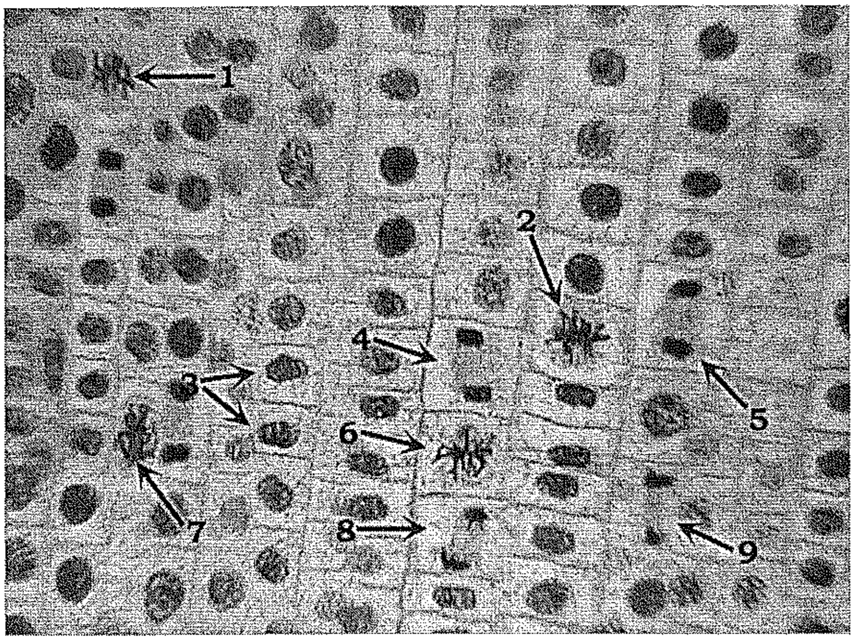
Concept 4: Cell Cycle & Heredity

Thinking Practice

1. Refer to the figure to the right.



   a. What process is being shown in this picture?

   Mitosis

   b. What type of organism are these cells from? How do you know?

   - Plant cells
   - They have a cell wall.

   c. Identify a numbered cell for each of the four major stages of mitosis.

   Prophase - 7
   Metaphase - 1, 2, 6
   Anaphase - 8, 5
   Telophase - 9, 4, 5 , Cytokinesis - 3 → After Mitosis

   d. In what stage are most of the cells in this image? What does this indicate about the amount of time spent in each phase of the cell cycle?

   Interphase - most cells in this image are shown in this phase which indicates a cell spends most of its life in this growing, resting phase of the cellcycle

2. Paclitaxel is a chemotherapy drug used to treat a variety of cancers. Paclitaxel inhibits both assembly and disassembly of microtubules.

   a. Which phase in the cell cycle is affected by Paclitaxel? How does this drug inhibit the growth of cancer?

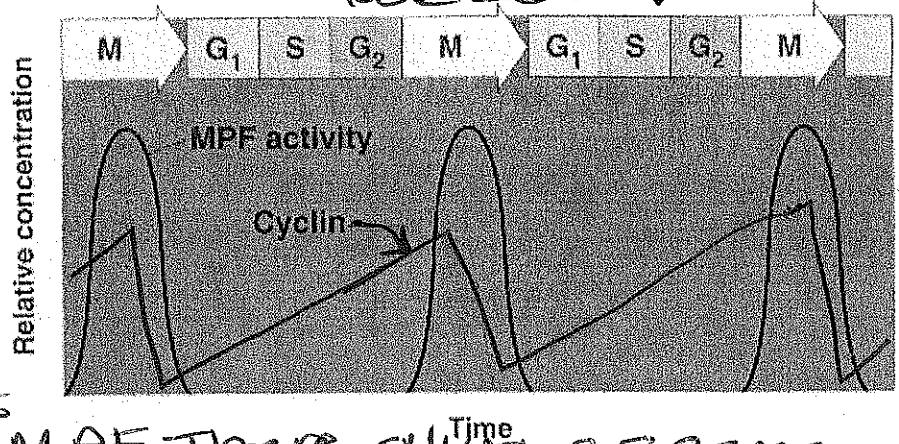
   Microtubules are used to move the chromosomes during anaphase. This drug would ultimately prevent the separation of the chromosomes so mitosis would not be correctly completed, therefore preventing cancer cells from replication

   b. Paclitaxel affects not only cancer cells, but normal cells as well. Would the effects of Paclitaxel be seen first in organs that have quickly dividing cells (like the intestine and hair follicles) or in organs that have slow or nondividing cells (like muscles and the nervous system). Justify your reasoning.

   If mitosis is prevented in normal cells such as the intestines and hair follicles, new cells would not be made to replace dead/damaged cells.
   Symptoms - loss of hair, ulcers in stomach - digestion problems
   It would not have as dramatic of an effect on slow dividing cells.

Cyclin is difficult to see - look below ↓

3. Two students debate about proteins that regulate the cell cycle. One argues that MPF triggers the production of cyclin, while the other argues that cyclin triggers the production of MPF.
   a. Based on the figure to the right, which statement is correct and why?



The increase of cyclin triggers the production of MPF. There always seems to be some cyclin present, but MPF does not increase until the amount of cyclin reaches a certain level.

   b. Propose a possible function of MPF, based on when it is produced in the cell cycle.

MPF increases at the begining of mitosis and decreases about halfway through mitosis. Based on when it is produced, it must be linked to promoting mitosis.

4. You have performed a dihybrid cross of plants and got the following data: 206 purple tall, 65 white tall, 83 purple short, 30 white short. Perform a chi-square analysis to test the null hypothesis that purple coloring is dominant to white and tall height is dominant to short height.

next page.

206 purple tall
65 white tall
83 purple short
30 white short
384

null hypothesis

dom	rec
purple	white
tall	short

(216) 9 : purple tall
(72) 3 : purple short
(72) 3 : ~~white~~ tall
(24) 1 : white short

$$\frac{(206-216)^2}{216} = 0.46 \quad PT$$

$$\frac{(65-72)^2}{72} = 0.68 \quad WT$$

$$\frac{(83-72)^2}{72} = 1.68 \quad PS$$

$$\frac{(30-24)^2}{24} = 1.5 \quad WS$$

$$\Sigma = 4.32$$

Degrees of freedom = 3

null hypothesis accepted. Chi Square value less than ~~[illegible]~~ 7.82. Purple is dominant to white and tall is dominant to short. Parents were heterozygous for both traits

5. A space probe discovers a planet inhabited by creatures that reproduce with the same hereditary patterns seen in humans. Three of the phenotypic characteristics of these creatures are: height, antennae, and nose morphology. Earth scientists were able to do some controlled breeding experiments with these organisms. 100 males and 100 females were used in the experiments and the results of a number of crosses are shown below. Review this information and use it answer the questions that follow.

Cross I: True-breeding (homozygous) tall creatures were crossed with true breeding short creatures. ALL of the F1 were tall. The F1 creatures were crossed and the following data was obtained.

F2 Phenotype	Male	Female
Tall	2575	2625
Short	1425	1375

Cross II: True breeding creatures WITH antennae are crossed with true-breeding creatures WITHOUT antennae. ALL of the F1 had antennae. The F1 creatures were crossed and the following data was obtained.

F2 Phenotype	Male
WITH antennae	3125
WITHOUT antennae	875

2010 FRQ was a little different, but Chirby's question is clearly based on it.

Cross III: Creatures that are true breeding for upturned snou … ed snouts. ALL of the F1 offspring had upturned snouts. The F1 c … a was obtained.

F2 Phenotype	Male
Upturned Snout	1750
Down Turned snout	1750

Cross IV: True breeding tall, with antennae creatures were cro… antennae creatures. ALL of the F1 offspring were tall, with ante… …g were crossed with true breeding short, without antennae creatures. The F2 data is in the table below.

F2 Phenotype	Male	Female
Tall, WITH antennae	2360	2220
Tall, WITHOUT antennae	220	[illegible]
Short, WITH antennae	260	[illegible]
Short, WITHOUT antennae	2240	[illegible]

2010 use the rubric to help you identify strategies to answer this question

a. What conclusions can be drawn from cross I and II? E… conclusions (Hint! You might need to do a chi square …

b. What conclusions can be drawn from cross III? Explai… (Hint! You might need to do a chi square analysis to su…

c. What conclusions can be drawn from cross IV? Explain… (Hint! You might need to do a chi square analysis to su…

~~Cell Cycle and Heredity Short Free Response (5 points)~~

Question 3 (continued)

(a) What conclusions can be drawn from cross I and cross II? **Explain** how the data support your conclusions for each cross. **(4 points maximum)**

Conclusion for cross I (1 point maximum)	**Possible explanations for cross I (1 point maximum)**
• Bronze dominant/red recessive • Autosomal (non-sex-linked)	• All F_1 /heterozygotes express dominant trait (bronze). • F_2 shows 3:1 ratio (bronze:red/dominant:recessive). • Equal distribution of F_2 phenotypes for both genders.
Conclusion for cross II (1 point maximum)	**Possible explanations for cross II (1 point maximum)**
• Stunted dominant/normal recessive • Autosomal (non-sex-linked)	• All F_1 /heterozygotes express dominant trait (stunted). • F_2 shows 3:1 ratio (stunted:normal/dominant:recessive). • Equal distribution of F_2 phenotypes for both genders.

(b) What conclusions can be drawn from the data from cross III? **Explain** how the data support your conclusions. **(4 points maximum)**

Conclusion for cross III (1 point per bullet; 2 points maximum)	**Explanation for cross III (1 point per bullet; 2 points maximum)**
• Genes linked • Crossing over • Genes 10 map units apart	• Not a 1:1:1:1 ratio (as predicted by independent assortment). • Not a 1:1 ratio/two recombinant phenotypes (unexpected). • Frequency of recombinant phenotypes was 10 percent (setup equation OK)/parental phenotypes (bronze/stunted and red/normal) are represented in 90 percent of offspring.

Question 3 (continued)

(c) **Identify** and **discuss** TWO different factors that would affect whether the island's fly population is in Hardy-Weinberg equilibrium for the traits above. **(4 points maximum)**

Identification (1 point per bullet; 2 points maximum)	**Discussion of effect (1 point per bullet; 2 points maximum)**
• Large population	• Minimized genetic drift.
• Random mating	• No gene pool change due to mate preferences.
• No mutation	• No new alleles in population.
• No immigration/emigration/ migration (no gene flow)	• No gene pool change by addition/loss of alleles.
• No natural selection	• No alleles favored or disfavored by environment.

Question 3

A new species of fly was discovered on an island in the South Pacific. Several different crosses were performed, each using 100 females and 100 males. The phenotypes of the parents and the resulting offspring were recorded.

Cross I: True-breeding bronze-eyed males were crossed with true-breeding red-eyed females. All the F_1 offspring had bronze eyes. F_1 flies were crossed, and the data for the resulting F_2 flies are given in the table below.

F_2 Phenotype	Male	Female
Bronze eyes	3,720	3,800
Red eyes	1,260	1,320

Cross II: True-breeding normal-winged males were crossed with true-breeding stunted-winged females. All the F_1 offspring had stunted wings. F_1 flies were crossed, and the data for the resulting F_2 flies are given in the table below.

F_2 Phenotype	Male	Female
Normal wings	1,160	1,320
Stunted wings	3,600	3,820

Cross III: True-breeding bronze-eyed, stunted-winged males were crossed with true-breeding red-eyed, normal-winged females. All the F_1 offspring had bronze eyes and stunted wings. The F_1 flies were crossed with true-breeding red-eyed, normal-winged flies, and the results are shown in the table below.

Phenotype	Male	Female
Bronze eyes, stunted wings	2,360	2,220
Bronze eyes, normal wings	220	300
Red eyes, stunted wings	260	220
Red eyes, normal wings	2,240	2,180