Section A: Why must a cell divide?

Cells are limited in size because the membrane must transport materials to the inside of the cell. As a cell gets bigger, the outside is unable to keep up with the inside, because the inside grows at a faster rate than the outside. As cells get larger, the surface to volume ratio gets smaller, meaning the cell membrane cannot supply the inside with what it needs to survive. Cell division occurs so multicellular organisms can grow and repair damaged tissue. In multicellular organisms, division occurs to produce egg and sperm for reproduction. In unicellular organisms, division is needed to reproduce the organism.

1. In multicellular organisms, why do cells need to divide? _____________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________
___________________________________________________________________________________________

Section B: Vocabulary

1. Explain the relationship between chromosomes, genes and DNA. ____________________________________________________________
___________________________________________________________________________________________

2. Define diploid.

3. Define haploid.

4. Check the correct box that matches the description of the two types of Eukaryotic cells.

5. Why is the chromosome number in each animal cell an even number? _____________________________________________
___________________________________________________________________________________________

6. Why is it important that gamete cells have only one set of chromosomes? _____________________________________________
___________________________________________________________________________________________

7. What are the two types of gametes? _____________________________________________

8. What process is the fusion of gametes that create a zygote? ________________ Is a zygote a diploid or haploid cell? ________________

9. The data table shows the number of chromosomes for somatic cells.

   a. Chromosome # for diploid human cell? _______
   b. Chromosome # for haploid pea plant? _______
   c. Chromosome # for dog gamete? _______
   d. Chromosome # for diploid frog cell? _______
   e. If a frog cell had 26 chromosomes, then the cell is diploid or haploid. _______
   f. If a mosquito cell had 3 chromosomes, then it would be a gamete or somatic cell. _______
   g. If an orangutan cell had 24 chromosomes, then the cell is diploid or haploid. _______
   h. If a corn cell had 20 chromosomes, then the cell is diploid or haploid. _______

10. In the karyotyping activity, identify the diploid number, gender and chromosomal abnormality in each patient.

    a. Patient A - ____________________________
    b. Patient B - ____________________________
    c. Patient C - ____________________________
    d. Patient D - ____________________________

11. Label the sister chromatids and the centromere on the duplicated chromosome. Label the chromatid and centromere on the single chromosome.

12. ____________________________ is a segment of DNA that codes for a protein.

13. What are homologous chromosomes? ____________________________
Section C: Cell Cycle

The cell cycle is the series of events that take place in a eukaryotic cell between its formation and the moment it replicates itself. These events can be divided in three main parts: (1) interphase (includes G1 phase, S phase, G2 phase), during which the cell is forming and carries on with its normal metabolic functions; (2) the M phase (mitosis or meiosis), during which the nucleus is dividing, and (3) cytokinesis, during which the cytoplasm divides and new daughter cells are formed. Thus, cell-division cycle is an essential process for repair and growth in eukaryotic organisms. It is also the process where unicellular or multicellular organisms reproduce asexually. Sometimes the cells exit the cell cycle and enter the G0 phase. In the G0 phase, cells are alive and metabolically active, but do not divide. In this phase cells do not copy their DNA and do not prepare for cell division. Many cells in the human body, including those in heart muscle, eyes, and brain are in the G0 phase. If these cells are damaged they cannot be replaced.

1. What are the three steps of cell cycle? _________________________________________ 
2. What occurs during interphase? ______________________________________________________ 
3. What occurs during M phase? ___________________________________________________________________ 
4. What occurs during cytokinesis? _________________________________________________________________ 
5. What is the G0 phase? __________________________________________________________________________ 
6. What type of cell enters the G0 phase? ____________________________________________________________ 

Section D: Interphase

The G1 phase is the major period of cell growth. During this stage new organelles are being synthesized, so the cell requires both structural proteins and enzymes, resulting in great amount of protein synthesis. The S phase (synthesis phase) is when DNA synthesis or replication occurs. At the beginning of the S stage, each chromosome is composed of one coiled DNA double helix molecule, which is called a chromatid. At the end of this stage, each chromosome has two identical DNA double helix molecules, and therefore is composed of two sister chromatids. During S phase, the centrosome is also duplicated. G2 phase is the shortest subphase during interphase in which the cell undergoes a period of rapid growth to prepare for the M phase. Although chromosomes have been replicated they cannot yet be distinguished individually because they are still in the form of loosely packed chromatin fibers.

1. When are chromosomes duplicated? 
2. If the parent cell has 20 chromosomes in G1, how many chromosomes will it have in the G2 phase? __________ 
3. Which phase is the longest in interphase? 
4. Are chromosomes visible during interphase? _________ 
5. What are chromatin? ______________________________________________________________ 
6. Which phase is protein synthesis going on? 
7. Which phase is the cell preparing for division? ______________________________________

Section E: Cell Cycle Webquest

On "Websites-Genetics" page, click on 'Cell Cycle'. Use the animation to answer these questions.

1. What are the 3 phases of the cell cycle? ____________________________________________________________________________ 
2. Interphase includes _____, _____ and ________ phases. 
3. How long does it take for DNA replication to occur? _________ 
4. What occurs in G1 phase? 
5. What occurs in G2 phase? 
6. What is the purpose of the M phase? 
7. What is the G0 phase? 
8. Give an example of cells that enter the G0 phase? 
9. What is apoptosis? 
10. Why is apoptosis an important process? 

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Section F: Mitosis Webquest
On "Websites-Genetics" page, click on 'Mitosis'. Use the animation to answer these questions.
1. What is divided in mitosis? ________________
2. What is divided in cytokinesis? ________________
3. What are the stages of mitosis? __________________________
4. What happens during prophase? ____________________________
5. What happens during metaphase? ____________________________
6. What happens during anaphase? ____________________________
7. What happens during telophase? ____________________________
8. In which phase do chromosomes become visible? ____________
9. What is the purpose of spindle-fibers (microtubules)? ____________________________
10. Why is cytokinesis important? ____________________________
11. How is cytokinesis in an animal cell different than a plant cell? ____________________________

Section G: How many chromosomes?
On "Websites-Genetics" page, click on 'Mitosis Animation'. Use the animations to answer the questions.
1. At the beginning of interphase, how many chromosomes are in the parent cell? _________
2. At the end of interphase, how many chromosomes are in the parent cell? _________
3. What are centrosomes? _______________________________________________________________________
4. What structures are found in the centrosomes? __________
5. What do the centrioles form? ____________________________________________
6. Where do the microtubules connect to the chromosome? ____________________________
7. If the spindle fibers malfunction, how is nuclear division affected? ____________________________
8. How many chromosomes are in each daughter cell? __________
9. Are the daughter cells genetically identical or different than the parent cell? __________
10. How many daughter cells are created when a cell undergoes mitosis and cytokinesis? _________
11. A parent cell has 24 chromosomes. When it undergoes mitosis, how many chromosomes will be in each daughter cell? _________ How many daughter cells will be created? _________

Section H: Onion Root Tip Cell Cycle
On "Websites-Genetics" page, click on 'Onion Root Tip'. Click next and assort the cell cycle pics.

<table>
<thead>
<tr>
<th>NUMBERS</th>
<th>INTERPHASE</th>
<th>PROPHASE</th>
<th>METAPHASE</th>
<th>ANAPHASE</th>
<th>TELOPHASE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Cell Number</td>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

Section I: Mitosis
1. Fill in the phases and label the diagrams.
Matching: Match the term to the description. Some will be used more than once.

a. G1  c. anaphase  f. mitosis  i. prophase  l. centromere
b. S  d. telophase  g. spindle fiber  j. metaphase  m. interphase
c. G2  e. cytokinesis  h. cell plate  k. chromatid

1. Sister chromatids are moving apart. ________
2. New nuclear membrane forms. ________
3. Cytoplasm is being divided. ________
4. Chromosomes become invisible. ________
5. Chromosomes are in the middle. ________
6. Nuclear membrane begins to fade. ________
7. Fibers pull chromatids towards poles. ________
8. Spindles are formed. ________
9. Chromosomes are visible. ________
10. Cell plate divides the cytoplasm. ________
11. Chromosomes replicate. ________
12. Reverse of prophase. ________
13. At the end of telophase I? ________
14. Cell prepares for division. ________
15. Normal metabolic activities occur. ________
16. Structure that connects chromatids. ________
17. The ½ of the chromosome. ________
18. Connects to centromeres. ________
19. Forms in plant cells for cytokinesis. ________
20. Structures centrioles produce. ________
21. Period of cell growth before division. ________
22. Normal cell prepares for division. ________
23. Sister chromatids are together in. ________
24. Nuclear division. ________

Section J: Meiosis Webquest
On “Websites-Genetics” page, click on “Meiosis Animation”. Use the animation to answer the questions.

1. At the beginning of interphase, how many chromosomes are in the parent cell? __________
2. At the end of interphase, how many chromosomes are in the parent cell? __________
3. How many divisions occur in meiosis? __________
4. In prophase I, what do the homologous chromosomes do? __________
5. What is crossing over? __________
6. In metaphase I, explain independent assortment. __________
7. How many chromosomes are in each daughter cell at the end of telophase I? __________
8. How many daughter cells are created at the end of cytokinesis I? __________
9. How many chromosomes are in each daughter cell at the end of cytokinesis 2? __________
10. At the end of cytokinesis 2, how many daughter cells are created? __________
11. Are the daughter cells at the end of meiosis and cytokinesis genetically identical or different? __________
12. Why is meiosis and sexual reproduction important? __________
13. Why types of cells are produced after meiosis? __________
14. Why is independent assortment important? __________
15. Why is shuffling of the chromosomes (crossing-over) important? __________
16. A parent cell has 24 chromosomes. When it undergoes meiosis, how many chromosomes will be in each daughter cell? __________ How many daughter cells will be created? __________

Additional Animations/Tutorials:
http://www.biology.arizona.edu/cell_bio/tutorials/cell_cycle/cells2.html
http://www.hartnell.edu/tutorials/biology/mitosis.html
http://www.hartnell.edu/tutorials/biology/meiosis.html
http://www.pbs.org/wgbh/nova/miracle/divi_flash.html

Quizzes:
http://www.sciencegeek.net/Biology/review/U3CellReproduction.htm
http://www.sciencegeek.net/Biology/review/U3Meiosis.htm
http://www.sciencegeek.net/Biology/review/U3Review.htm
http://www.neok12.com/quiz/CEDIV05
http://www.neok12.com/quiz/CEDIV03