Cell Growth and Division

Why do cells divide*

- **Life and reproduction require cell division**
- **You require constant cell reproduction to live**

(a)

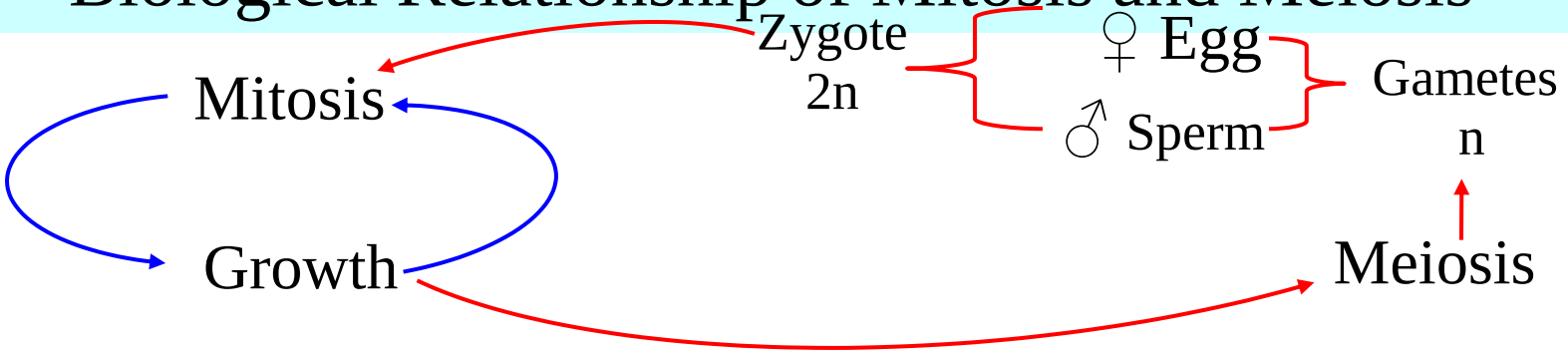
mitotic cell division

(b)

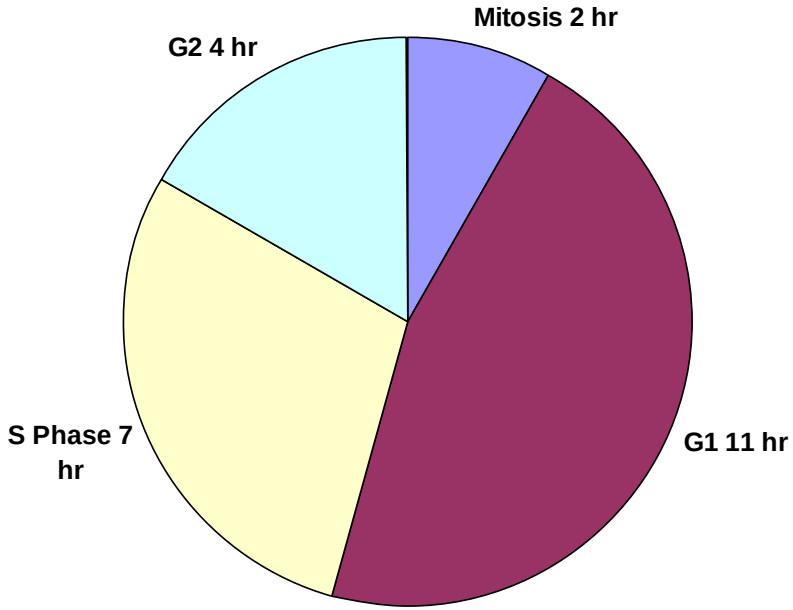
mitotic cell division

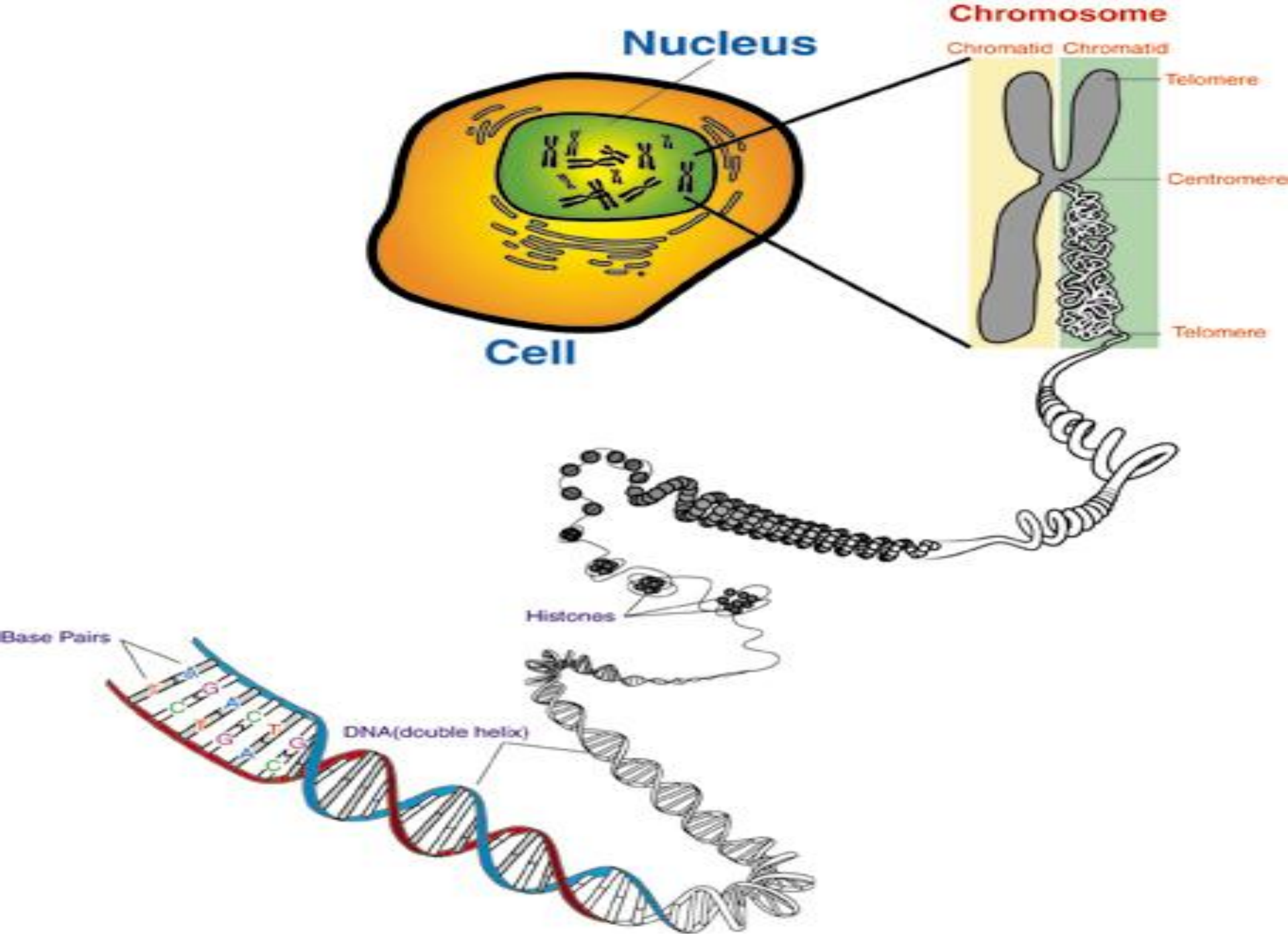
(c)

Biological Relationship of Mitosis and Meiosis



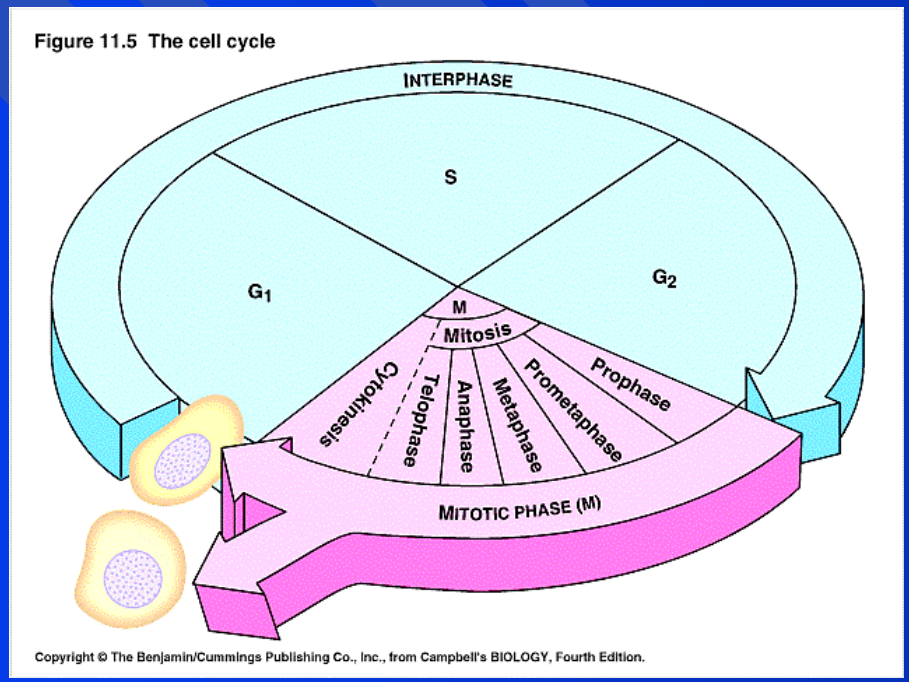
Cell Cycle




Chromosome
Nucleus
Chromatid
Chromatid
Telomere
Centromere
Telomere
Cell
Histones
Base Pairs
DNA(double helix)

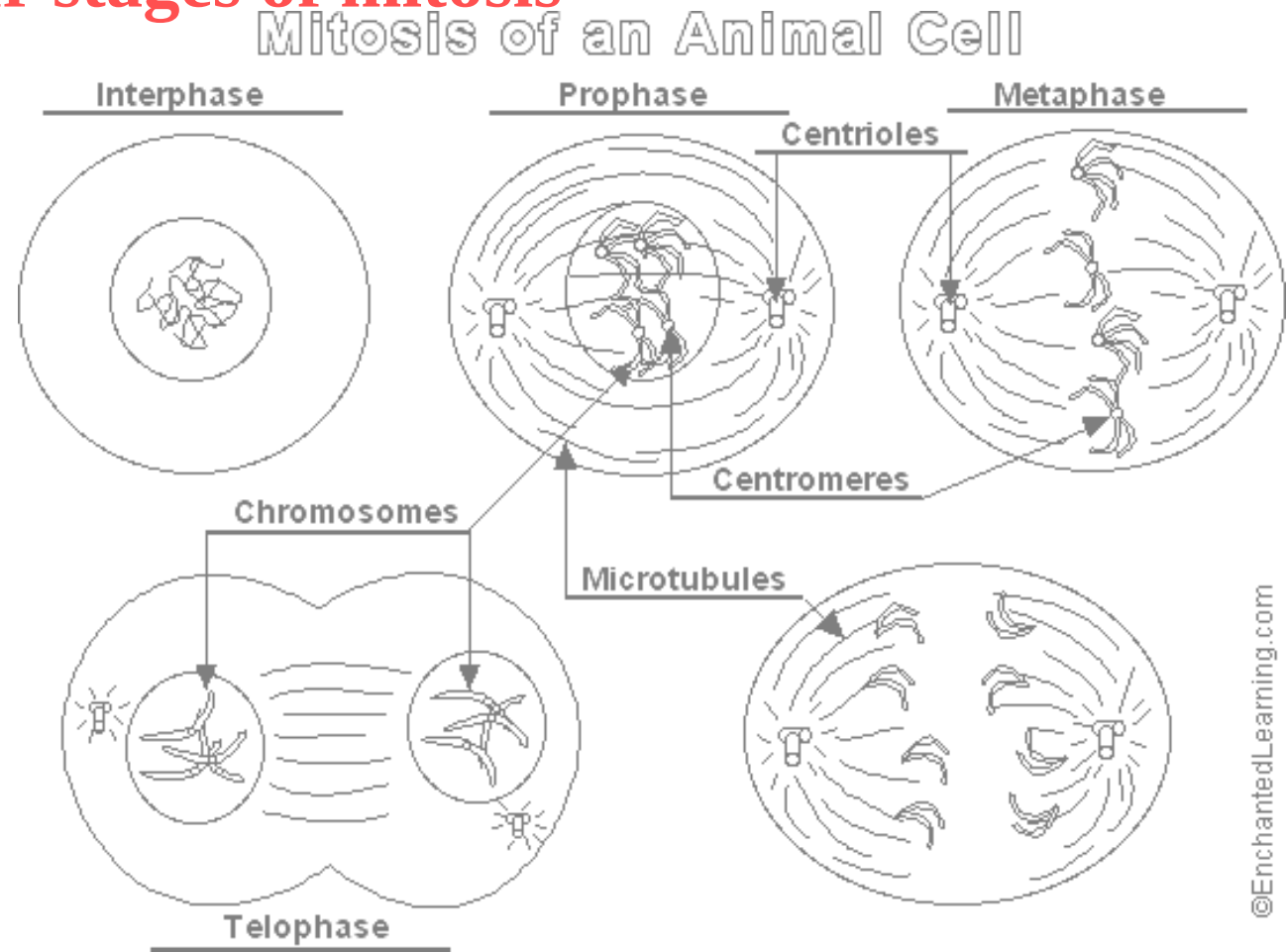
The cell cycle

- **A cell spends most of its life in *interphase** – the phase where the normal life processes go on**



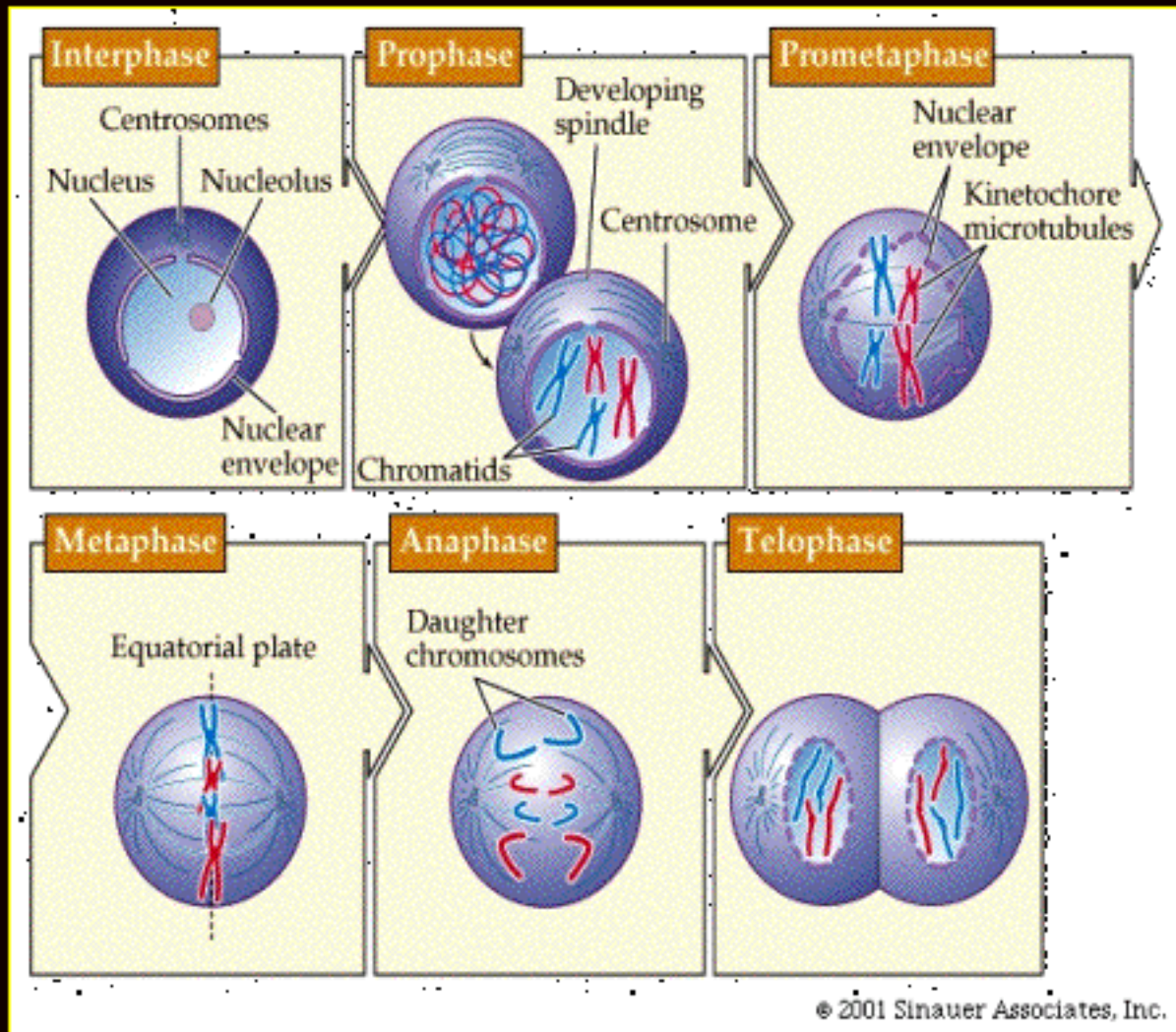
Mitosis *

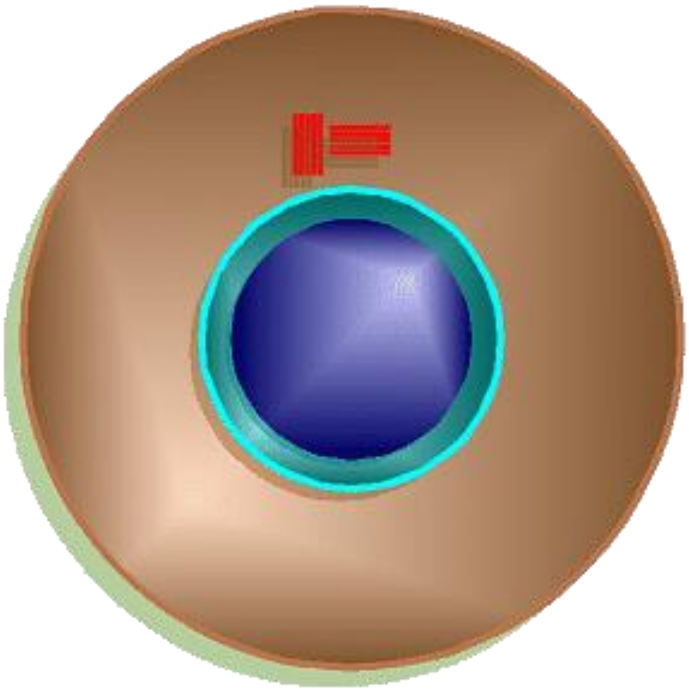
- is the process of cell division*
  - When a cell replicates itself*
  - There are four stages of mitosis *



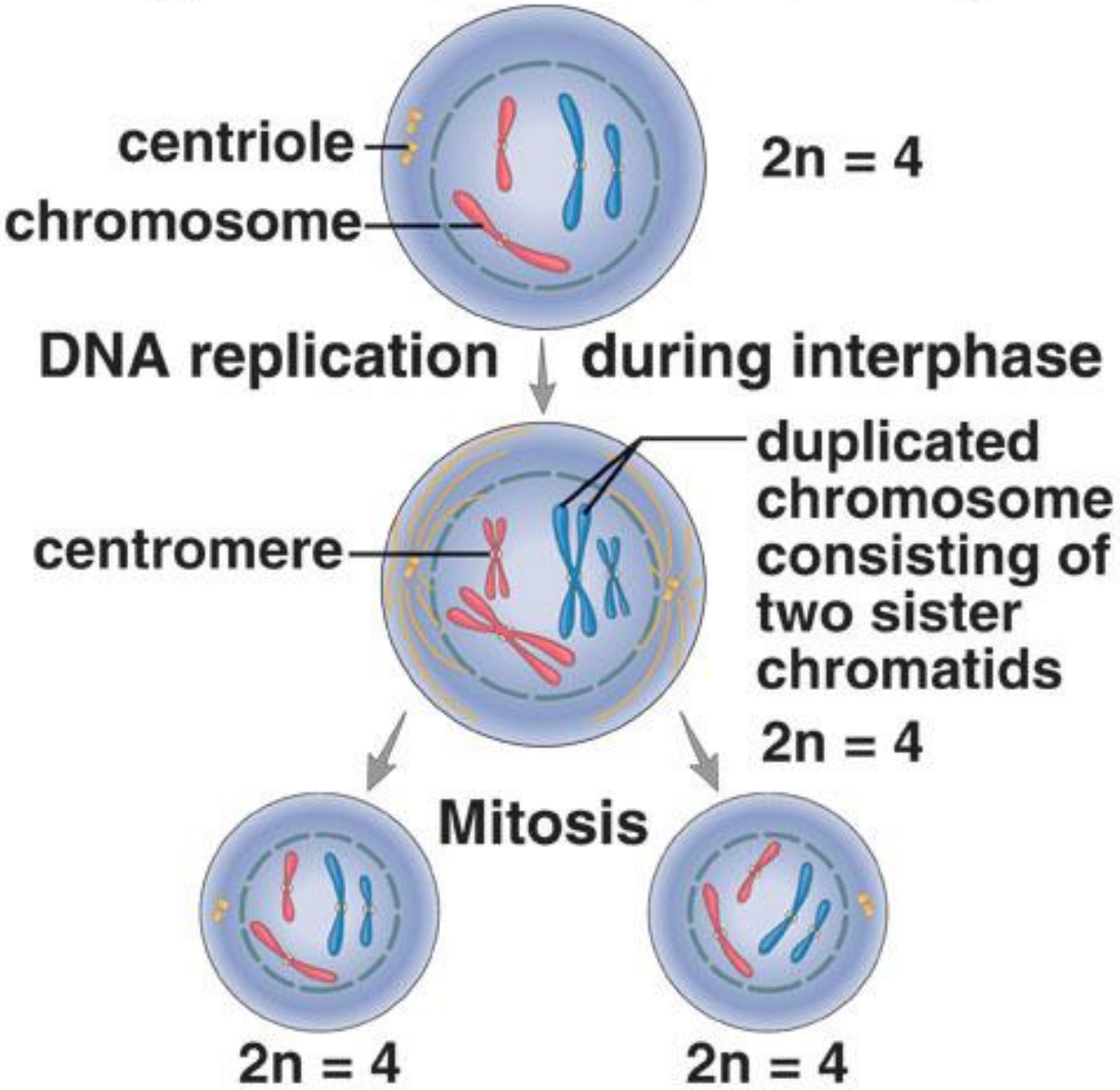
Mitosis is a Contiuum

- But, it's divided into *subphases* for description
  - **Prophase**
    - **prometaphase**
  - **Metaphase**
  - **Anaphase**
  - **Telophase**

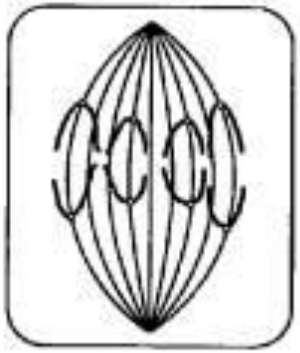




Mitosis Overview

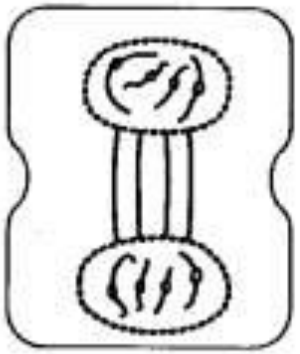


Mitosis



3. Anaphase

1. Prophase



4. Telophase

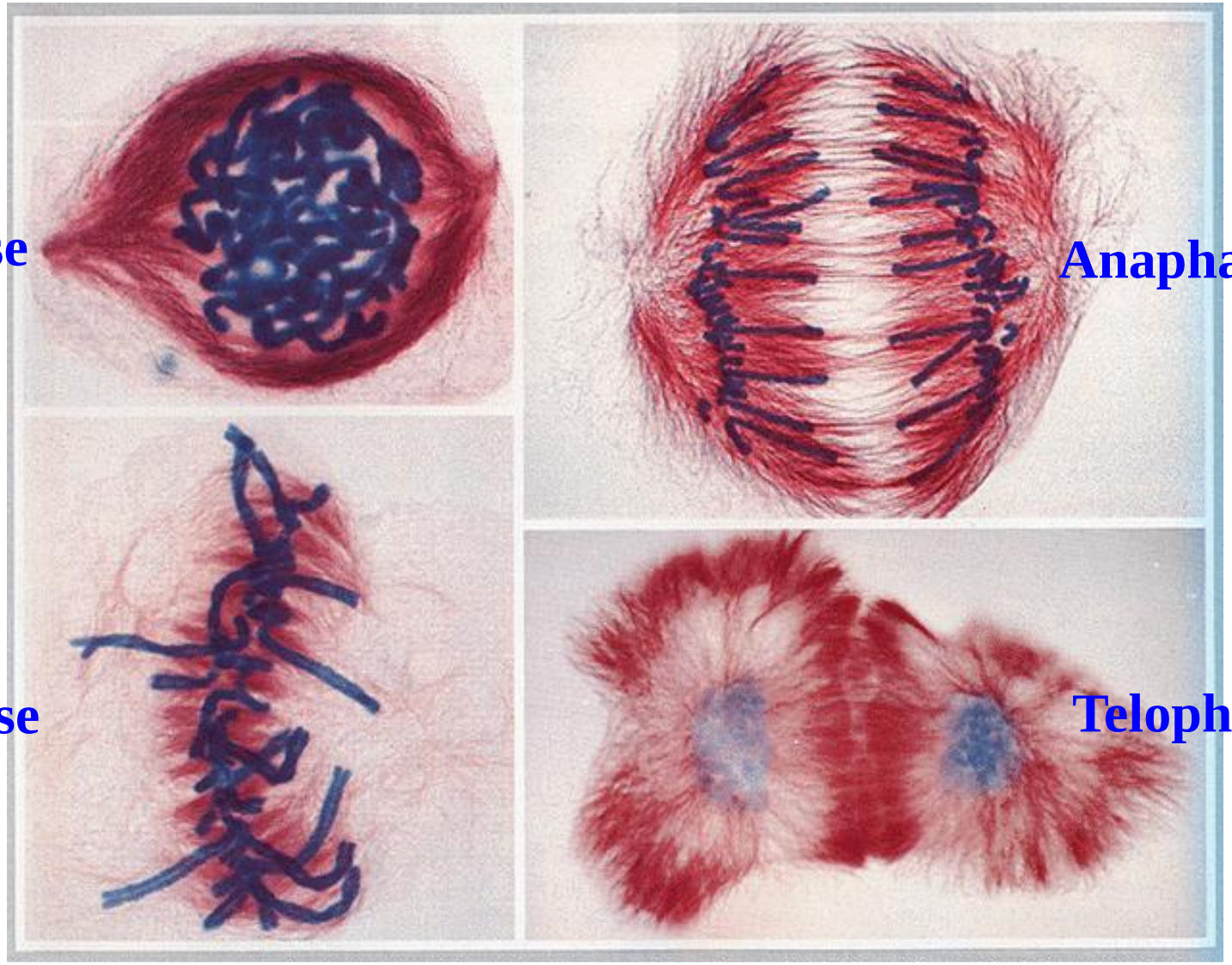
2. Metaphase

Adopted from: http://www.mrothery.co.uk

Real Pictures

Prophase

Anaphase

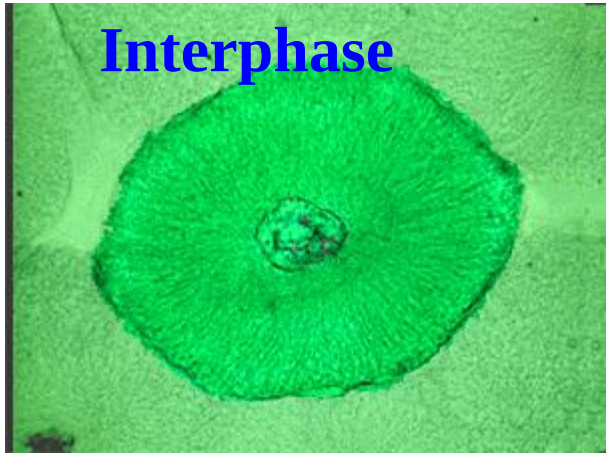


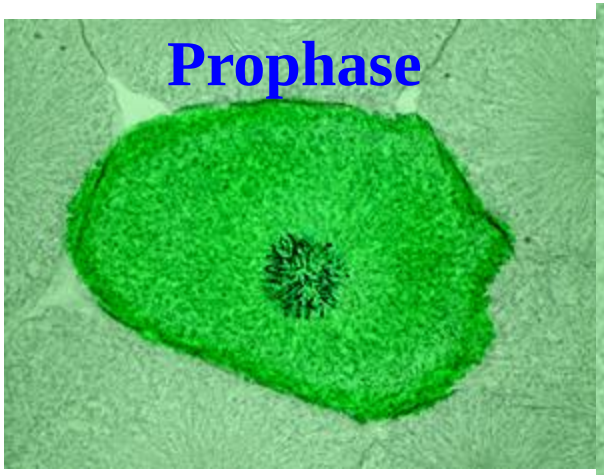
Metaphase

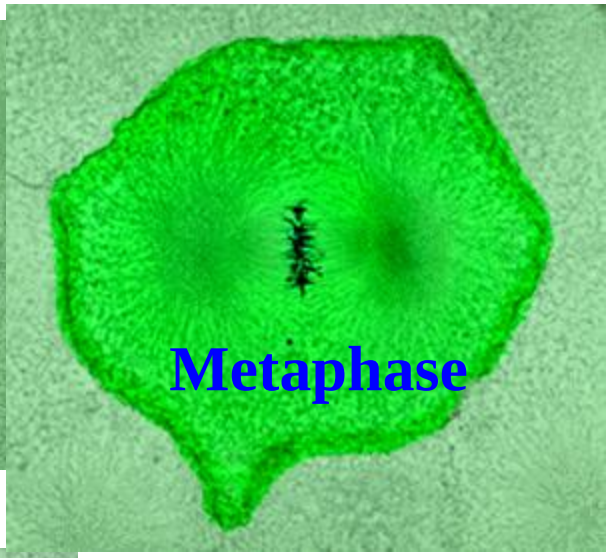
Telophase

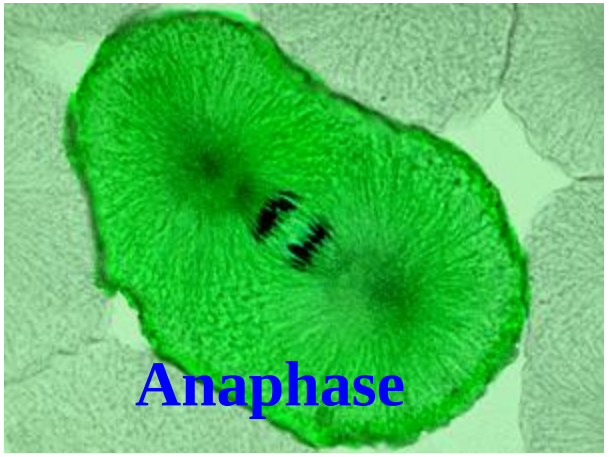
Picture adopted from: http://www.micro.utexas.edu/courses/levin/bio304/genetics/celldiv.html

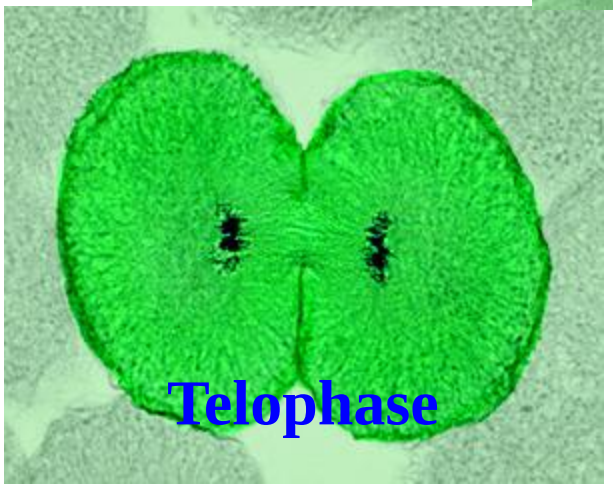
Real Pictures











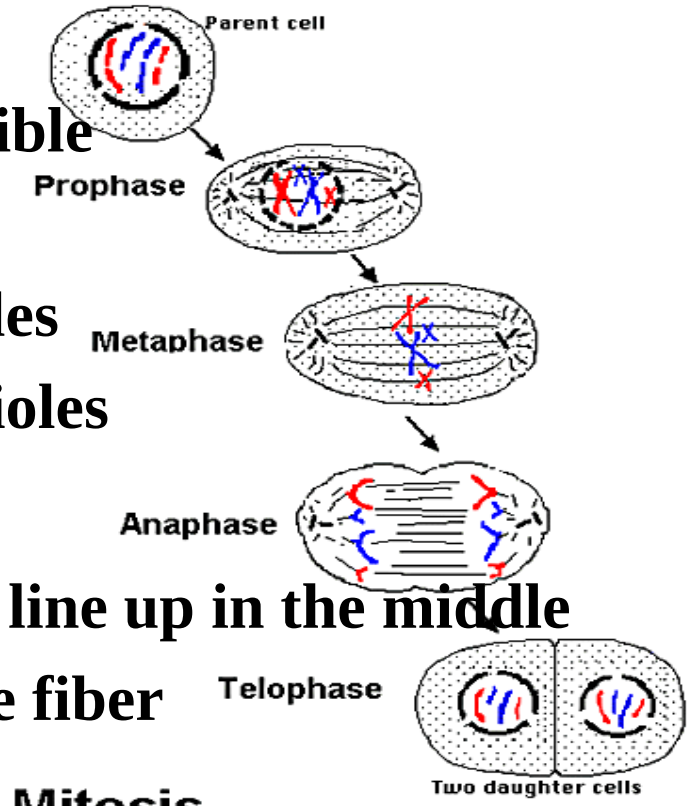
Picture adopted from: http://www.uoguelph.ca/zoology/devobio/210labs/mitosis1.html

Steps of Animal Mitosis*

- **Interphase is the phase between mitosis***
  - **All Cells Normal Activities**
  - **Chromosomes replicate just before mitosis***

Mitosis has four phases*

- **Prophase***
  - **Chromosomes become fully visible**
  - **Nuclear membrane fades**
  - **Centrioles move to opposite poles**
  - **Spindle fibers form from centrioles**
- **Metaphase ***
  - **Double stranded chromosomes line up in the middle**
  - **Centro mere attaches to spindle fiber**



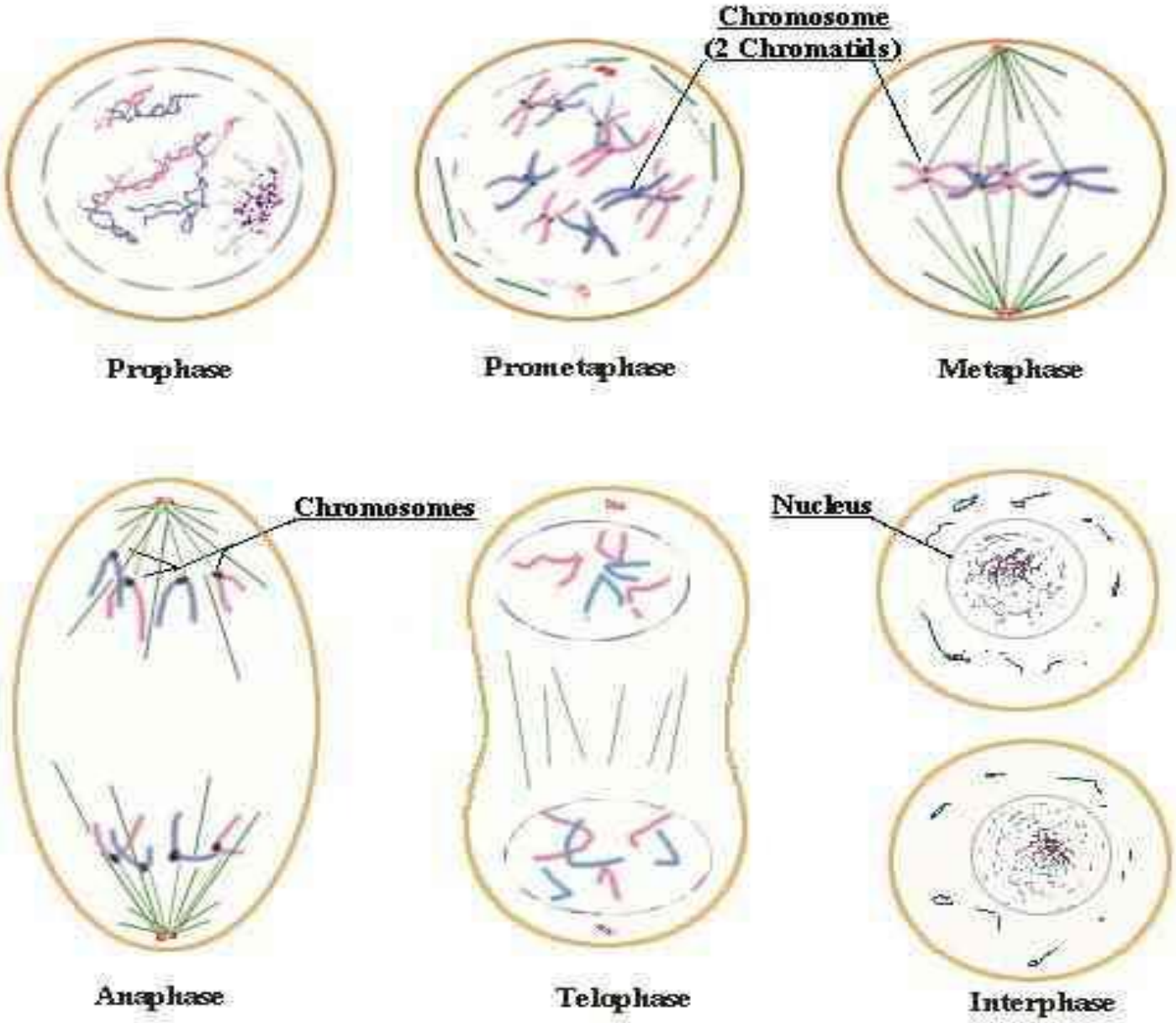
Mitosis

Last Two phases of mitosis*

- **Anaphase***
  - **Centromeres separate causing each strand of the double strand to go to opposite ends**
- ***Telophase****
  - **spindle fibers begin to disappear**
  - **chromosomes become harder to see**
  - **nuclear membrane reforms**
  - **nucleolus appears in each new nucleus**

*What is the purpose of centrioles, spindle fibers, and centromeres in mitosis?**

Mitosis



Results of mitosis *

- **Two cells identical to the original cell**
- **In human cells they start with 46 and end with 46***

Quiz

Name _____

1. Draw and label the four stages of mitosis using 4 chromosomes.
2. What is the result of mitosis?

Asexual reproduction

- **new organisms are produced from one parent**
- ***Fission***
  - **Reproducing by simple mitosis**
  - **One organism divided and becomes two**
- ***Budding***
  - **When a new organism grows from the body of another organism and then drops of and grows into another organism**
- ***Regeneration***
  - **When an organism grows new parts that have been cut or broken off**

  - Know the three types of asexual reproduction*

Sexual reproduction and Meiosis

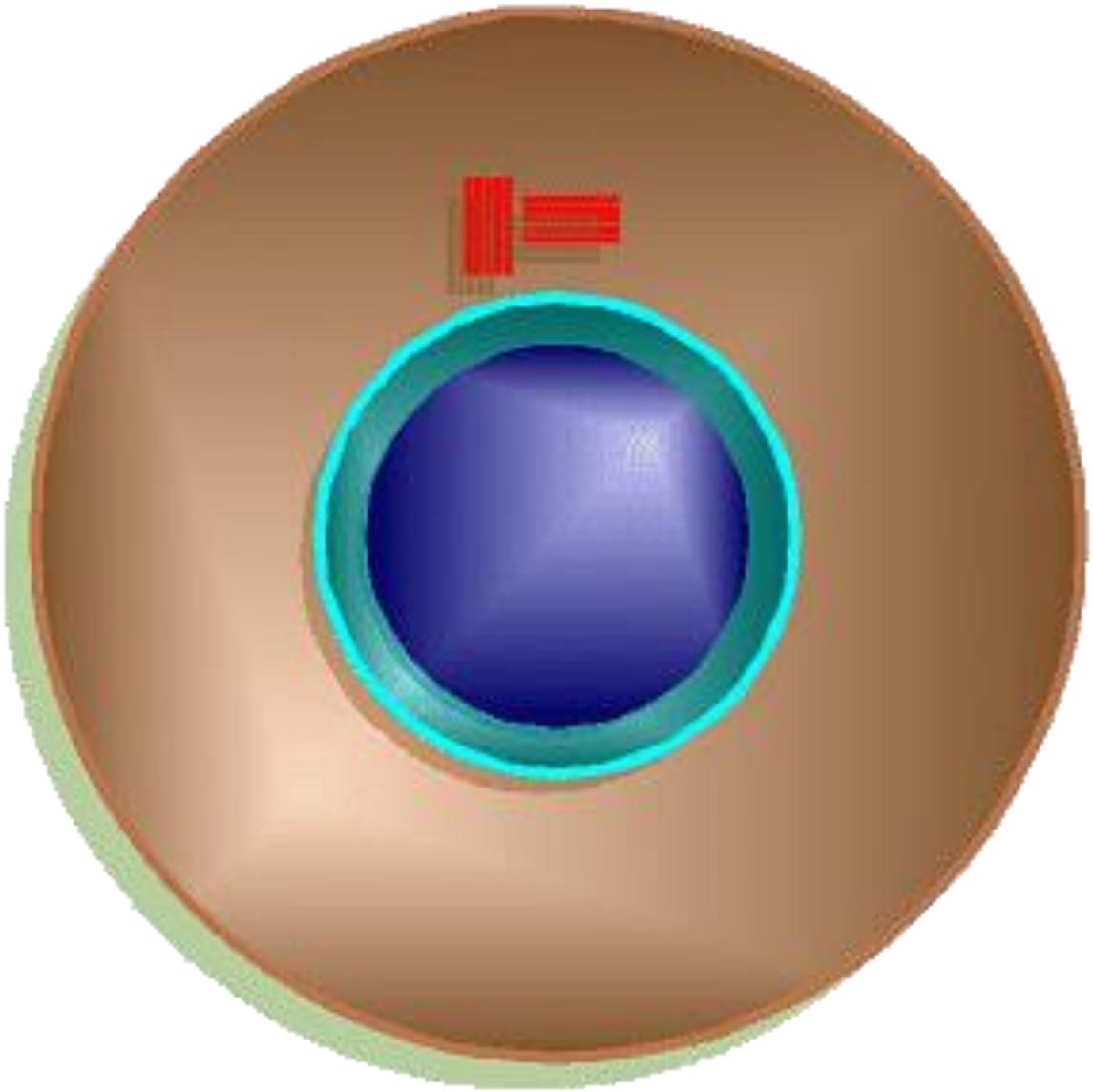
- ***Sexual reproduction****
  - **Involves the uniting of an egg and sperm**
    - **The *egg** is the female sex cell**
    - **The *sperm** is the male sex cell**
  - **Involves two separate individuals**
- **Production of sex cells**
  - **Sex cells have ½ the number of chromosomes that other cells have***
  - **In human body cells there are 46 chromosomes***
  - **In *egg* or *sperm* there is 23* chromosomes**
  - **The production of sex cells is called meiosis ***

The importance of sex cells

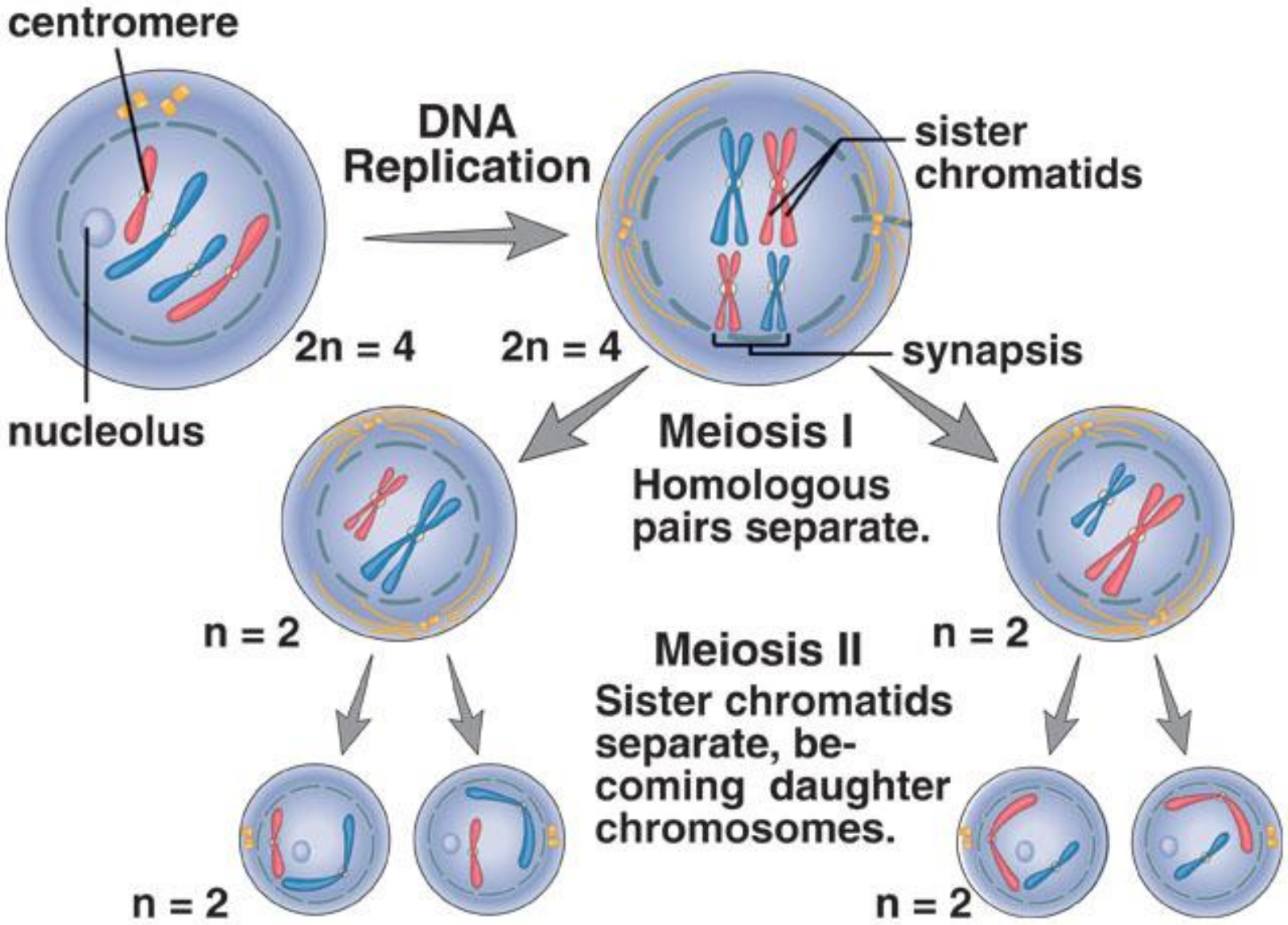
- **Half of your chromosomes came from mom and half from your dad**
- **A complete set of chromosomes is called the *diploid* *number (in humans that is 46)**
- **The number that is found in sex cells is the *haploid** number or ½ as many as there are in body cells (in humans that is 23)**
- ***Fertilization* *is the joining of the egg and the sperm.**
- **The cell that forms in fertilization is called a *zygote**.**

Meiosis

- **is the process of getting from the diploid number of chromosome to the haploid number (how sex cells are formed)**

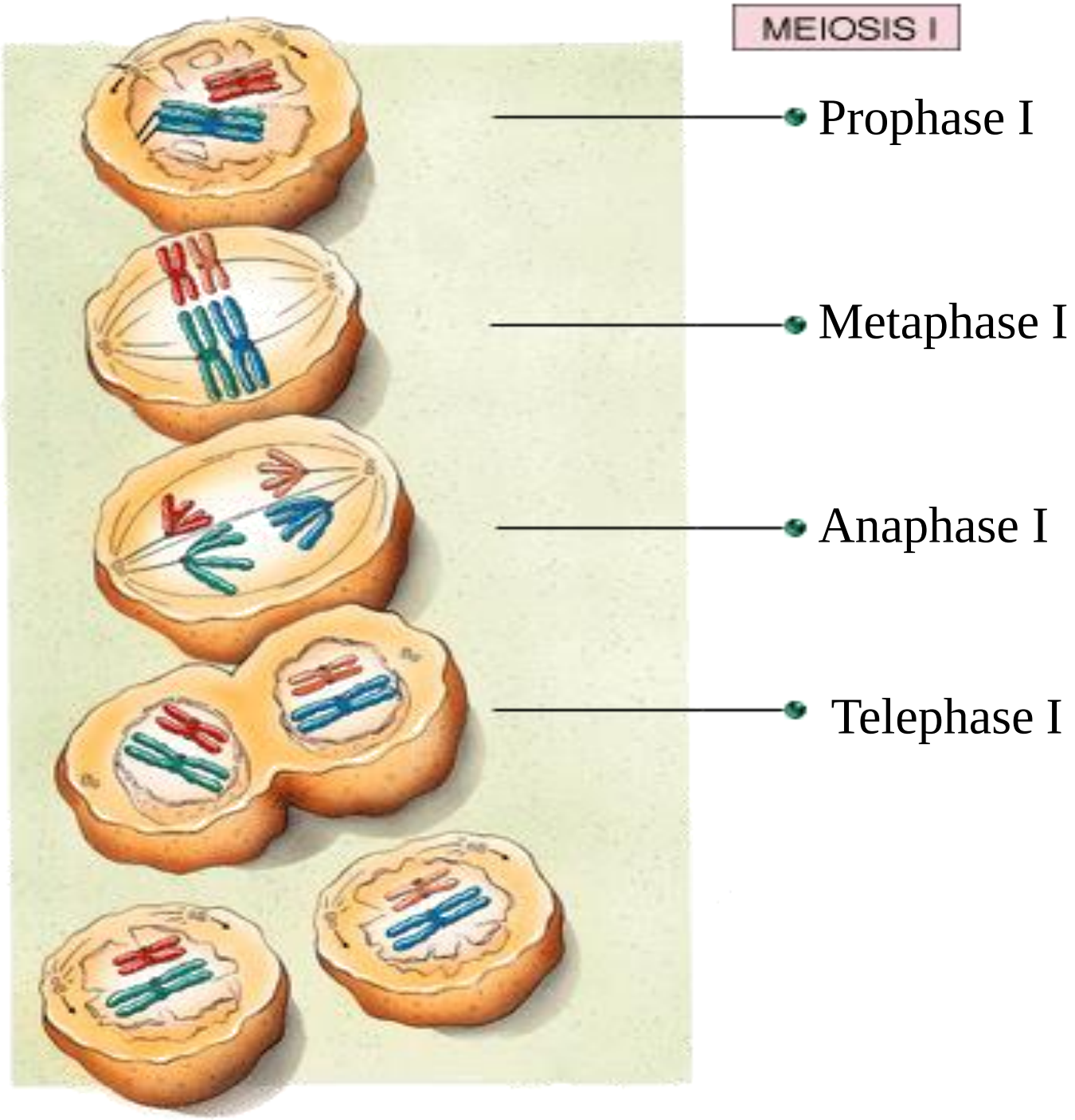


Meiosis Overview

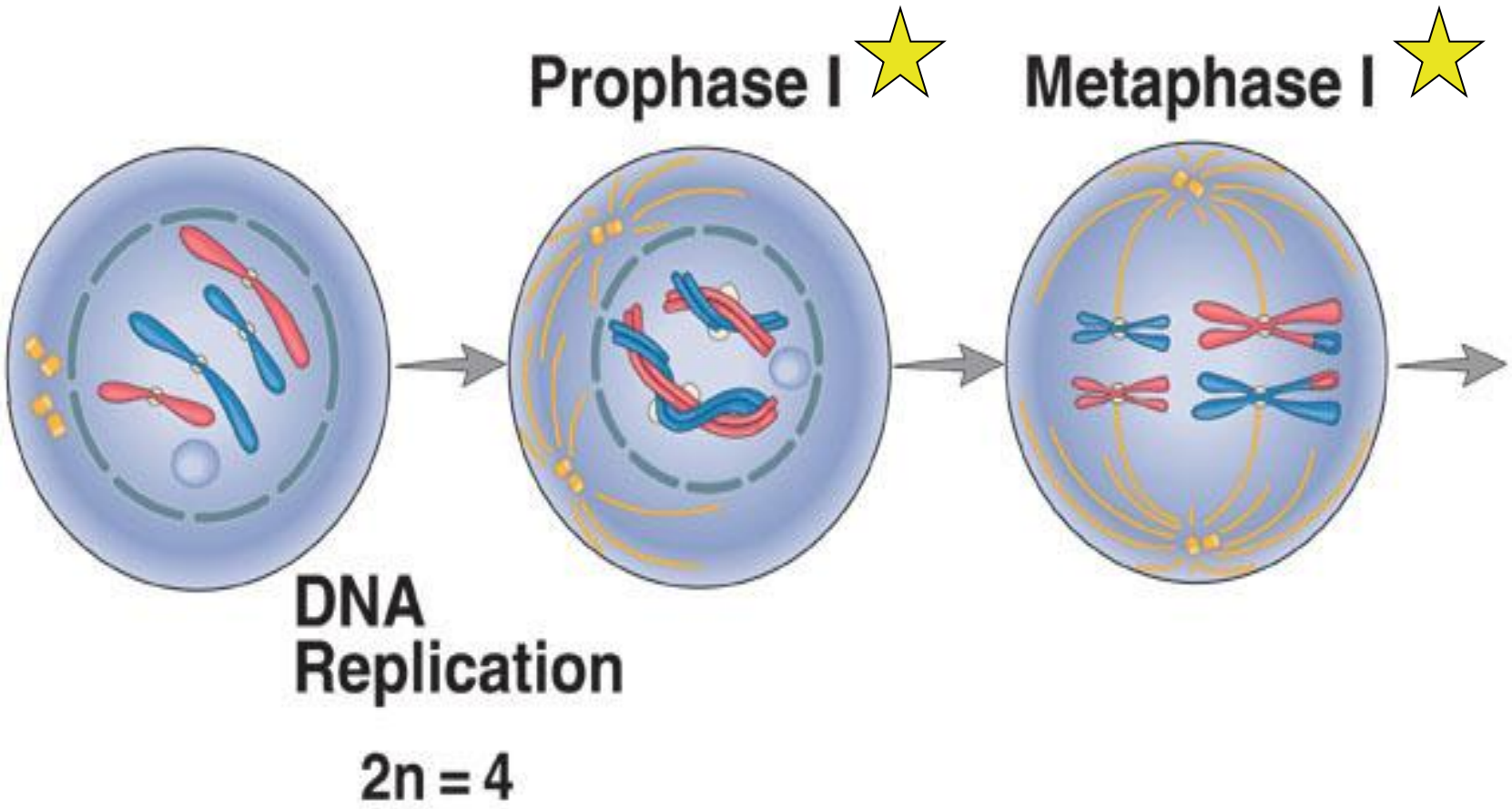


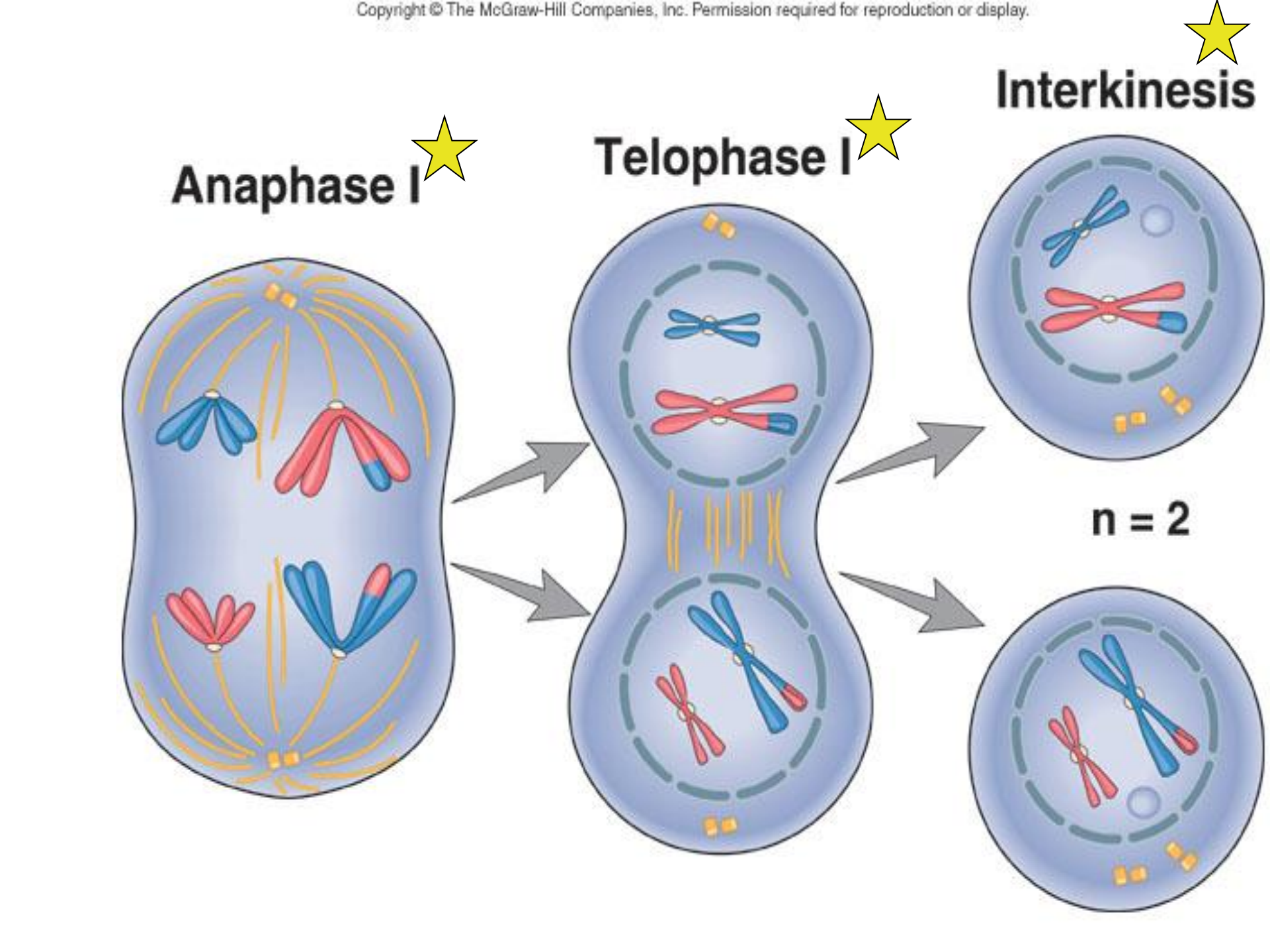
Meiosis I

- ***Prophase*** **I double stranded chromosomes and spindle fibers appear**
  - **chromosomes come together in matching pairs (find their mate)**
- ***metaphase*** **I**
  - **paired chromosomes line up in the center and attach to spindle fibers**
  - **The *centromere* of each double stranded chromosome is attached to the spindle fiber**
- **Anaphase I**
  - **Each double stranded chromosomes separates**
- ***Telephase*** **I**
  - **Cytoplasm divides to form two cells**
  - **Each cell has a haploid number of double stranded chromosomes**


MEIOSIS I
Prophase I
Metaphase I
Anaphase I
Telephase I

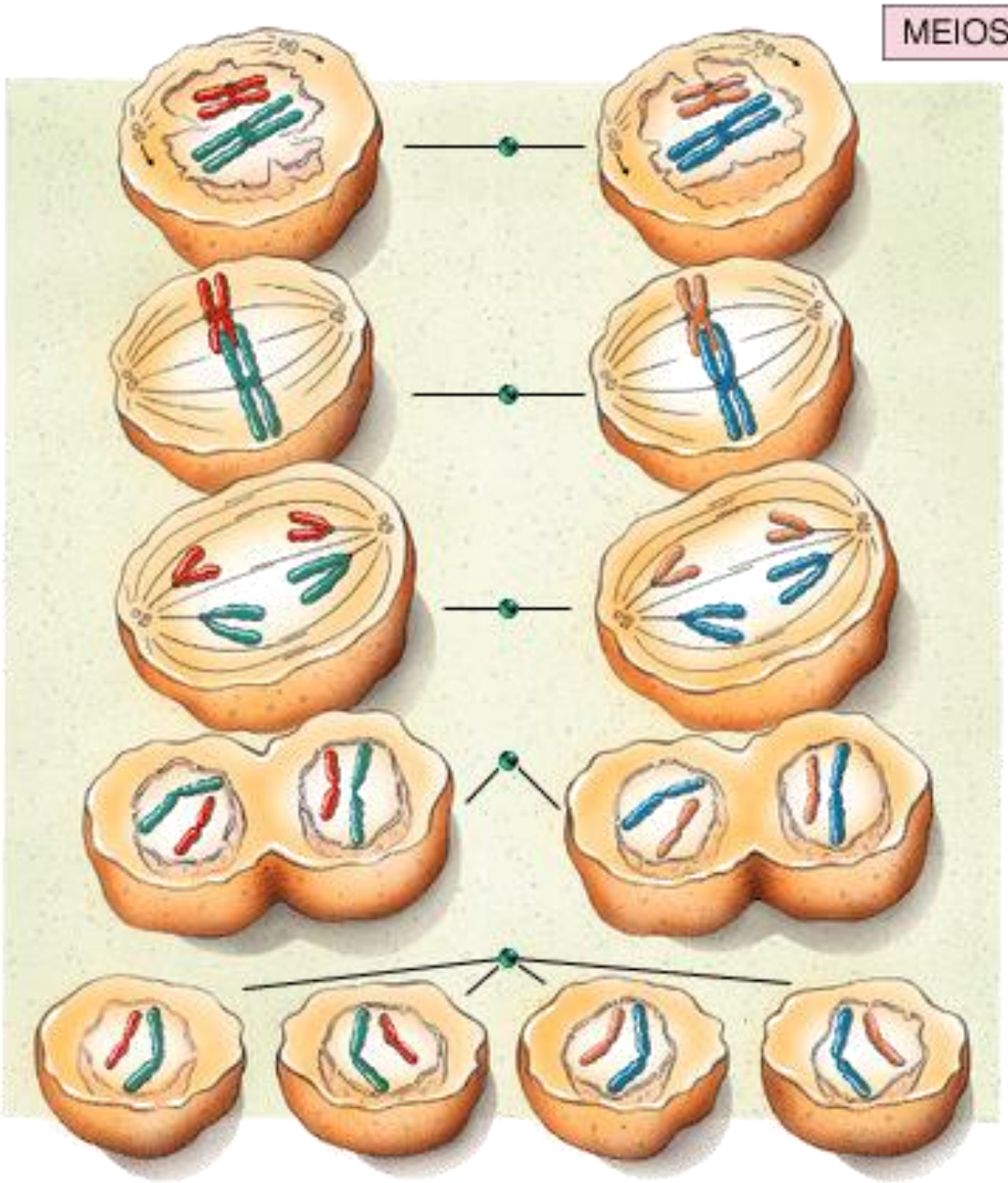
Meiosis I



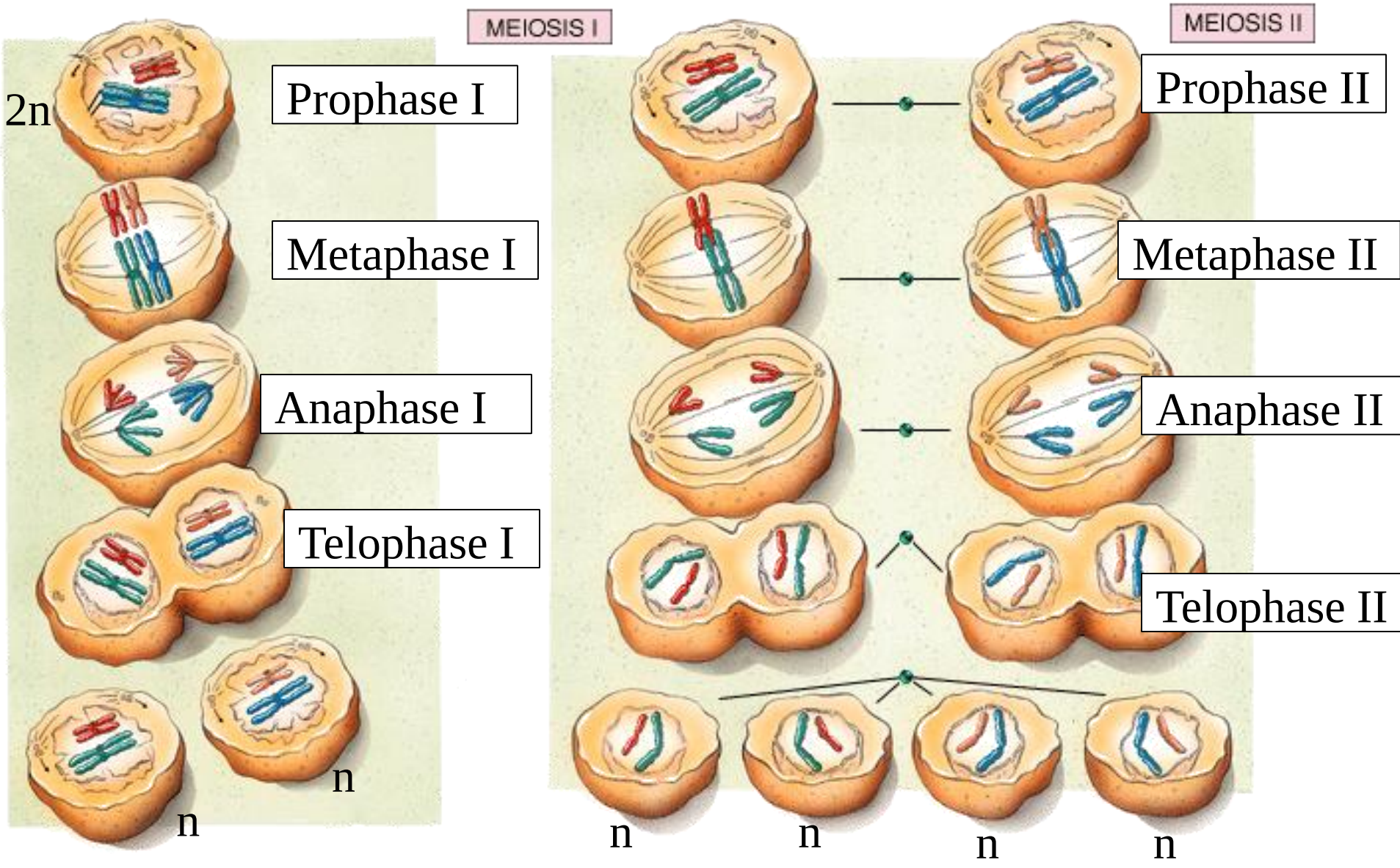


Meiosis II

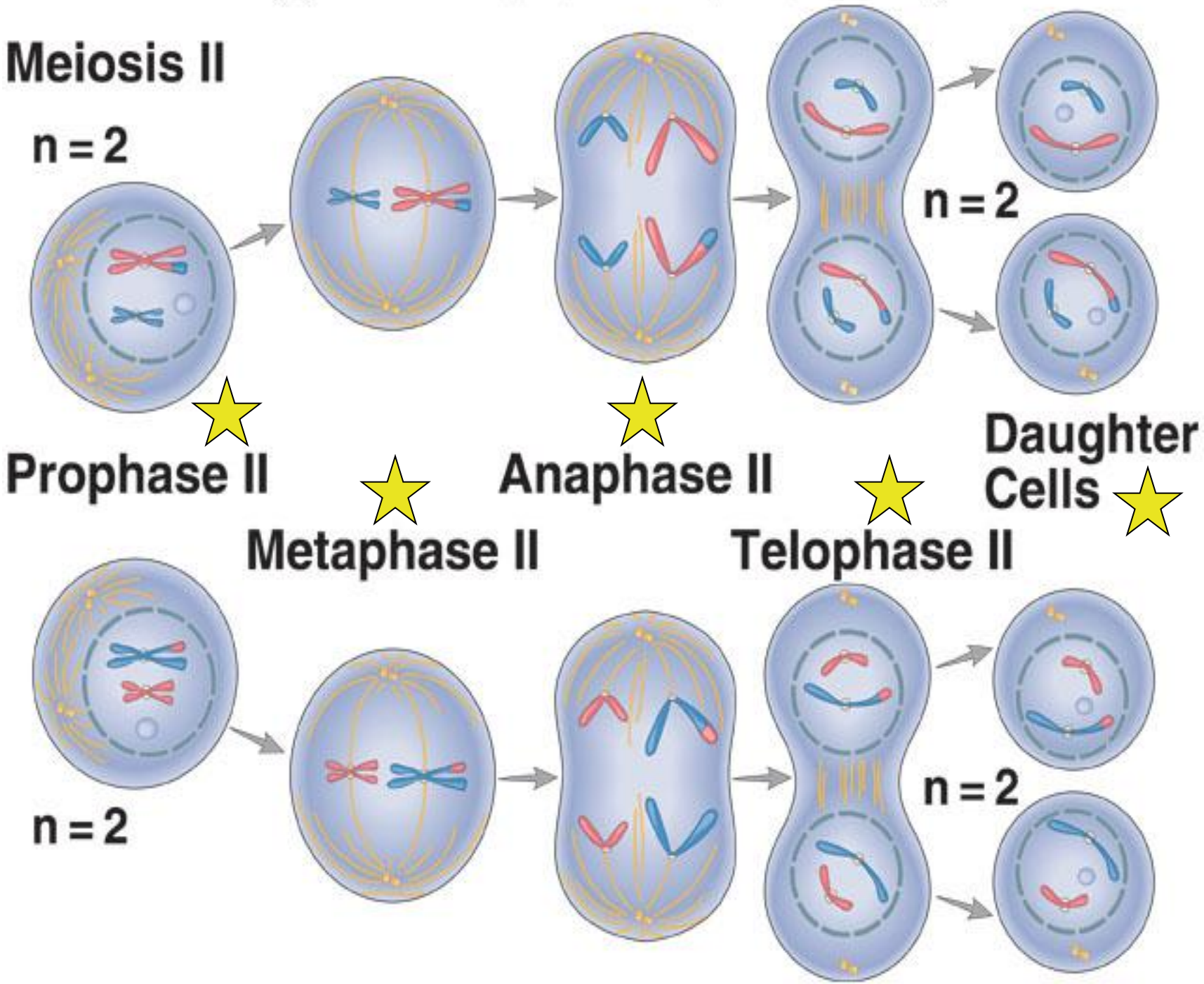
- **second division of meiosis**
- ***prophase* II**
  - **Double stranded chromosome and spindle fibers present**
- ***metaphase* II**
  - **Double stranded chromosomes line up in the middle of the cell**
- ***anaphase II***
  - ***Centromere* divides and a single stranded chromosome moves to each end of the cell**
- ***telephase* II**
  - **chromosomes disappear**
  - **nuclear membrane**


MEIOSIS II
Prophase II
Metaphase II
Anaphase II
Telephase II

Meiosis

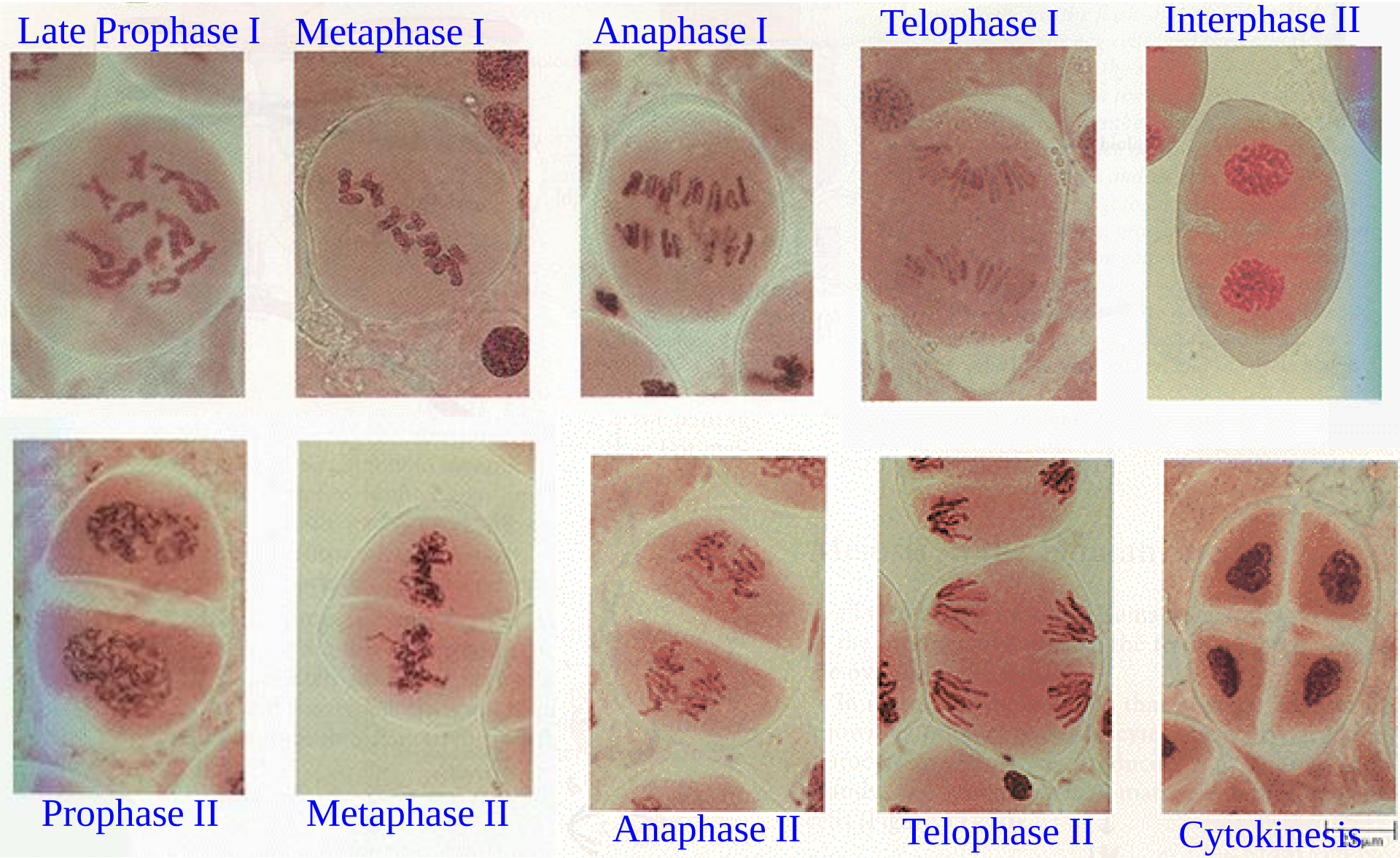


Picture adopted from: http://onlinetc.its.brooklyn.cuny.edu/Core81/chap7.html



Pictures adopted from:

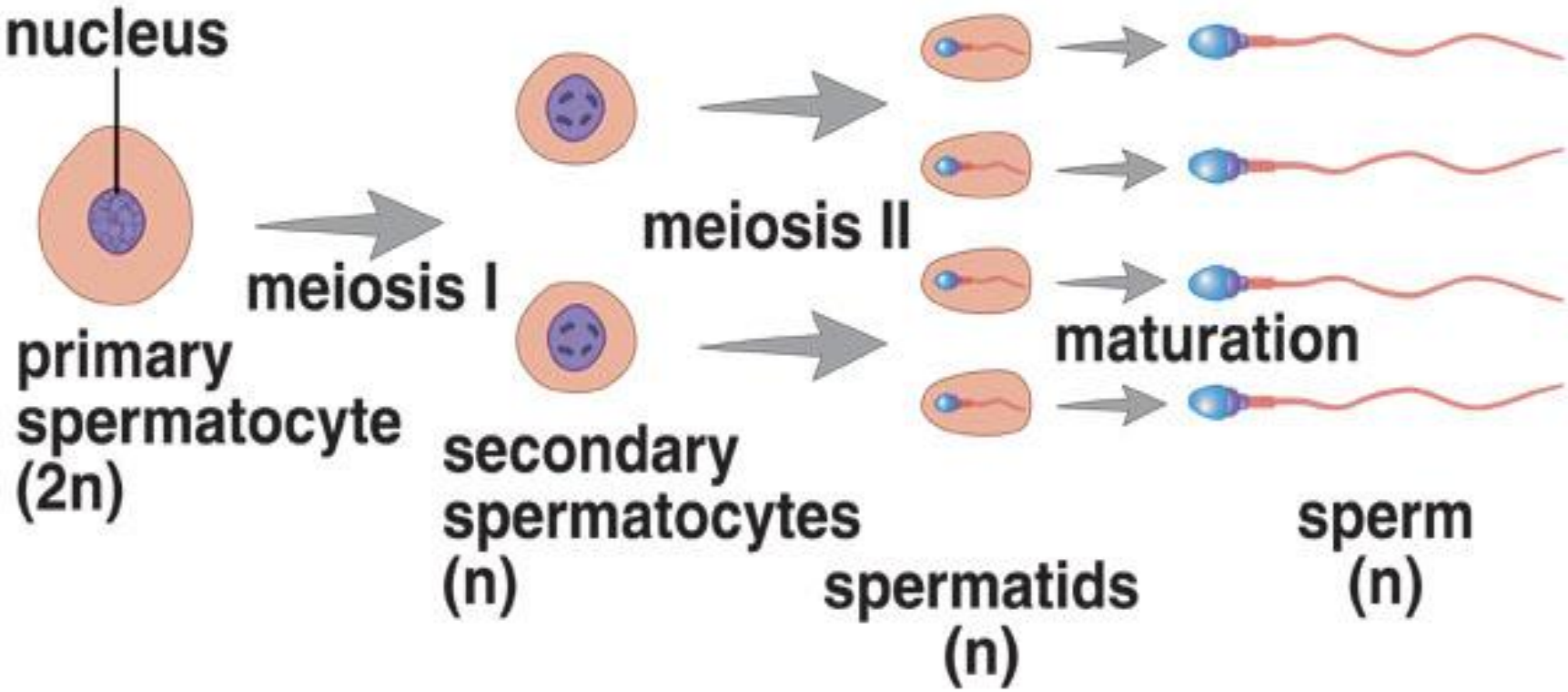
http://www.micro.utexas.edu/courses/levin/bio304/genetics/celldiv.html



Results of Meiosis

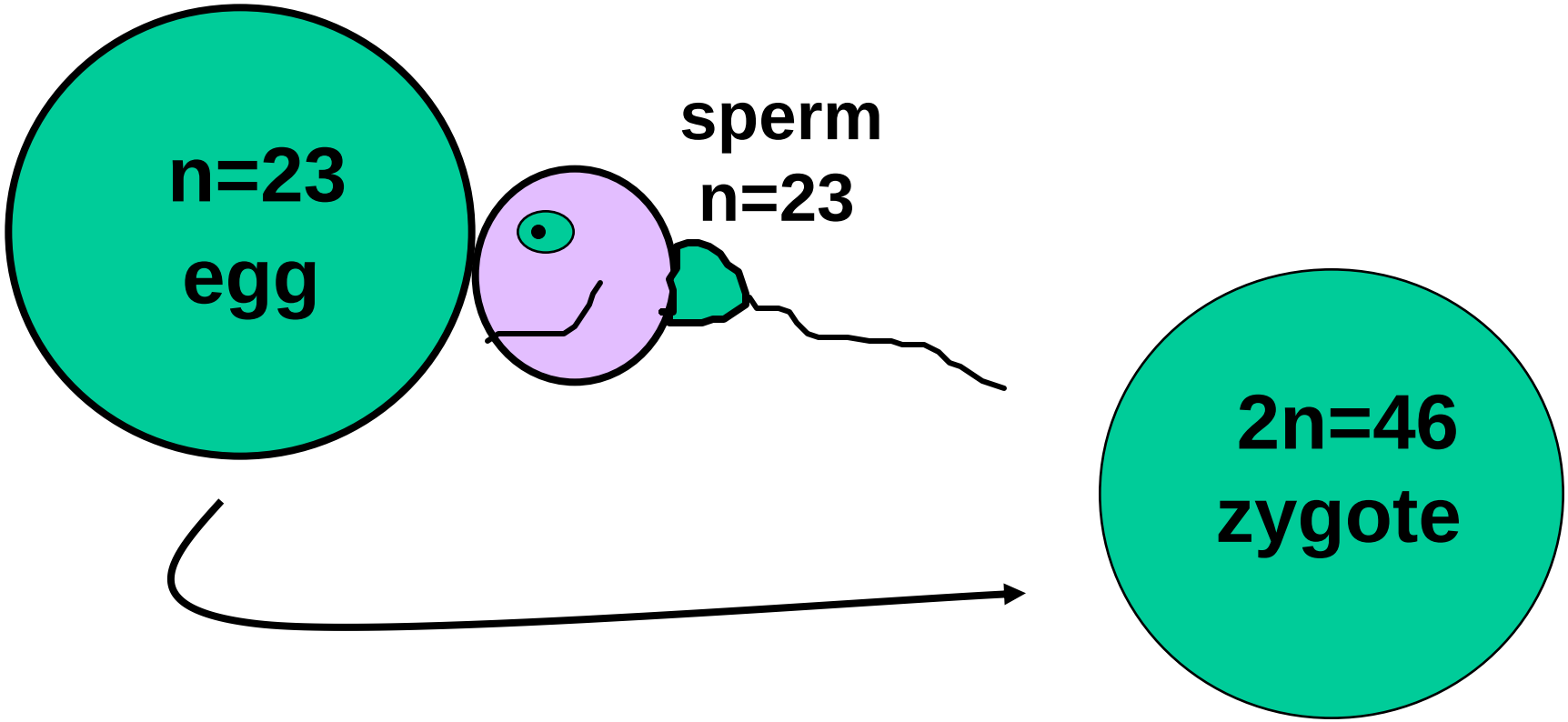
- **The result of meiosis is four sex cells with one half the number of chromosomes as the original cell**

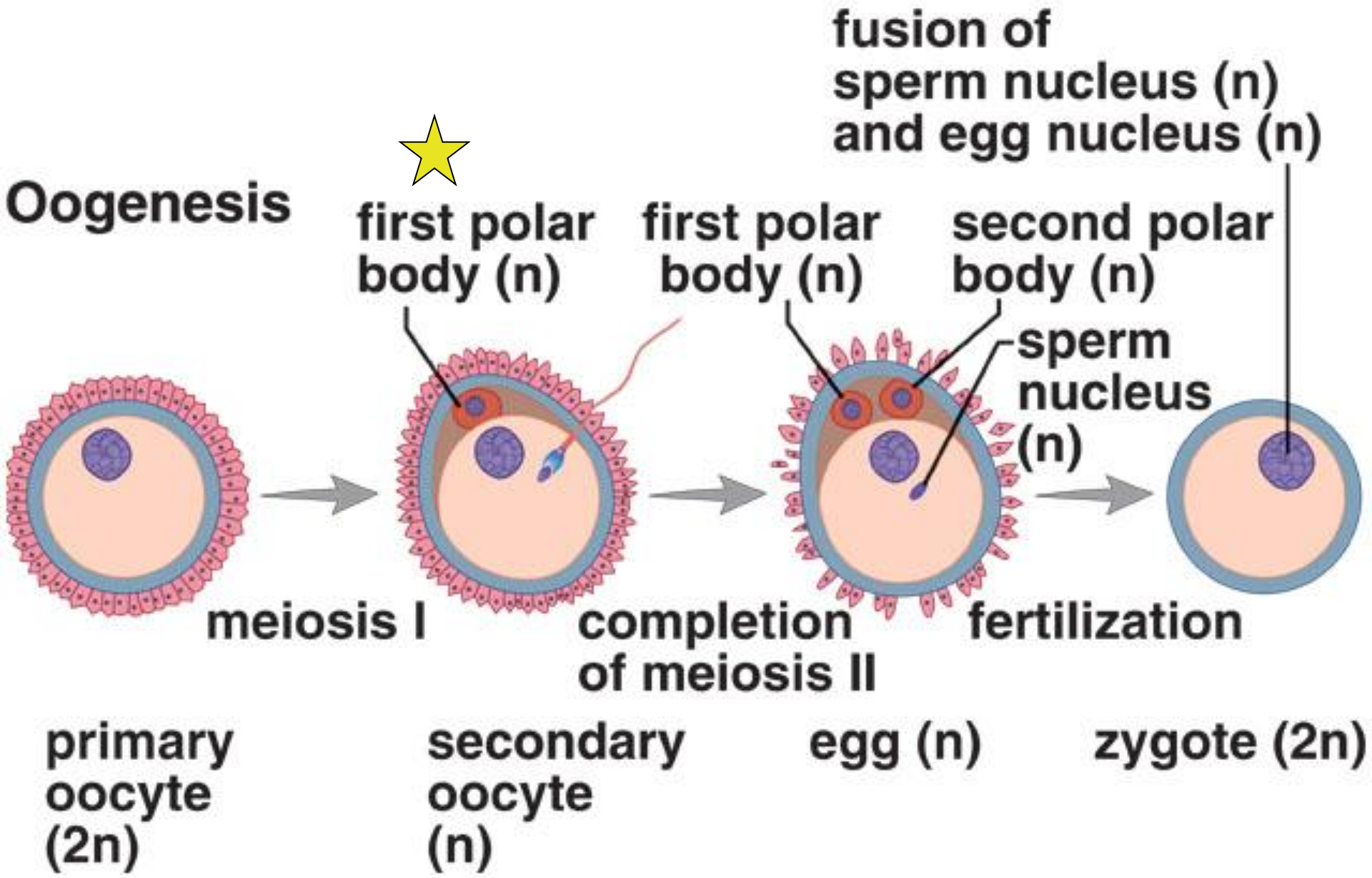
Spermatogenesis



Fertilization

- The fusion of a **sperm** and **egg** to form a **zygote**.
- A zygote is a fertilized egg





Quiz

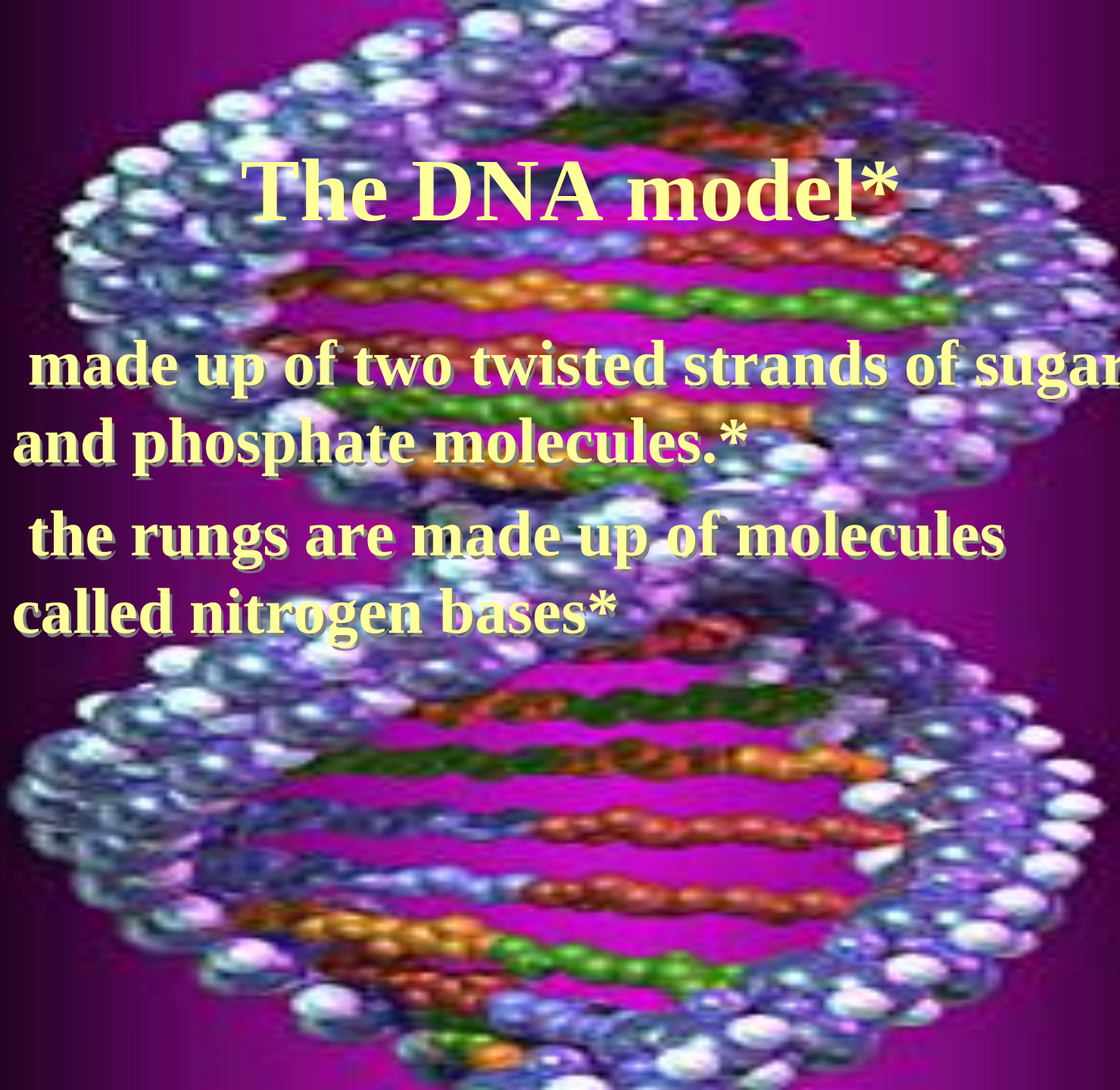
1. Draw and label the stages of meiosis I & meiosis II using 4 chromosomes.

DNA (Deoxyribonucleic acid)*

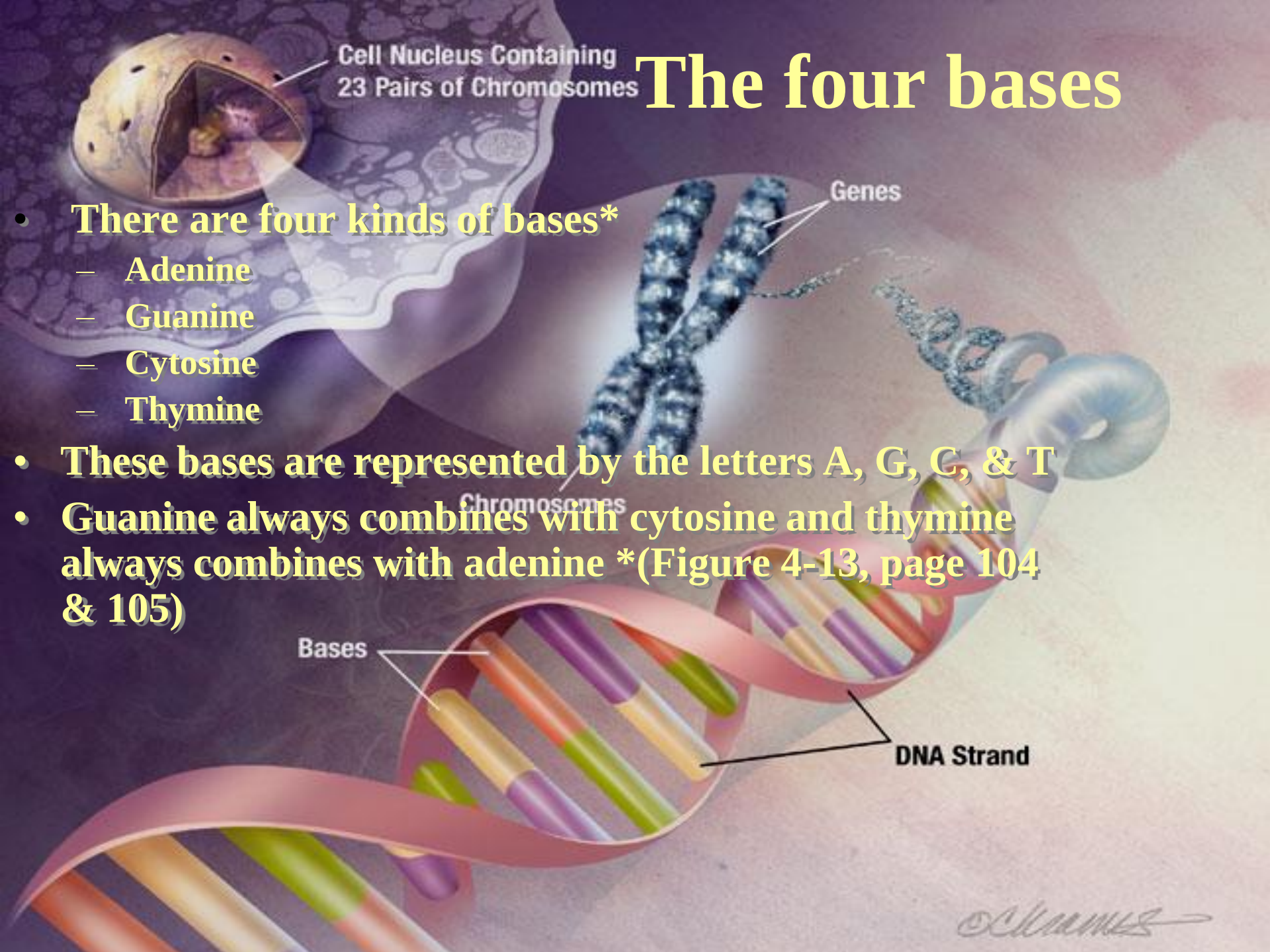
- history
  - Rosalind Franklin discovered that DNA was a strand of molecules in a two spiral form
  - James Watson and Francis Crick* made a model of the DNA molecule in 1953

The DNA model*

- made up of two twisted strands of sugar and phosphate molecules.*
- the rungs are made up of molecules called nitrogen bases*



The four bases

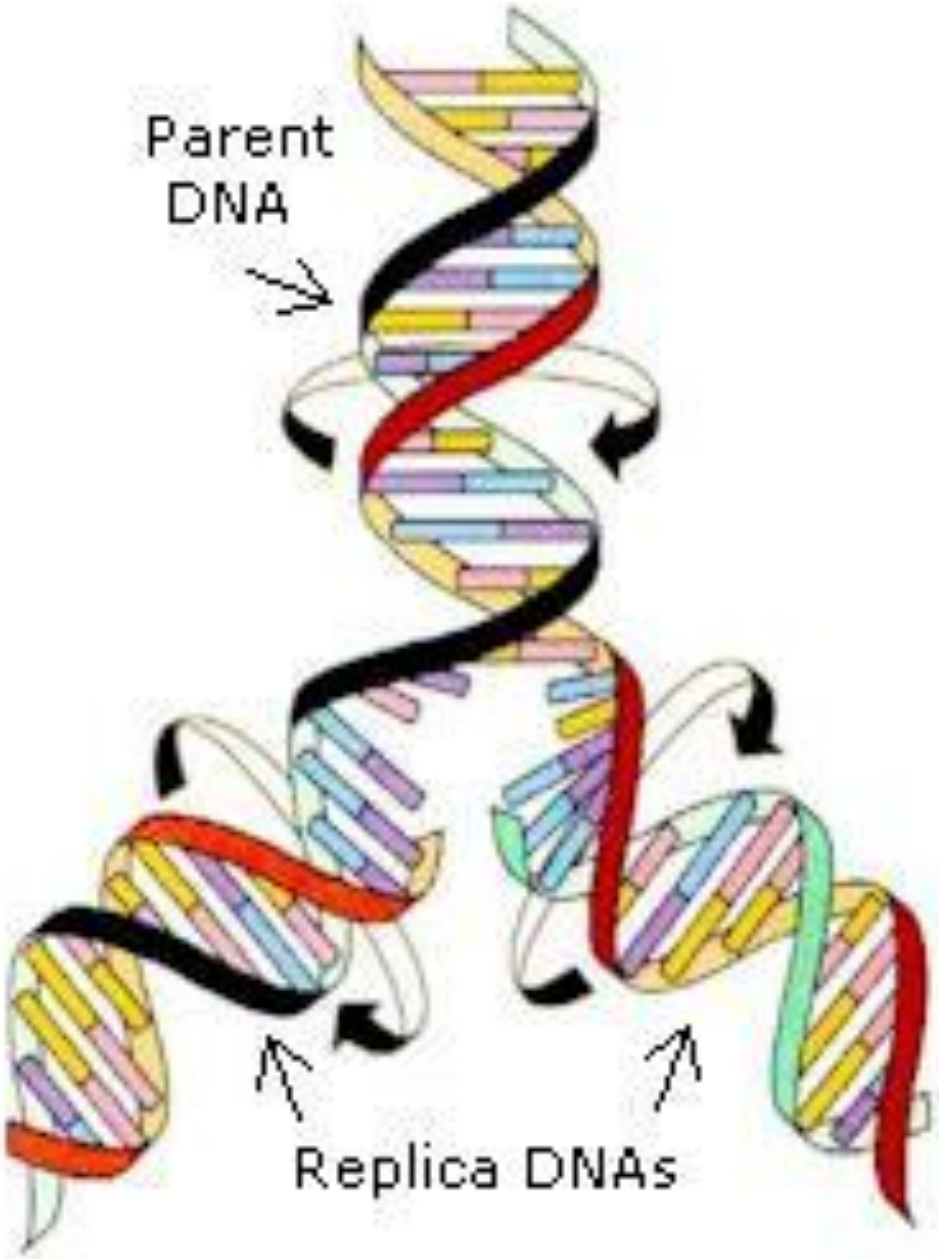


- There are four kinds of bases*
  - Adenine
  - Guanine
  - Cytosine
  - Thymine
- These bases are represented by the letters A, G, C, & T
- Guanine always combines with cytosine and thymine always combines with adenine *(Figure 4-13, page 104 & 105)

How DNA Copies Itself*

- **DNA replicates just before mitosis**
- **DNA molecule unwinds**
- **An enzyme breaks apart the nitrogen bases, causing the DNA to unzip and expose the bases**
- **The bases attached to each strand pair up with new bases found in the nucleus**
- **Sugar and phosphate groups form the side of the new DNA strand.**
- **Each new DNA strand has the exact information and is exactly like the original DNA strand.**

Explain how DNA is copied.


Parent
DNA
Replica DNAs

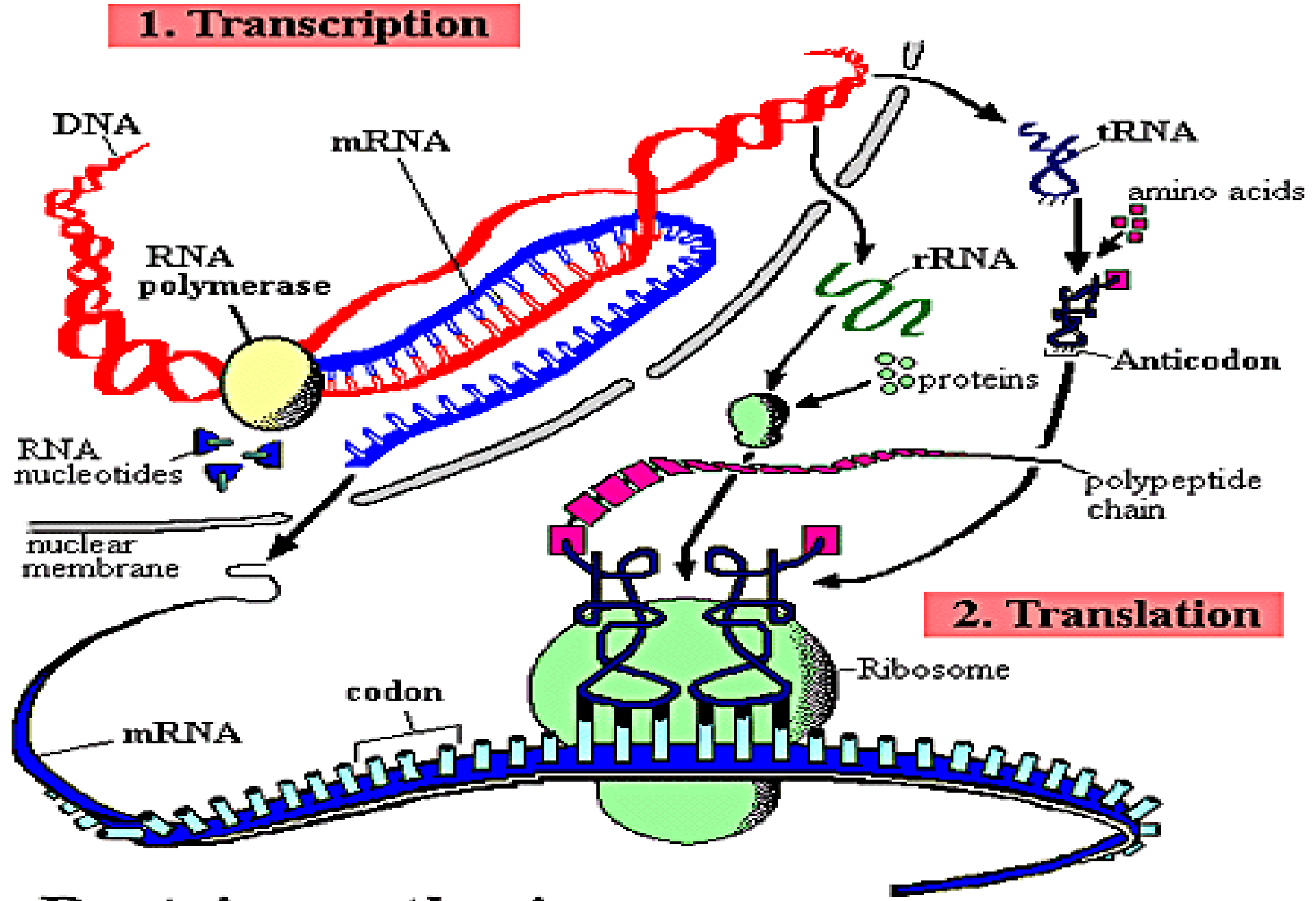
DNA Replication

Genes*

- **is a certain part on the DNA that tells how to make a certain protein**
- **We are made up of different types of proteins, so DNA directs the way we are made up**

Genes to Proteins

- **Proteins are made up of amino acids and DNA tells the order of amino acids.***
- **RNA is involved in the making or proteins.**
- **RNA is different from DNA in three ways**
  - RNA is Ribonucleic acid
  - RNA is a single strand
  - RNA has uracil instead of thymine
- **RNA is a transfer agent of the information on the DNA to making the protein.**
- **Two types of RNA**
  - **Messenger RNA gets its message from the DNA and moves out of the nucleus to the ribosomes**
- **Transfer RNA**



Protein synthesis

Protein Synthesis Animation

Explain how proteins are made.

- DNA unzips
- Messenger RNA is made
- mRNA goes to the ribosome
- At the ribosome transfer RNA brings amino acids to be put together in the right order to form a protein.