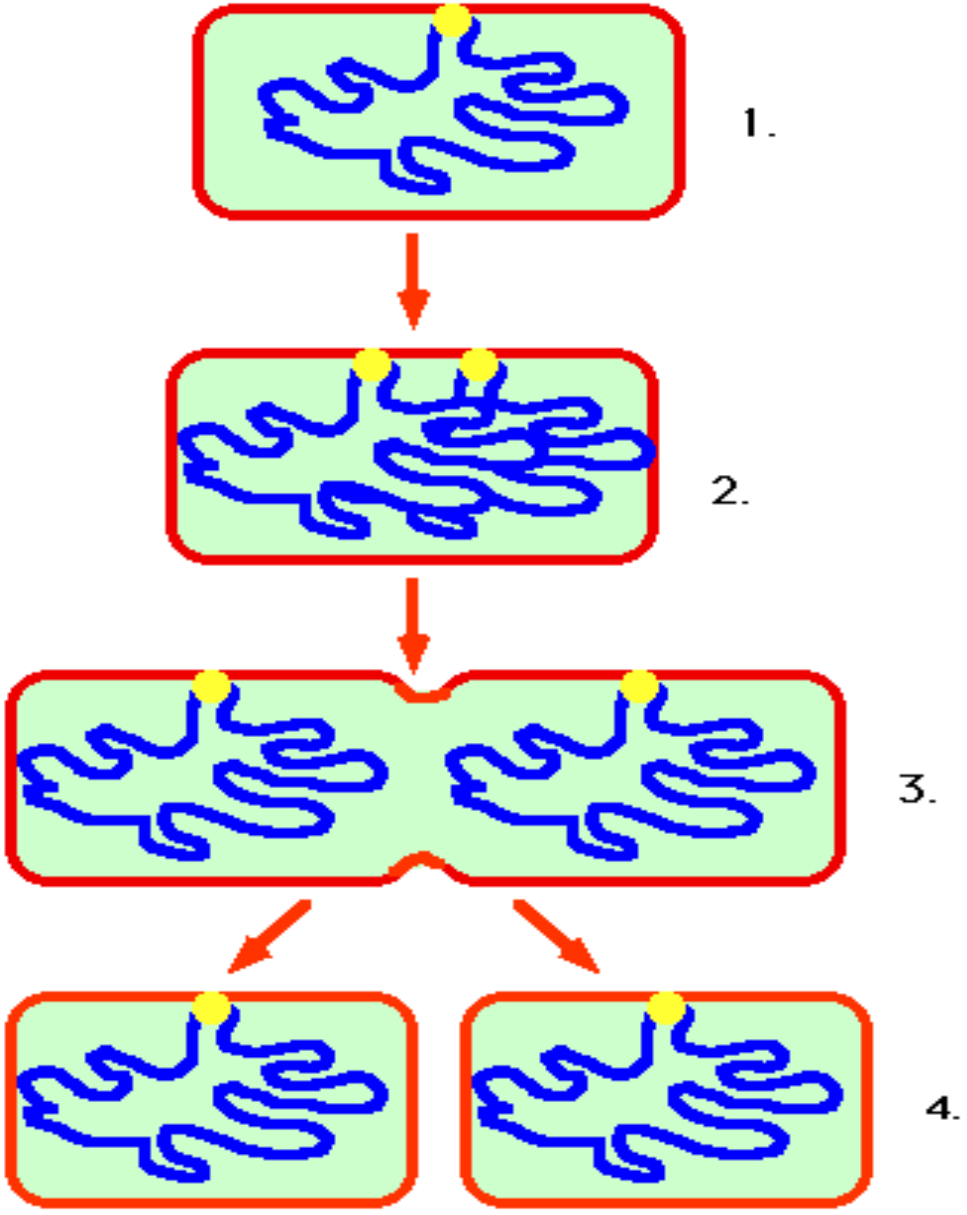
Vegetative Reproduction

Fragmentation

Spore Formation

# Binary Fission

- **Occurs only in unicellular organisms** like bacteria
- Parent undergoes cell division to produce 2 clones



# Binary Fission

**Allows for very rapid growth of a population**

eg. A single bacterium that multiplies every 20 minutes will be 32 768 after 5 hours, and will be 2 097 152 after 7 hours!

# Budding

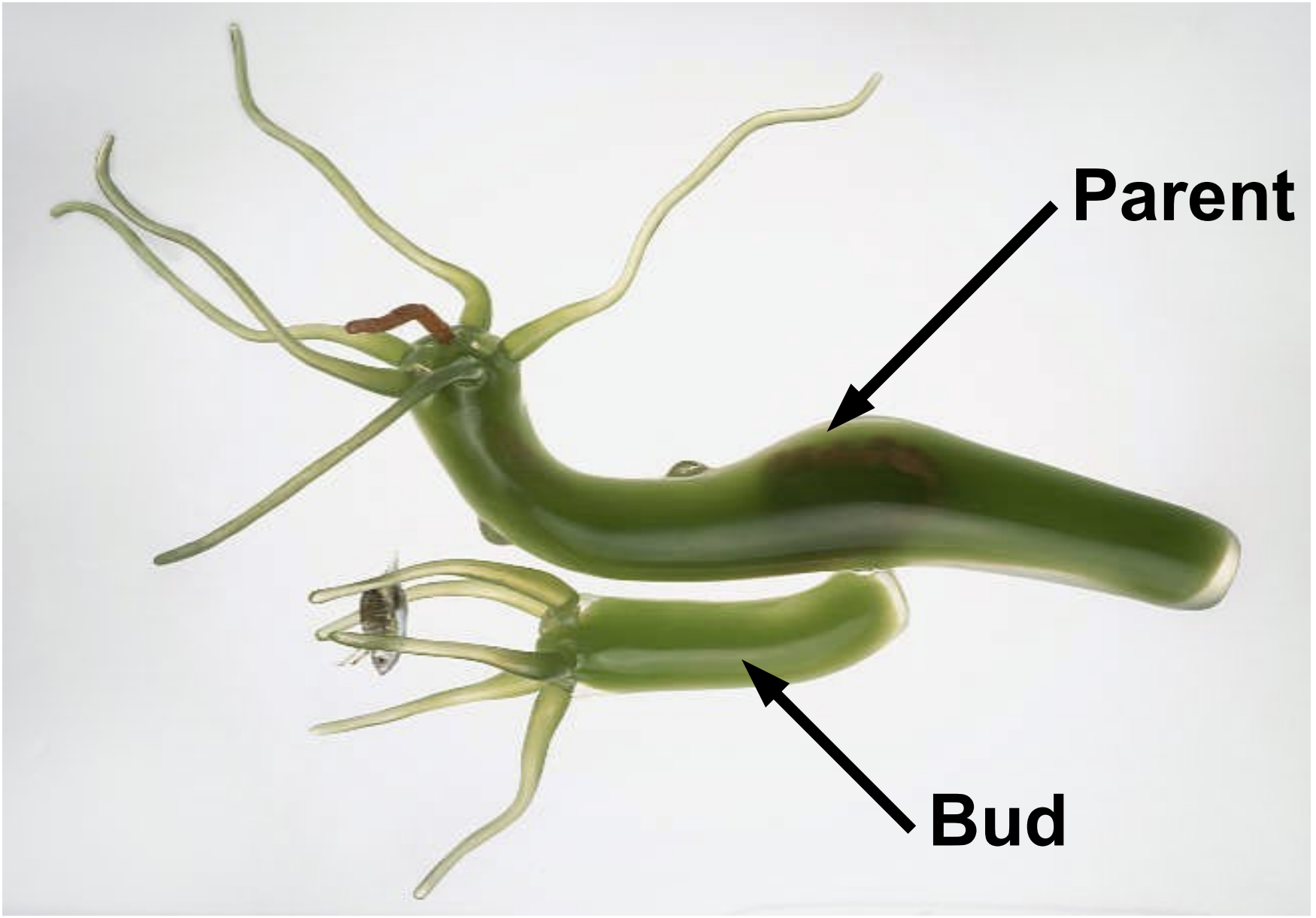
**Offspring start as a small growth on the parent called a bud**

Bud grows until big enough to survive on its own, then breaks off the parent

Since it grew directly from the parent, it is a clone

eg. hydra

# Budding

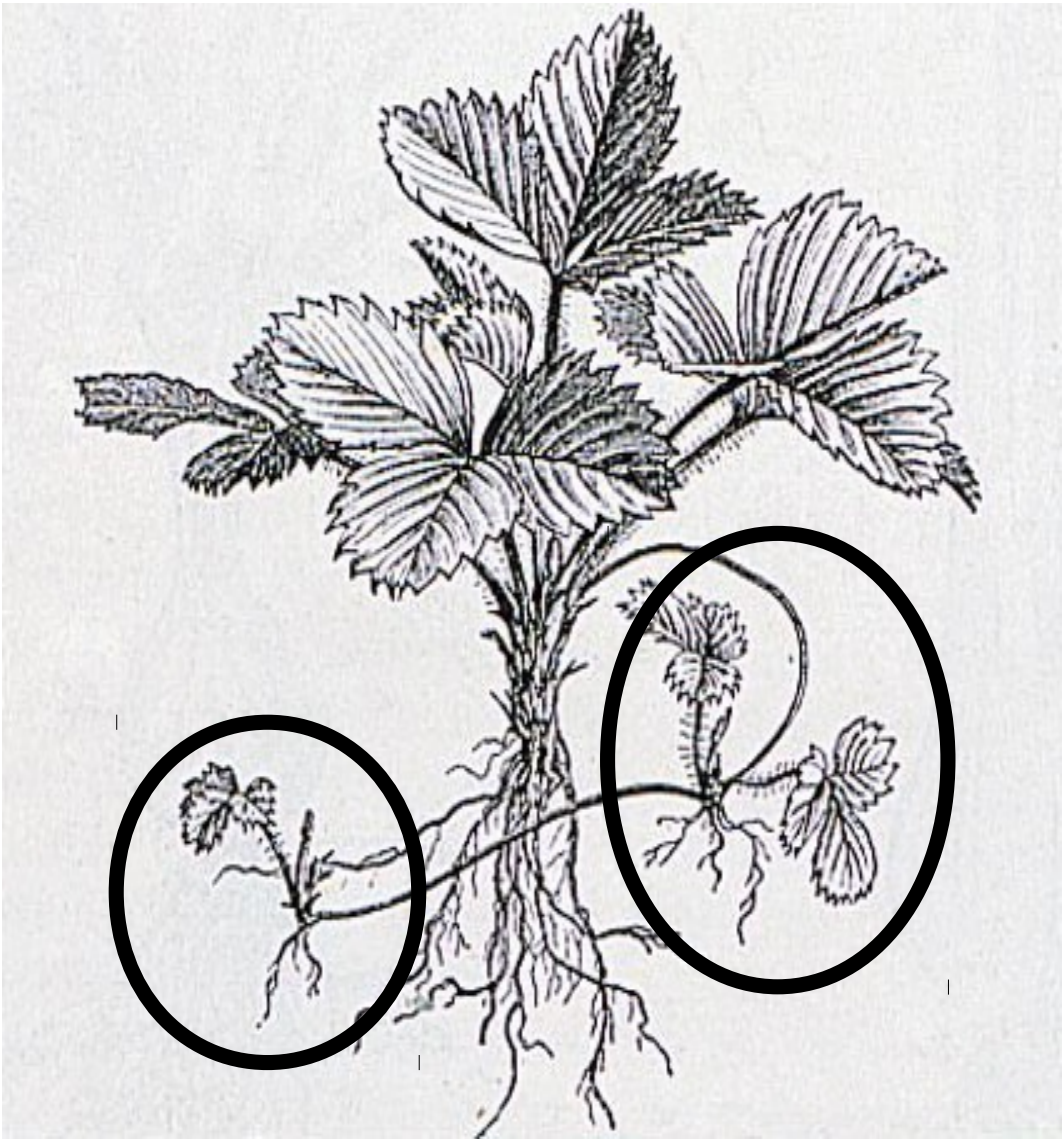


# Vegetative Reproduction

**Occurs in plants only**

Plant sends out a horizontal stem, called a **runner**

The runner can grow its own roots and start a new plant



# Vegetative Reproduction

**Bulbs** (daffodils) and **tubers** (potatoes) are also forms of vegetative reproduction

# Fragmentation

**Part of the animal breaks off and grows into a new organism**

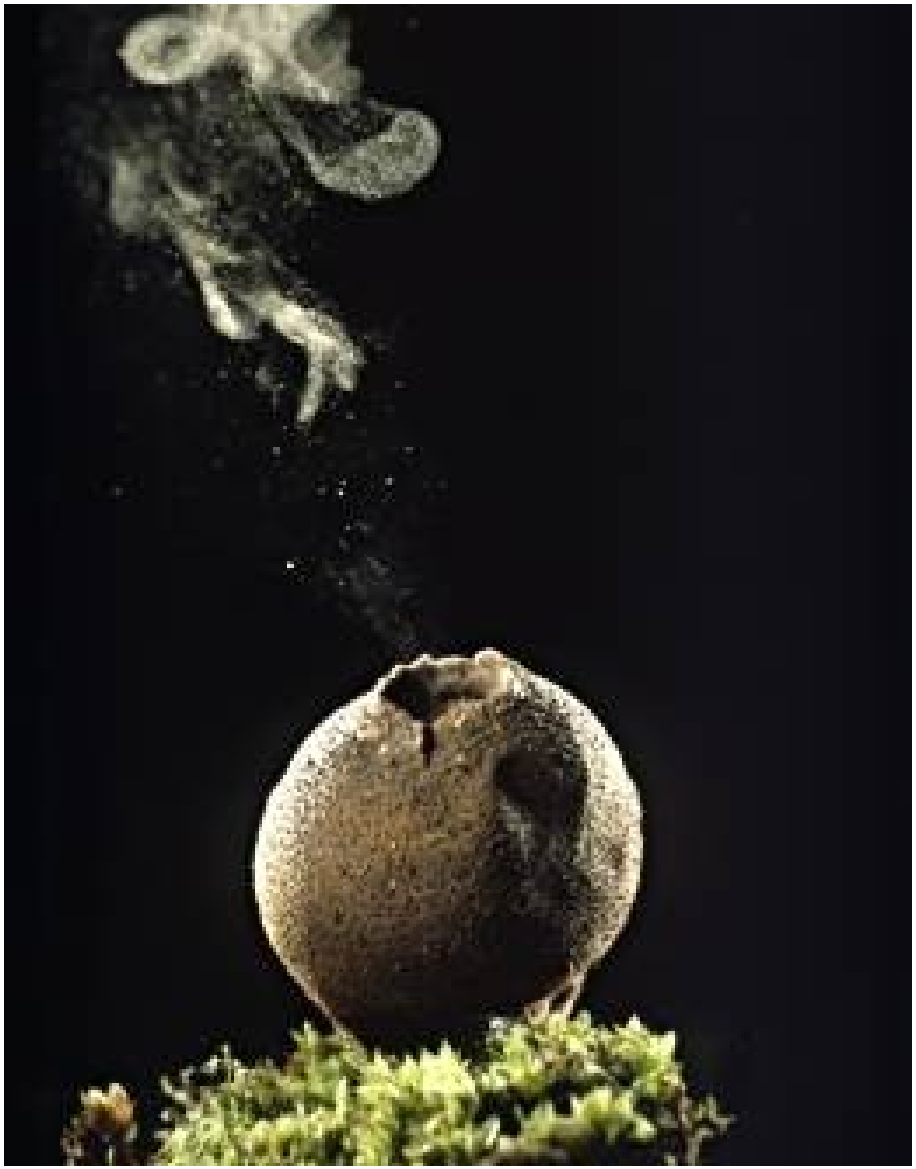
Requires regeneration to occur – meaning the lost or missing part must regrow!

# Fragmentation

# Fragmentation

# Spore Formation

- Spores are made by cell division
- They are cells with thick cell walls
- Produced in huge numbers by fungi and ferns



# Characteristics of Asexual Reproduction

1. **Only 1 organism needed to reproduce**
2. **All offspring are clones to each other and parent**
3. **A single organism can produce lots of offspring very quickly**

1 and 3 are good things (pros)

2 can be bad (con) – a disease can kill the entire population!

# Textbook Questions

Read pages 57 – 59

Answer questions 1, 2, 3, 4, 6, 9, 12, 13, 14

# Mitosis Review

# Review Questions

Page 70 and 71

Questions 1 – 21

Extension Questions 22 – 26 (if you can)

Test Tuesday