SI Biology - Full Discipline Demo

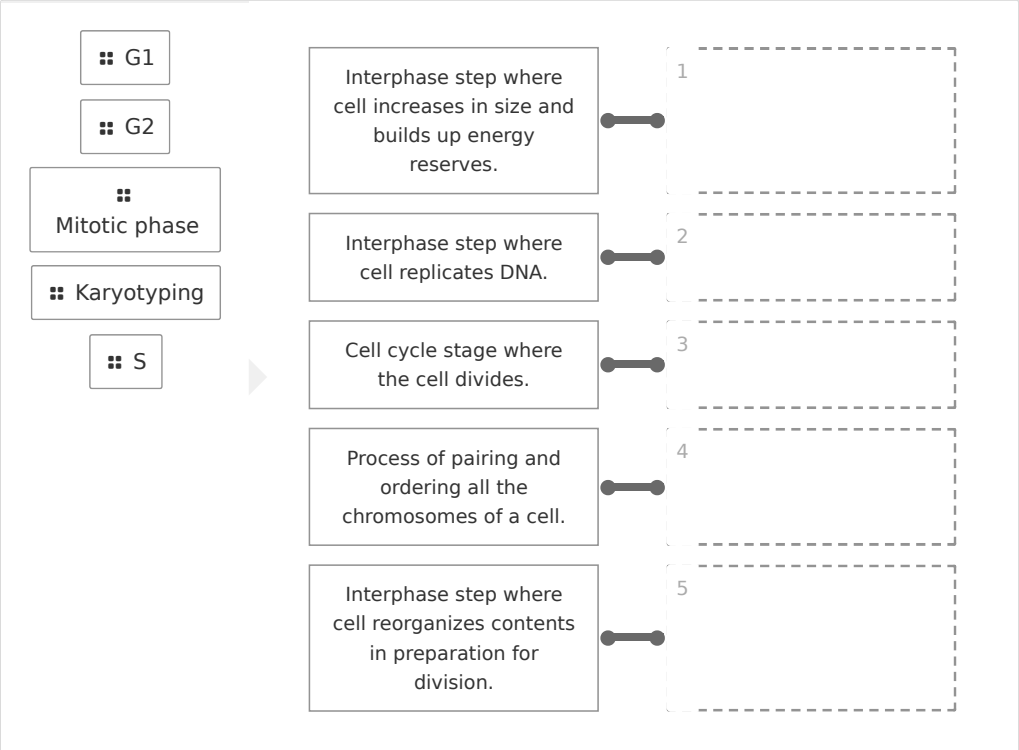
Mitosis and Meiosis

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Biology - Full Discipline Demo
Course	SI Biology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

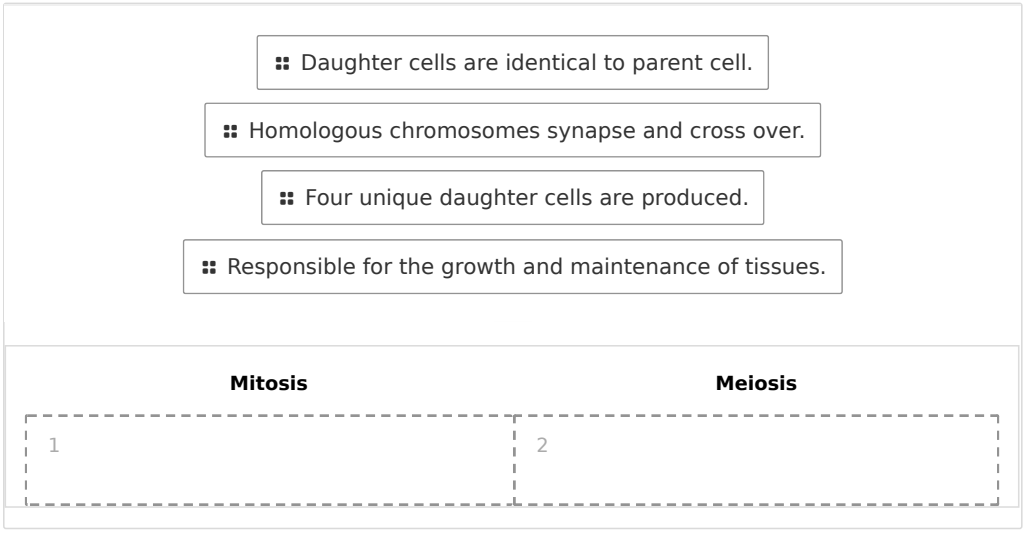
Match each term with the best description.



Correct answers:

1 G1 2 S 3 Mitotic phase 4 Karyotyping 5 G2

Categorize each statement as referring to mitosis or meiosis.



Correct answers:

1 Daughter cells are identical to parent cell.

Responsible for the growth and maintenance of tissues.

2 Homologous chromosomes synapse and cross over.

Four unique daughter cells are produced.

Exploration

Cell division occurs during the _____ phase of the cell cycle.

- G1
- G2
- S
- Mitotic ✔

During _____ of mitosis, chromosomes align at the cell's equator.

- anaphase
- prophase
- metaphase ✔
- telophase

Crossing over occurs during _____ of meiosis.

- anaphase II
- metaphase I
- prophase I ✔
- prophase II

Meiosis results in four identical daughter cells.

- True
- False ✔

Karyotyping is used to detect abnormalities in either chromosome numbers or structure, which can be indicators of genetic disease.

- True ✔
- False

Exercise 1

How do prophase, prophase I, and prophase II differ from each other? Reference Photos 1, 7, and 11 in your explanation.

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How do mitosis and meiosis differ in the daughter cells that are produced? Reference Photos 6 and 14 in your explanation.

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Photo 1: Prophase Model
(SAMPLE ANSWER BELOW)

Data Table 1: Mitosis Description
(SAMPLE ANSWER BELOW)

Mitosis Step	Description of Step
Prophase	The chromosomes condense and become more tightly coiled, forming two sister chromatids bound together at the centromere. Mitotic spindle fibers begin appearing from the centrosomes and the nucleolus disappears.
Prometaphase	The nuclear envelope fragments and the microtubules surrounding the spindle enter the nuclear area and attach to the condensed chromosomes, moving them toward the cell's equator.
Metaphase	The chromosomes align at the metaphase plate (the cell's equator) and the two kinetochores of each chromosome are attached to microtubules from opposite spindle poles.
Anaphase	The sister chromatids separate from each other and are pulled towards opposite ends of the cell.
Telophase	Nuclear envelopes are formed around each of the newly separated sets of chromosomes.
Cytokinesis	Divides the cytoplasm to produce two new cells. In animal cells, a cleavage furrow is formed, pinching the cell in two. In plant cells, the cells are divided through the formation of a cell plate.

Photo 2: Prometaphase Model
(SAMPLE ANSWER BELOW)

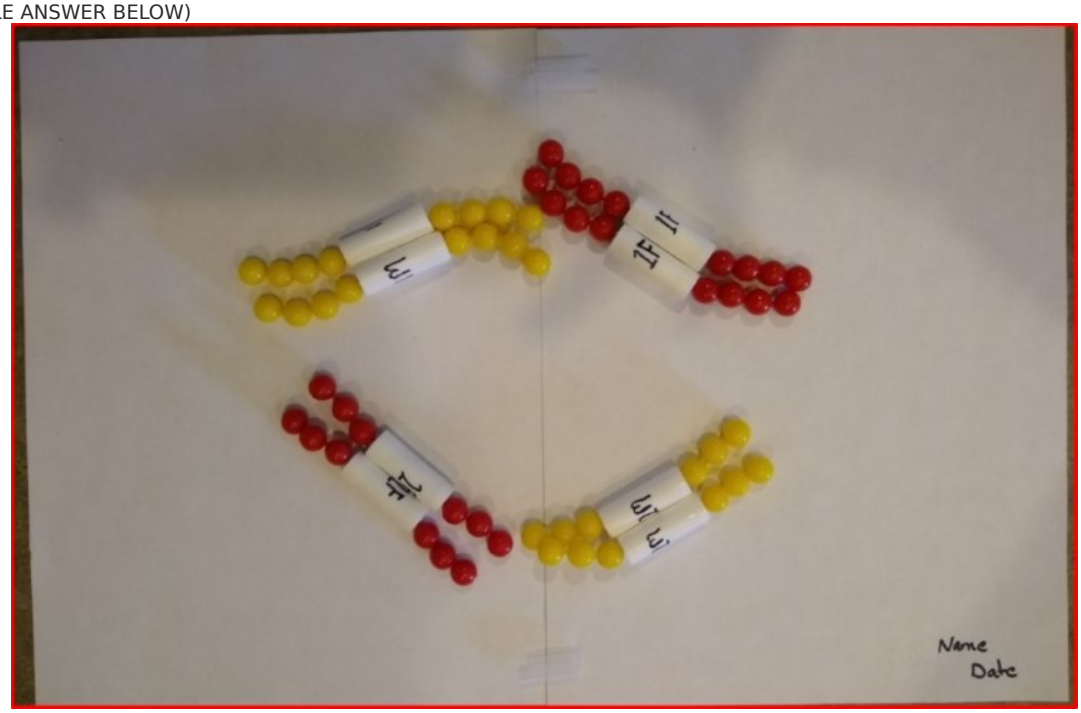


Photo 3: Metaphase Model

(SAMPLE ANSWER BELOW)

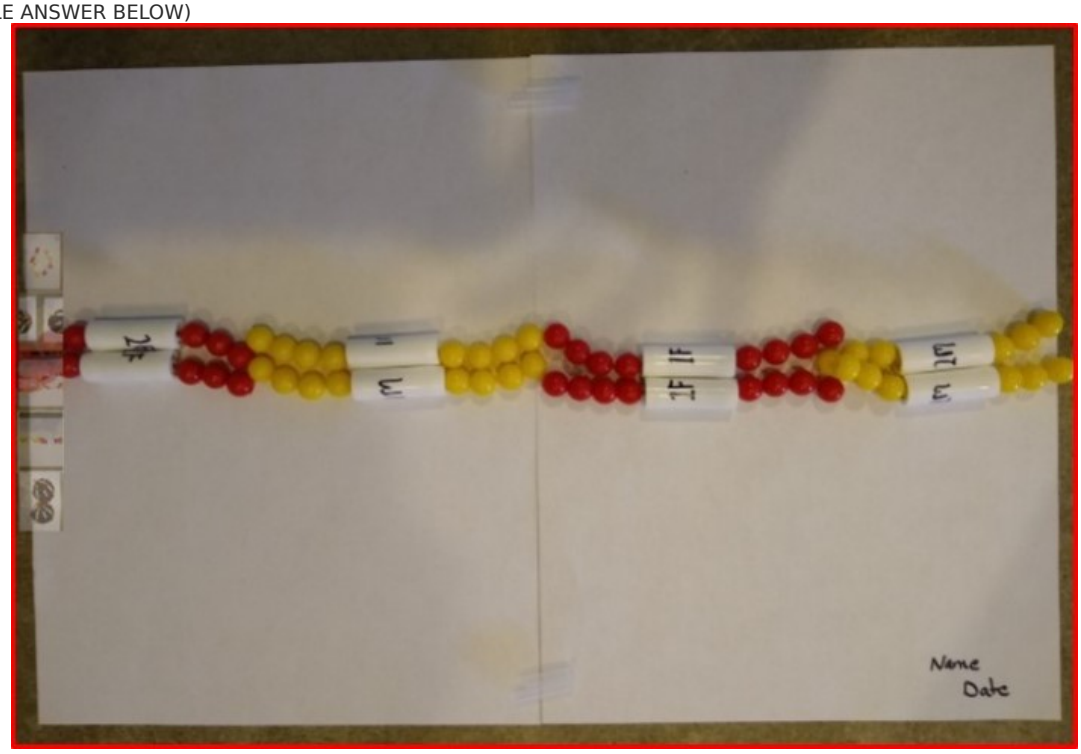


Photo 4: Anaphase Model
(SAMPLE ANSWER BELOW)

Photo 5: Telophase Model
(SAMPLE ANSWER BELOW)

Photo 6: Cytokinesis Model

(SAMPLE ANSWER BELOW)

Photo 7: Prophase I Model
(SAMPLE ANSWER BELOW)

Data Table 2: Meiosis Stage Descriptions
(SAMPLE ANSWER BELOW)

Meiosis Phase	Description of Step
Prophase I	Homologous chromosomes condense and pair, becoming closely entwined around one another in a process called synapsis. The chromosomes then cross over one another, exchanging genetic information. The other processes of prophase I mirror those of prophase in mitosis with the centrioles migrating, the nucleoli disappearing, and the breakdown of the nuclear envelope.
Metaphase I	The pairs of homologous chromosomes align along the metaphase plate. The chromatids in each chromosome attach to the microtubules, directing the chromosomes from each pair toward opposite poles
Anaphase I	The homologous chromosomes separate and each moves toward an opposite pole, with the centromere leading the way. The sister chromatids remain attached to each other during this process, unlike anaphase of mitosis.
Telophase/ Cytokinesis I	The chromosomes arrive at opposite poles in the cell and the cell divides, forming two daughter cells, each with half the number of chromosomes as the parent cell.
Prophase II	A new spindle apparatus is formed in each cell, chromosomes condense, and the nuclear envelope breaks down.
Metaphase II	The chromosomes (non-identical, sister chromatids) are positioned along the metaphase plate. The microtubules attach to each of the chromatids.
Anaphase II	The sister chromatids separate from one another as the centromeres separate and move to opposite poles of the cell.
Telophase/ Cytokinesis II	The nuclei form and the cells divide, resulting in four daughter cells, each containing half the DNA of the parent cell.

Photo 8: Metaphase I Model
(SAMPLE ANSWER BELOW)

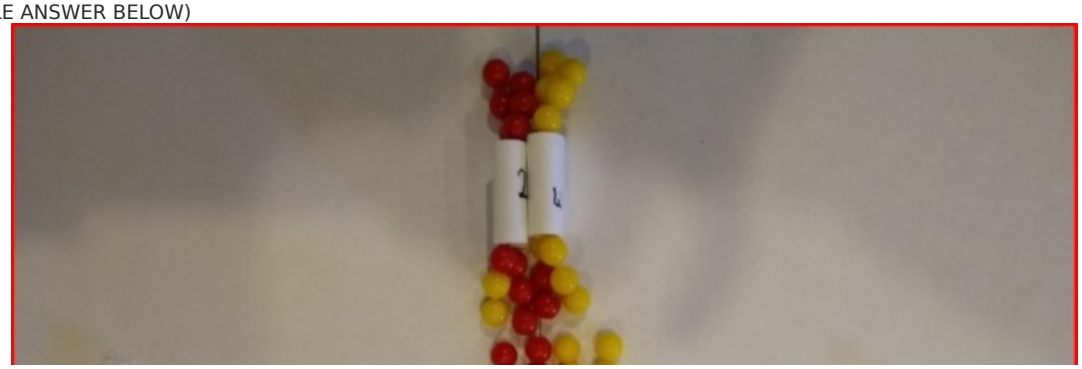


Photo 9: Anaphase I Model

(SAMPLE ANSWER BELOW)

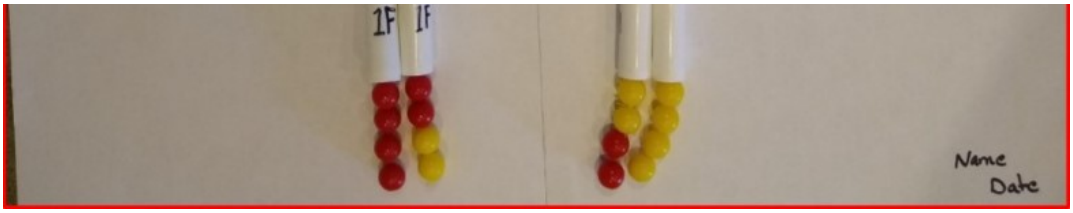
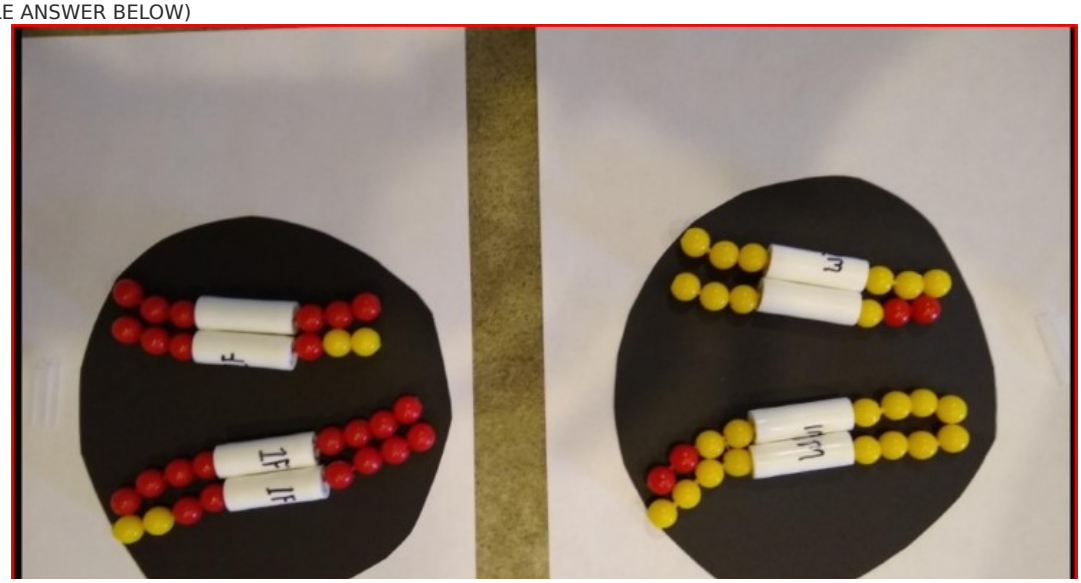


Photo 10: Telophase/Cytokinesis I Model

(SAMPLE ANSWER BELOW)



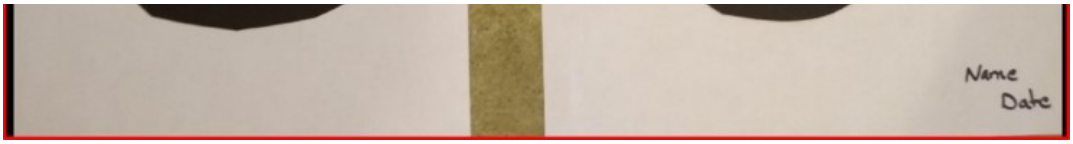


Photo 11: Prophase II Model
(SAMPLE ANSWER BELOW)

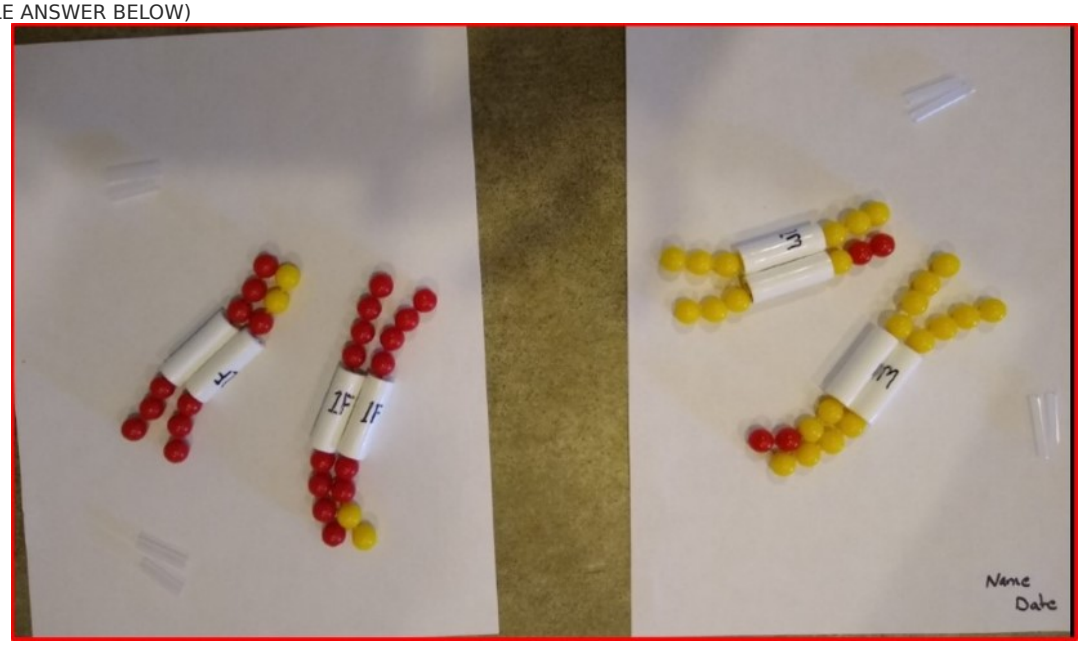


Photo 12: Metaphase II Model

(SAMPLE ANSWER BELOW)

Photo 13: Anaphase II Model

(SAMPLE ANSWER BELOW)

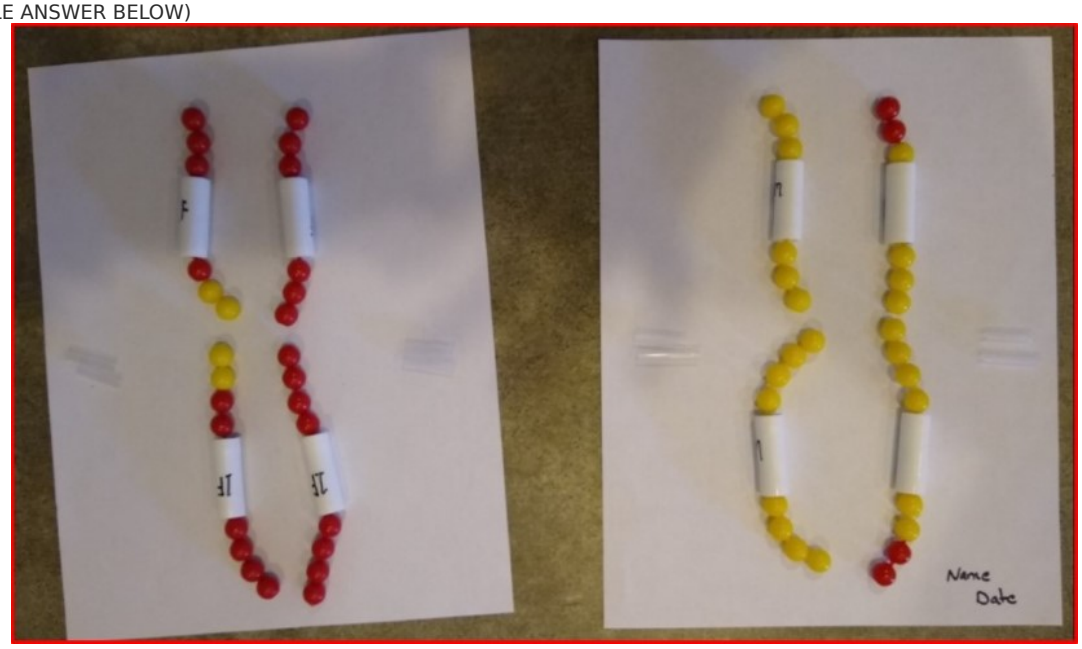
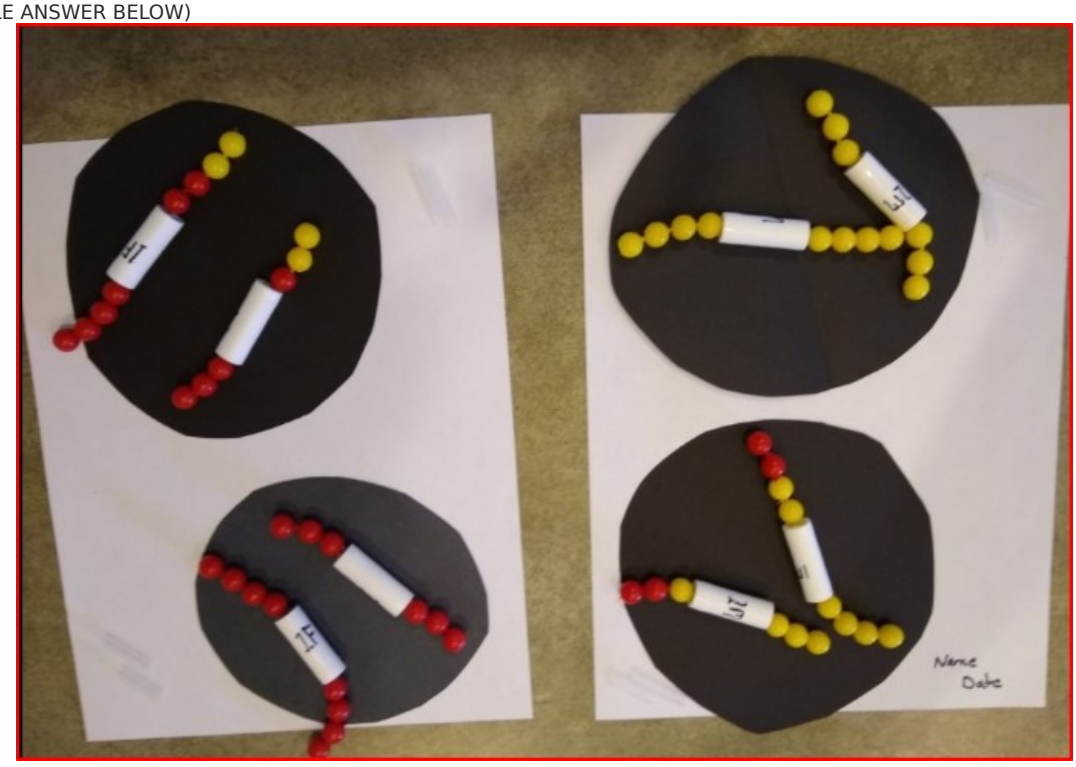


Photo 14: Telophase/Cytokinesis II Model
(SAMPLE ANSWER BELOW)



Exercise 2

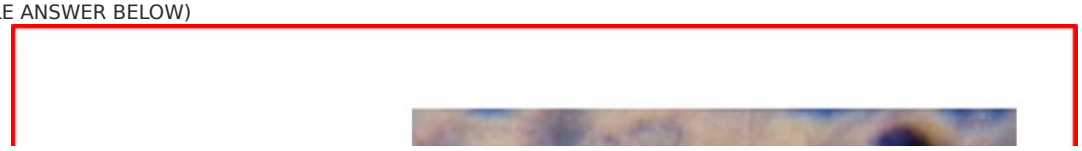
What percentage of the cell cycle does the mitotic phase occupy? How was this supported when viewing the onion root tip slide?

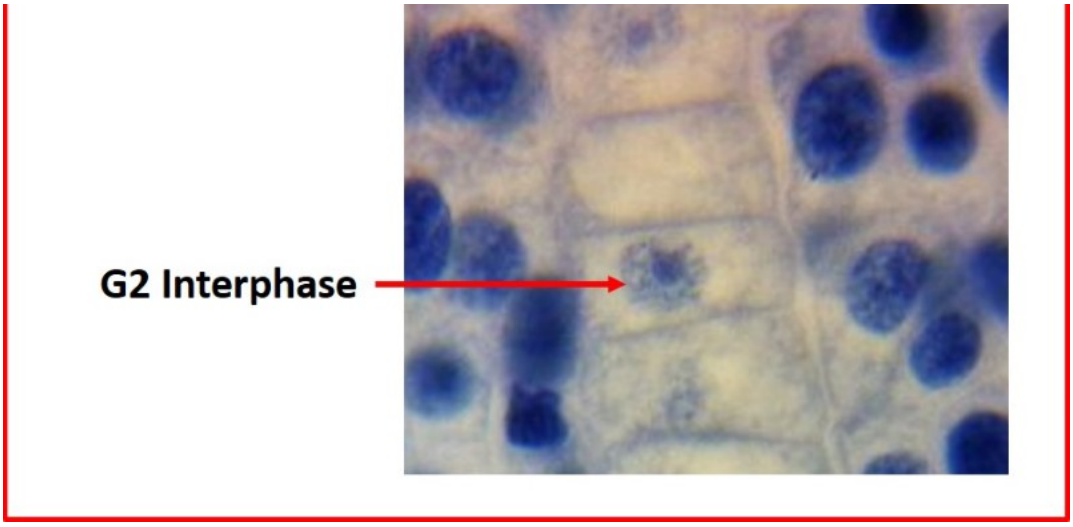
The mitotic phase accounts for 10% of the cell cycle. This was supported by the onion root tip slide in which only about 10% of the cells were undergoing mitosis.

How did mitosis differ between the plant and animal cells viewed in this exercise? Reference specific photos to support your explanation.

Telophase/cytokinesis differed between the onion root tip cells and the whitefish blastula cells. In the blastula, a cleavage furrow formed, pinching the cell in two as shown in **Photo 26**. In the root tip, the cells divided through the formation of a cell plate as shown in **Photo 20**.

Photo 15: Plant Cell - G2 of Interphase
(SAMPLE ANSWER BELOW)





Data Table 2: Microscopy Magnification

(SAMPLE ANSWER BELOW)

	Magnification
Plant Cell- G_2 of Interphase	600X
Plant Cell- Prophase	600X
Plant Cell- Prometaphase	600X

Plant Cell- Metaphase	600X
Plant Cell- Anaphase	600X
Plant Cell- Telophase/Cytokinesis	600X
Animal Cell- G_2 of Interphase	150X
Animal Cell- Prophase	150X
Animal Cell- Prometaphase	150X
Animal Cell- Metaphase	150X
Animal Cell- Anaphase	150X
Animal Cell- Telophase/Cytokinesis	150X

Photo 16: Plant Cell - Prophase
(SAMPLE ANSWER BELOW)

Photo 17: Plant Cell - Prometaphase
(SAMPLE ANSWER BELOW)

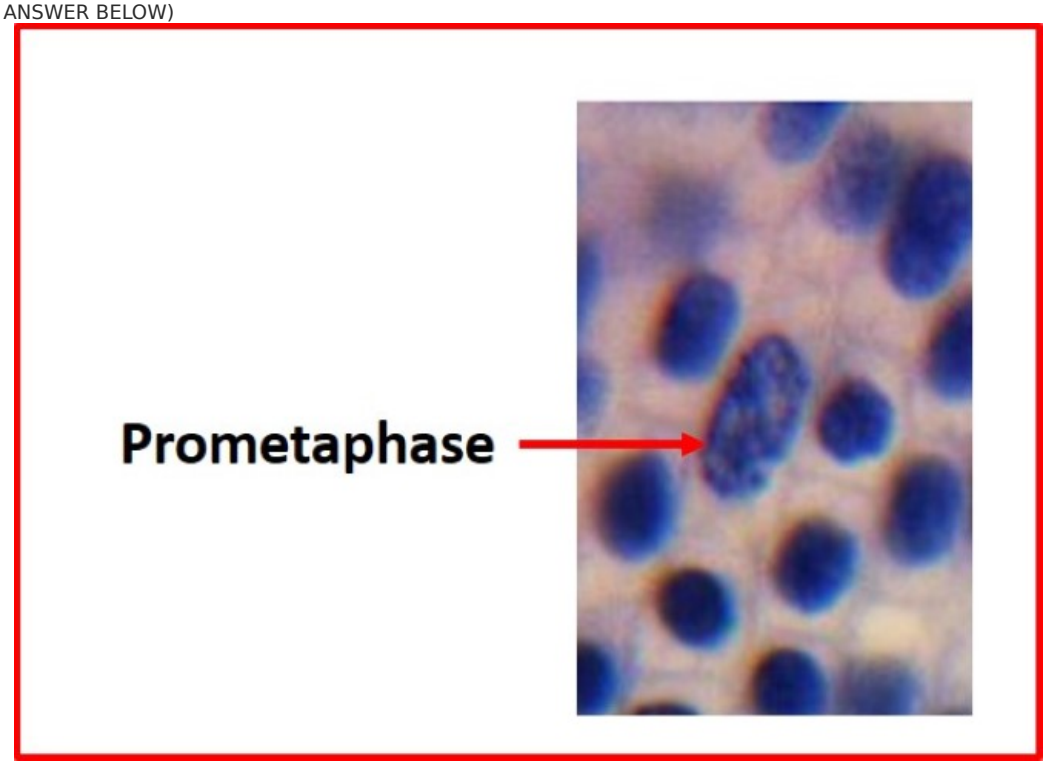


Photo 18: Plant Cell - Metaphase

(SAMPLE ANSWER BELOW)

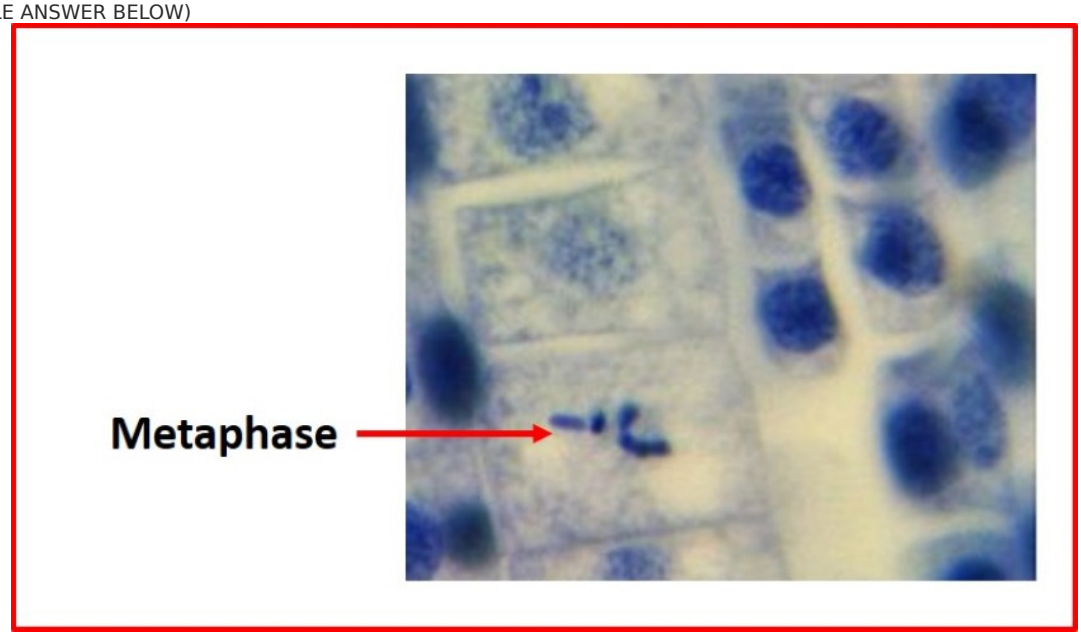


Photo 19: Plant Cell - Anaphase

(SAMPLE ANSWER BELOW)

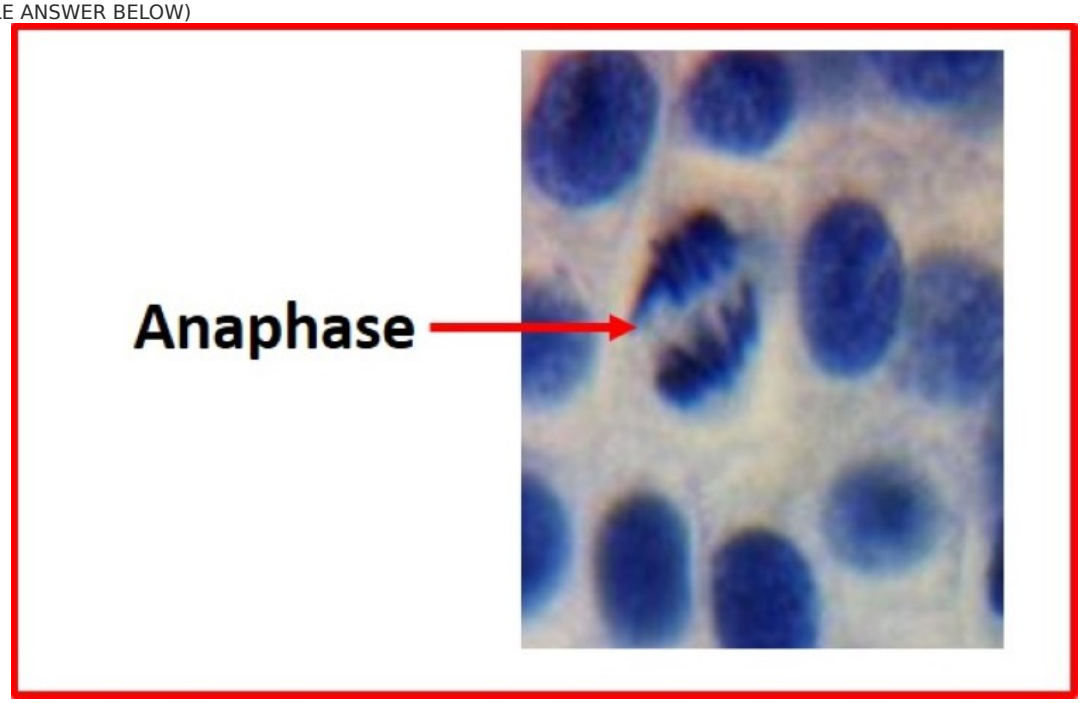


Photo 20: Plant Cell - Telophase/Cytokinesis
(SAMPLE ANSWER BELOW)

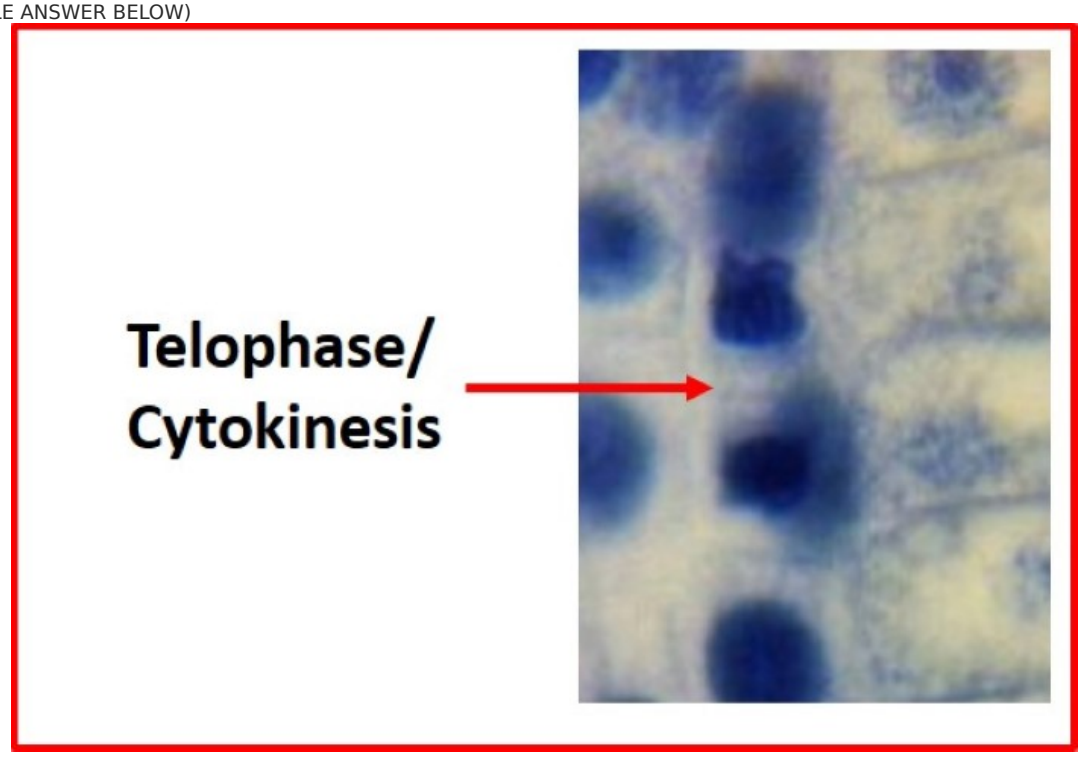


Photo 21: Animal Cell - G2 of Interphase
(SAMPLE ANSWER BELOW)

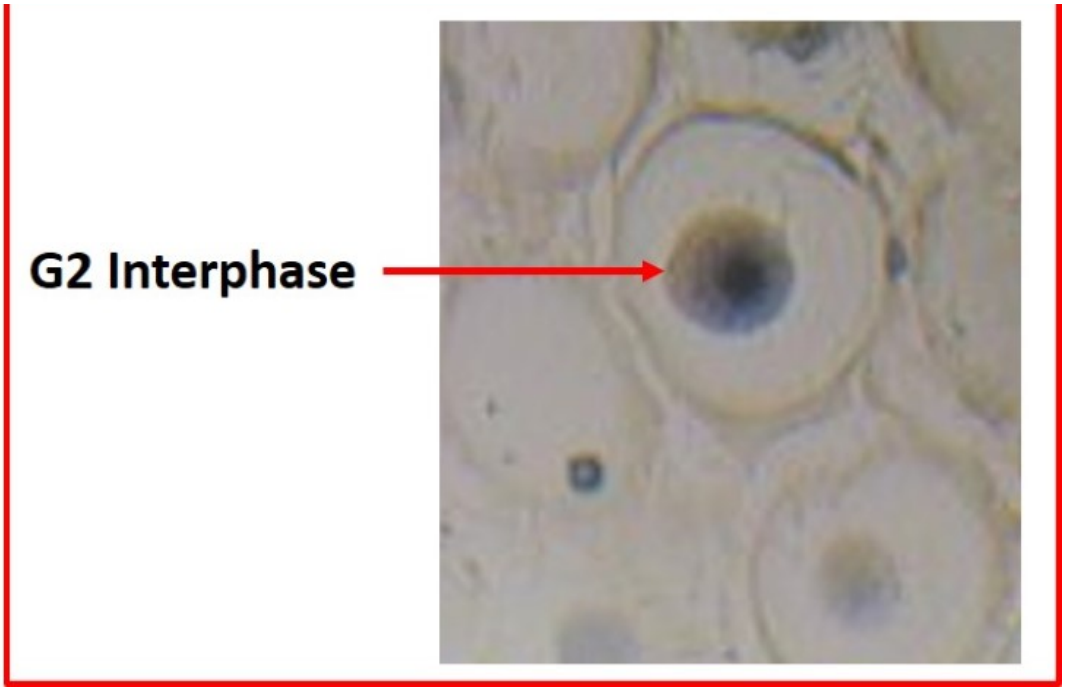
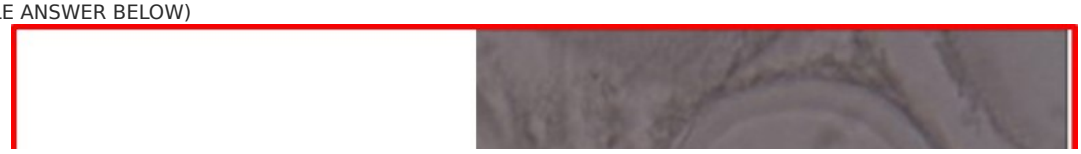


Photo 22: Animal Cell - Prophase
(SAMPLE ANSWER BELOW)



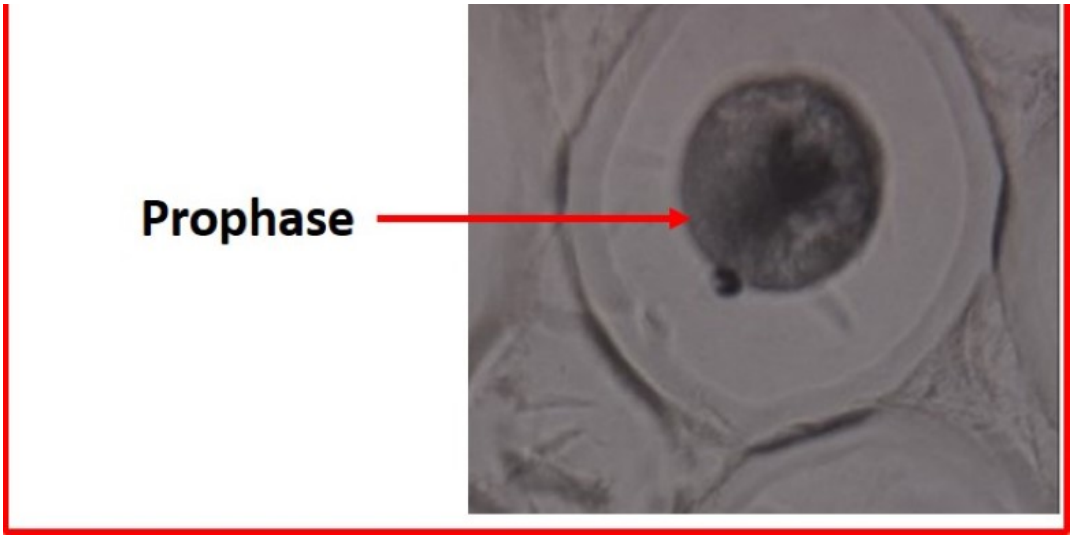
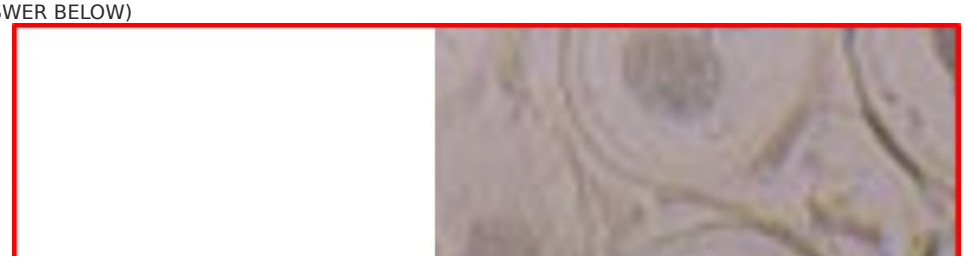


Photo 23: Animal Cell - Prometaphase

(SAMPLE ANSWER BELOW)



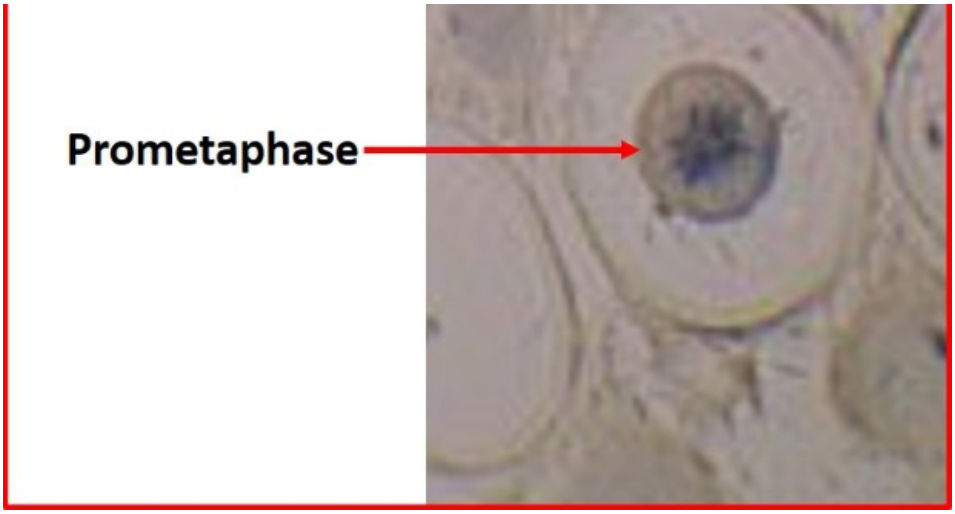


Photo 24: Animal Cell - Metaphase
(SAMPLE ANSWER BELOW)

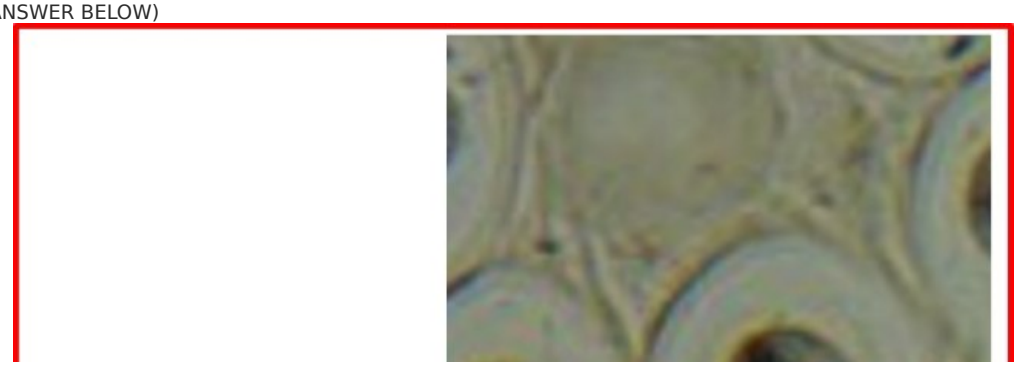
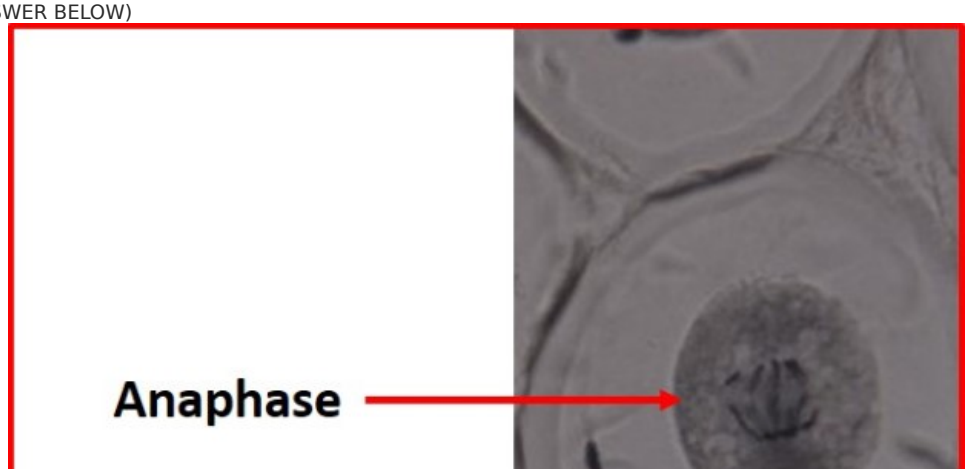


Photo 25: Animal Cell - Anaphase
(SAMPLE ANSWER BELOW)



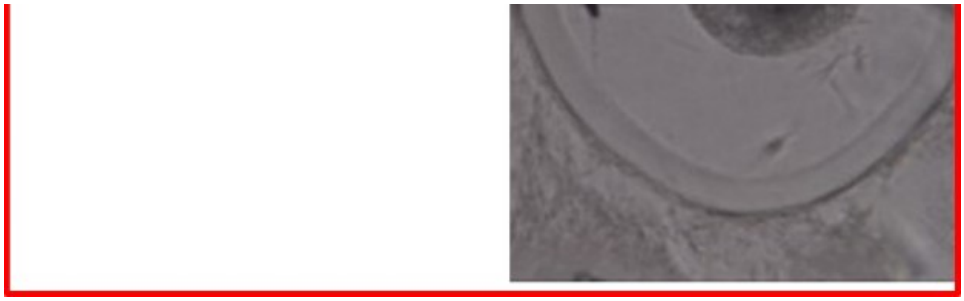
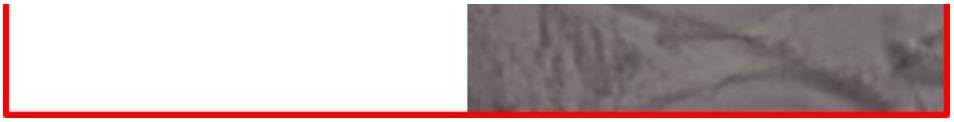


Photo 26: Animal Cell - Telophase/Cytokinesis

(SAMPLE ANSWER BELOW)



Exercise 3

How are karyotypes used to screen for genetic disease?

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Karyotyping results for a human fetus produced a karyotype with 22 pairs of normally shaped chromosomes and single X and Y chromosomes. What should be concluded about the health of fetus? Explain your answer by referencing normal human karyotypes.

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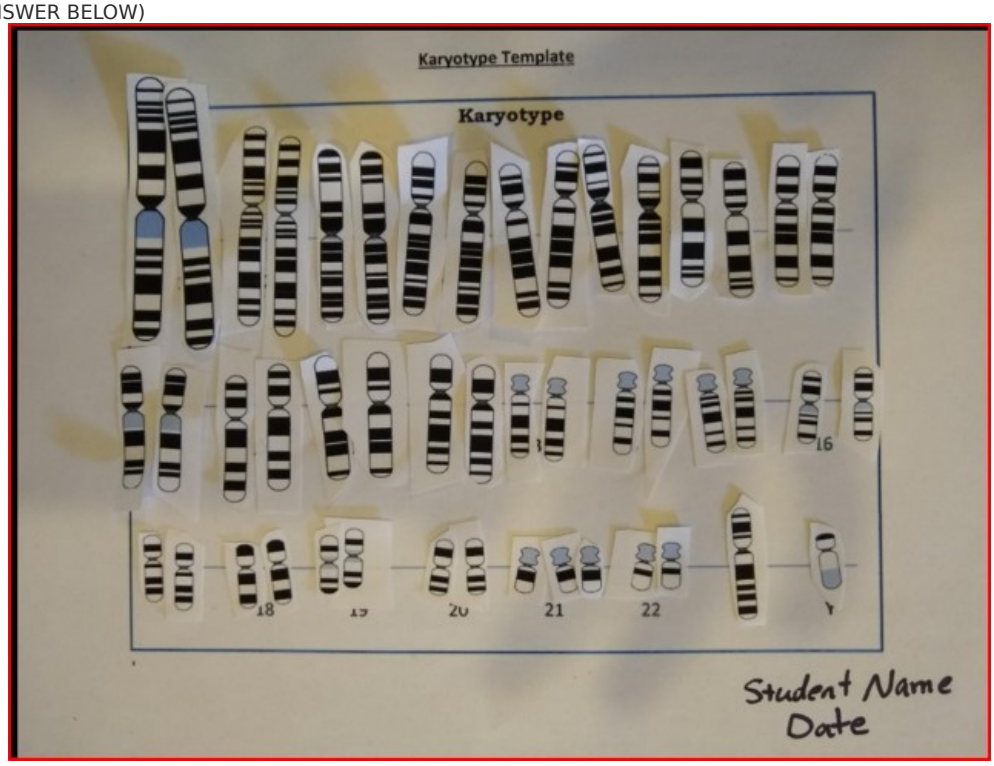
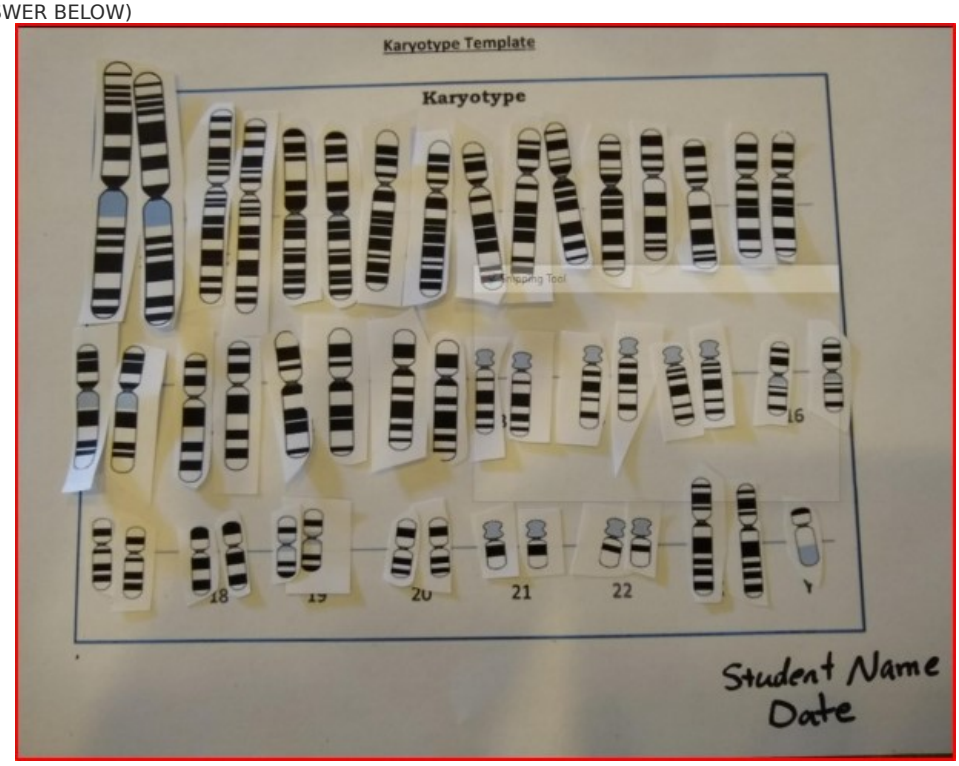
Photo 27: Possible Chromosome Disorder 1 Karyotype
(SAMPLE ANSWER BELOW)



Data Table 2: Karyotype Analysis
(SAMPLE ANSWER BELOW)

Karyotype #	Disorder Present (Y/N)	Disease
1	Y	Down Syndrome
2	Y	Klinefelter Syndrome

Photo 28: Possible Chromosome Disorder 2 Karyotype
(SAMPLE ANSWER BELOW)



Competency Review

_____ composes 90% of the cell cycle.

- Anaphase
- Interphase ✔
- Synapsis
- Telophase

DNA is replicated during the _____ phase of interphase.

- G0
- G1
- G2
- S ✔

During mitosis, a parent cell divides to produce two identical daughter cells.

- True ✔
- False

During the _____ stage of mitosis, chromosomes condense and mitotic spindle fibers begin to form.

- anaphase
- metaphase
- prophase ✔
- telophase

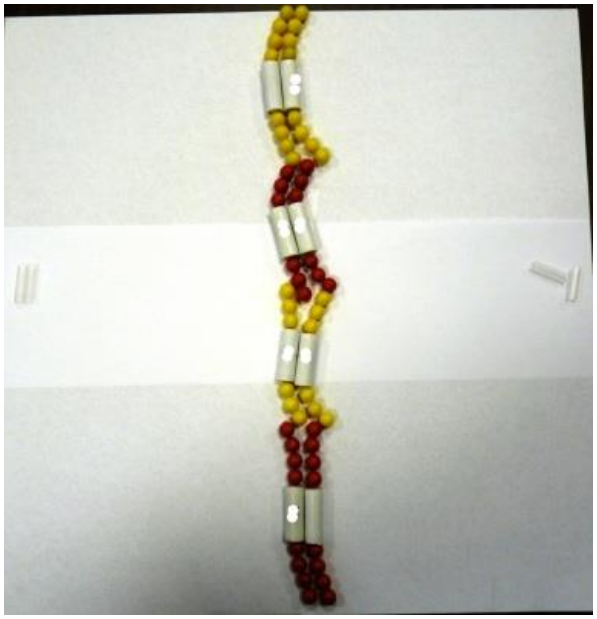
Meiosis occurs in _____ cells.

- bone
- nerve
- reproductive ✔
- blood

Karyotyping is performed using reproductive cells.

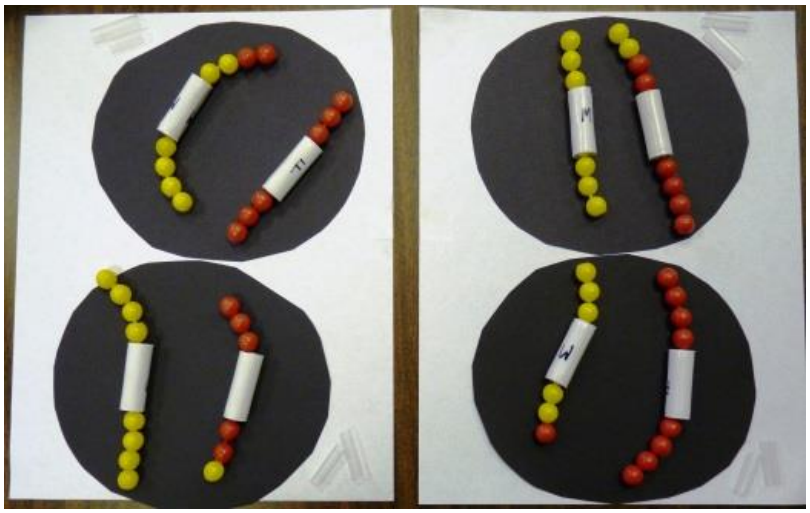
- True
- False ✔

The model photo represents the _____ stage of mitosis.



- anaphase
- metaphase ✔
- prophase
- telophase

The model photo represents daughter cells produced by meiosis.

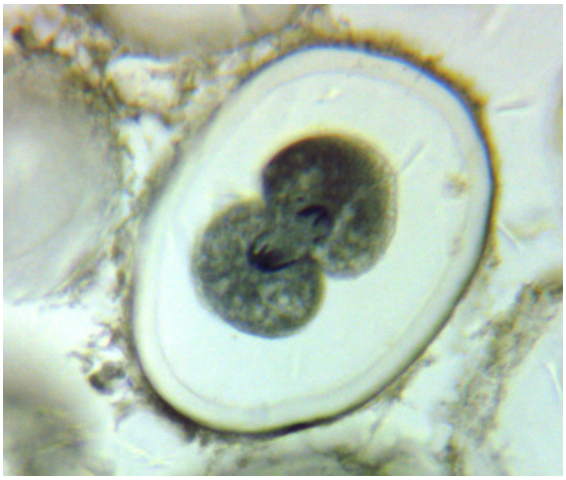


- True ✔
- False

Most of the cells examined on a microscope slide of an onion root tip are actively dividing.

- True
- False ✔

The microscope image is of an animal cell undergoing the _____ stage of mitosis.



- anaphase
- metaphase
- prophase
- telophase ✔

A karyotype with three copies of chromosome 21 is indicative of _____ syndrome.

- Down ✔
- Patau
- Edwards
- Klinefelter

Extension Questions

Identical twins are formed from one fertilized egg, but fraternal twins form from two different fertilized eggs. Apply your knowledge of mitosis and meiosis to explain the genetic differences between identical and fraternal twins. (SAMPLE ANSWER BELOW)

Because identical twins are formed from one fertilized egg, they are created by mitosis. During mitosis, a parent cell (the fertilized egg) produces two genetically identical daughter cells. Each twin arises from one of these daughter cells. Therefore, identical twins are genetically identical. Fraternal twins arise from two separate fertilized eggs. Each egg includes unique genetic information due to chromosomes crossing over in meiosis I. Furthermore, the two sperm that fertilize the two eggs are also genetically distinct. Therefore, the fraternal twins are no more genetically similar as siblings born in separate births.