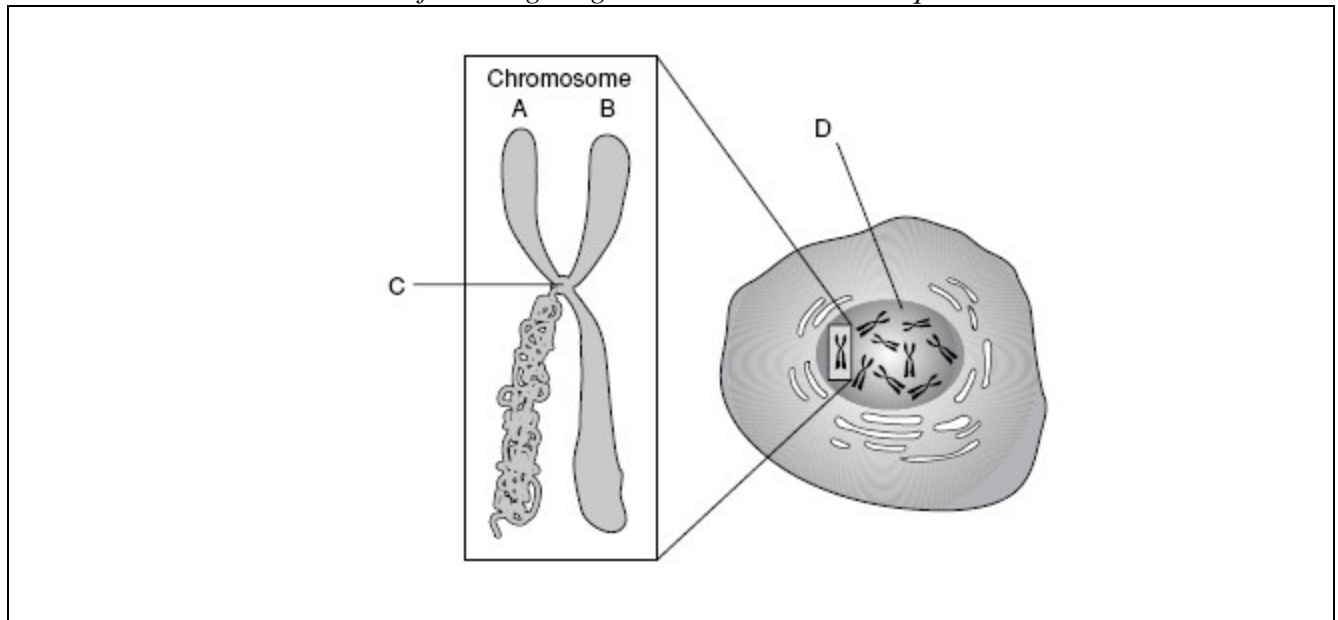


**ASSESSMENT****Chapter 16 Test****BLM 16.5.1****Multiple Choice Questions**

- Decide which of the choices best completes the statement or answers the question.
  - Locate that question number on the separate answer sheet provided.
  - Use the procedure described by your teacher to answer each question. For example, “fill in the circle that corresponds to your choice” or “make an X over the letter corresponding to your choice.”
1. The sequence of events from one cell division to the next cell division is called
    - a. meiosis.
    - b. mitosis.
    - c. cytokinesis.
    - d. cell cycle.

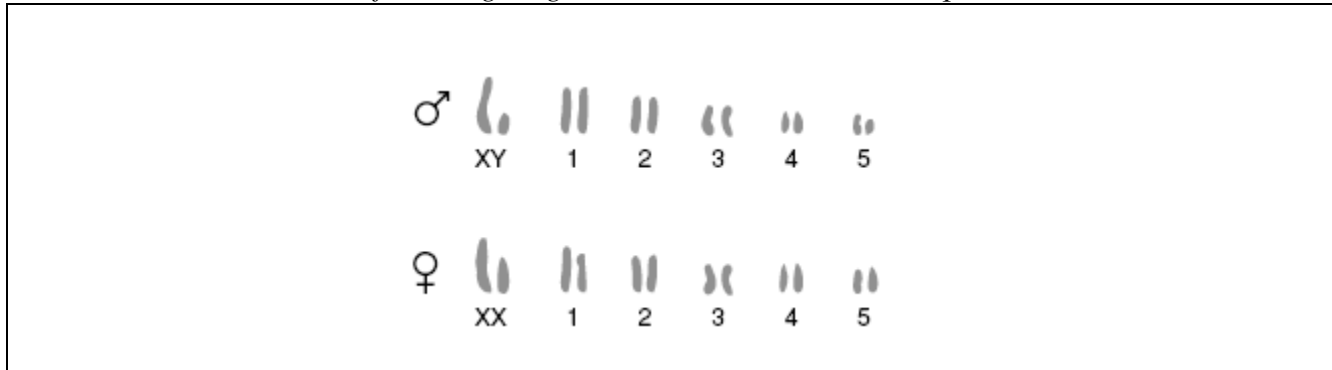
*Use the following diagram to answer the next question.*



2. Letter “C” on this illustration represents
  - a. the centromere.
  - b. a chromatid.
  - c. crossing-over.
  - d. the spindle.

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*Use the following diagram to answer the next three questions.*



3. The diploid ( $2n$ ) number of chromosomes for the Caribbean Fruit Fly is
  - a. 5.
  - b. 6.
  - c. 10.
  - d. 12.
4. The chromosomes for this image were taken from a rapidly dividing
  - a. reproductive cell.
  - b. polyploid cell.
  - c. somatic cell.
  - d. haploid cell.
5. Identify the non-homologous chromosomes on this diagram.
  - a. chromosome 1
  - b. chromosome 2
  - c. chromosome 3
  - d. chromosome X and chromosome Y
6. In a stem cell, identify the phase in interphase in which the DNA is replicated to form an identical chromosome.
  - a. Gap 1 (G1) phase
  - b. S phase
  - c. Gap 2 (G2) phase
  - d. prophase
7. The division of the cytoplasm in a dividing stem cell is called
  - a. the S phase.
  - b. spermatogenesis.
  - c. oogenesis.
  - d. cytokinesis.

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Use the following information to answer the next question.

### The p53 gene

The p53 gene was the first cell cycle checkpoint gene to be discovered in humans. It is referred to as a tumour suppressor gene because its normal function is to suppress the development of tumours by detecting genetic mistakes in G1 cells. This results in arrested cell growth (cell cycle arrest) or destruction (programmed cell death) of the cells with the mistake.

Source: [http://www.barrettsinfo.com/content/5\\_how\\_does\\_cancer\\_develop\\_in\\_barretts.htm](http://www.barrettsinfo.com/content/5_how_does_cancer_develop_in_barretts.htm)

8. Predict what happens when genetic abnormalities develop in the p53 gene leading to loss of its normal function.
  - a) Tumours develop more readily because cells with genetic mistakes are allowed to divide and pass the mistake on to daughter cells.
  - b) Tumours are suppressed because cells with genetic mistakes are destroyed.
  - c) Tumours develop more readily because the surrounding normal, somatic cells are allowed to divide more rapidly.
  - d) Tumours develop more readily because abnormal cytokinesis takes place in these cells.
9. Identify the phase of mitosis that is described below:
 

“During this phase, the nuclear membrane breaks down, releasing the chromosomes into the cytoplasm. The nucleolus disappears and the centrioles move to opposite poles of the cell.”

  - a. telophase
  - b. anaphase
  - c. metaphase
  - d. prophase

Use the following information to answer the next question.

### Chemotherapy Drugs

Cancer cells are called neoplastics. Most chemotherapy drugs are known as “anti-neoplastics” [anti-nee-oh-PLAS-tics.]. Most anti-neoplastics work by stopping cell division at some stage of the cell cycle. They cause cell death in any dividing cell, and since most human cells are not dividing all the time, they preferentially kill cancer cells.

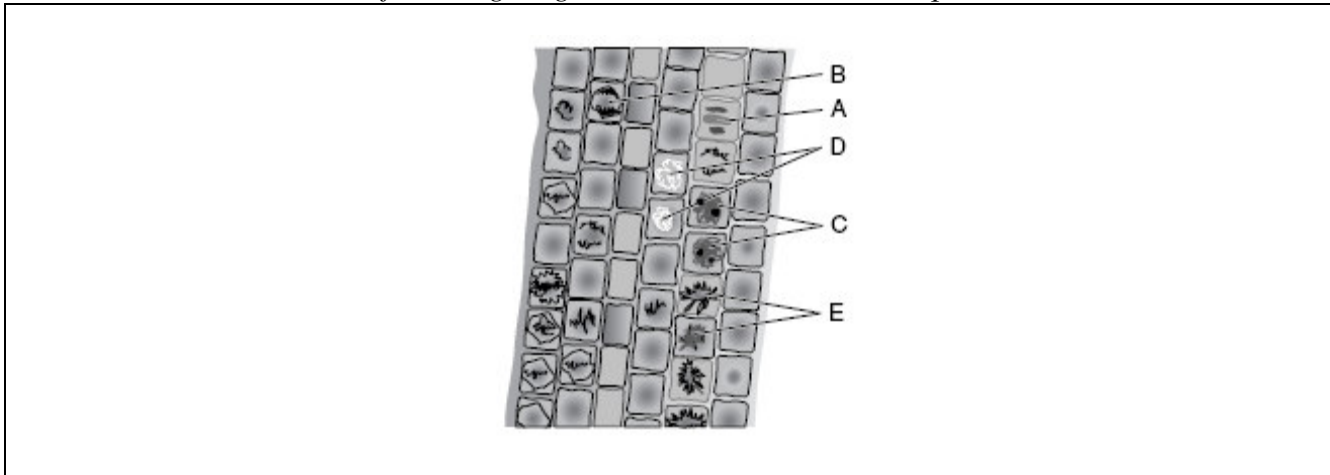
Vincristine is an alkaloid isolated from the Madagascar periwinkle, *Catharantus roseus*, formerly classified as *Vinca rosea*. This led to this drug being called a *Vinca* alkaloid, and thus vincristine. Vincristine binds to tubulin, the protein that makes up the spindle fibre microtubules.

Source: <http://www.biology.iupui.edu/biocourses/N100/goodfor6.html>

10. Which of the following statements best explains why vincristine is used to treat some cancer patients?
  - a. It blocks actively dividing cells from making DNA during prophase.
  - b. It prevents the formation of spindle fibres during metaphase.
  - c. It prevents the synthesis of DNA in the S phase.
  - d. It blocks the division of the cytoplasm during cytokinesis.

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Use the following diagram to answer the next two questions.



11. Which row correctly identifies the phases labelled B and C?

Row	Phase Labelled B	Phase Labelled C
A	anaphase	telophase
B	prophase	metaphase
C	anaphase	interphase
D	metaphase	prophase

12. The structures that you would see in a dividing animal cell but NOT in these dividing onion cells are the

- spindles.
- cell membranes.
- centrioles.
- chloroplasts.

13. If a diploid cell of an organism contains 8 chromosomes, how many chromosomes will each daughter cell contain after meiosis II ?

- 8
- 4
- 16
- 2

14. If you were observing the chromosomes during metaphase I of meiosis, you would see that the chromosomes are arranged as

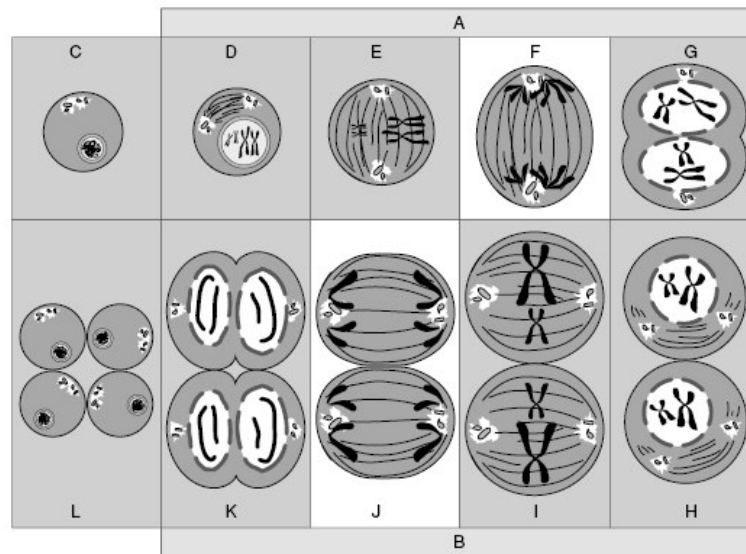
- single chromosomes.
- unpaired duplicated chromosomes.
- homologous pairs of chromosomes.
- unwound, thin strands of chromatin.

**ASSESSMENT****Chapter 16 Test****BLM 16.5.1**

15. Crossing over occurs between
- sister chromatids of the same chromosomes.
  - chromatids of non-homologous chromosomes.
  - chromatids of two daughter nuclei.
  - non-sister chromatids of a homologous pair.
16. During which meiotic division do cells become haploid?
- anaphase I of meiosis I
  - anaphase II of meiosis II
  - anaphase II of mitosis I
  - anaphase II of mitosis II
17. Which row in the table below correctly identifies the two key events in meiosis that ensure genetic recombination in sexually reproducing organisms?

Row	Event	Event
A	crossing over	independent assortment
B	interphase	cytokinesis
C	binary fission	vegetative propagation
D	conjugation	spermatogenesis

*Use the following diagram to answer the next two questions.*



18. The phases of meiosis depicted by the letters E and I respectively are
- prophase I and prophase II.
  - prophase II and prophase I.
  - metaphase I and metaphase II.
  - metaphase II and metaphase I.

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19. Interkinesis is the period of time between meiosis I and meiosis II. This phase is represented on this diagram by the cells(s) identified by the letter

- a. C.
- b. D.
- c. L.
- d. H.

20. Which row below is incorrect?

#### Comparison of Meiosis I and Mitosis

Row	Meiosis I	Mitosis
a.	Prophase I—pairing of homologous chromosomes	Prophase—no pairing of homologous chromosomes
b.	Metaphase I—homologous duplicated chromosomes at metaphase plate	Metaphase—duplicated chromosomes at metaphase plate
c.	Anaphase I—homologous chromosomes separate	Anaphase—sister chromatids separate
d.	Telophase I—two diploid daughter cells are formed	Telophase—two haploid daughter cells identical to the parent cell are formed

21. Which row below is incorrect?

#### Comparison of Meiosis II and Mitosis

Row	Meiosis II	Mitosis
a.	Prophase II—no pairing of homologous chromosomes	Prophase—no pairing of homologous chromosomes
b.	Metaphase II—diploid number of chromosomes at the metaphase plate	Metaphase—homologous duplicated chromosomes at metaphase plate
c.	Anaphase II—sister chromatids separate, becoming daughter chromosomes that move to the poles	Anaphase—sister chromatids separate, becoming daughter chromosomes that move to the poles
d.	Telophase II—four haploid daughter cells are formed	Telophase—two diploid daughter cells identical to the parent cell are formed

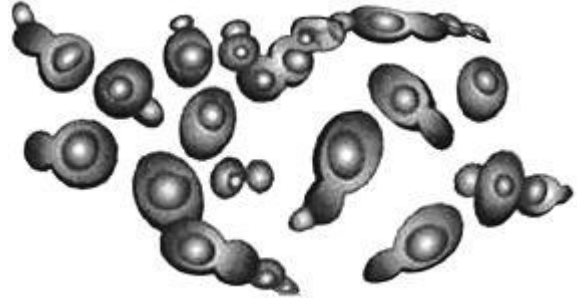
22. Which row does NOT indicate a difference between spermatogenesis and oogenesis in humans?

Row	Spermatogenesis	Oogenesis
a.	occurs in males	occurs in females
b.	produces haploid eggs	produces diploid cells
c.	produces four sperm per meiosis	produces one egg per meiosis
d.	typically goes to completion	does not typically go to completion

**ASSESSMENT****Chapter 16 Test****BLM 16.5.1**

23. The yeast cells shown here are reproducing using an asexual process called

- a. budding
- b. vegetative reproduction
- c. fragmentation
- d. conjugation



24. A female green aphid can reproduce using a form of asexual reproduction in which an unfertilized egg develops into an adult. This form of reproduction is called

- a. budding.
- b. conjugation.
- c. spermatogenesis.
- d. parthenogenesis.

25. The dominant stage in the life cycle of a pine tree is

- a. the diploid ( $2n$ ) sporophyte stage.
- b. the haploid ( $n$ ) sporophyte stage.
- c. the diploid gametophyte stage.
- d. the haploid gametophyte stage.

26. In the life cycle of a pine tree, the ovules are found on the

- a. needle-like leaves.
- b. seed cones.
- c. pollen cones.
- d. root hairs.

27. The free-swimming stage in the life cycle of members of the phylum Cnidaria is called the

- a. medusa.
- b. polyp.
- c. bud.
- d. gamete.

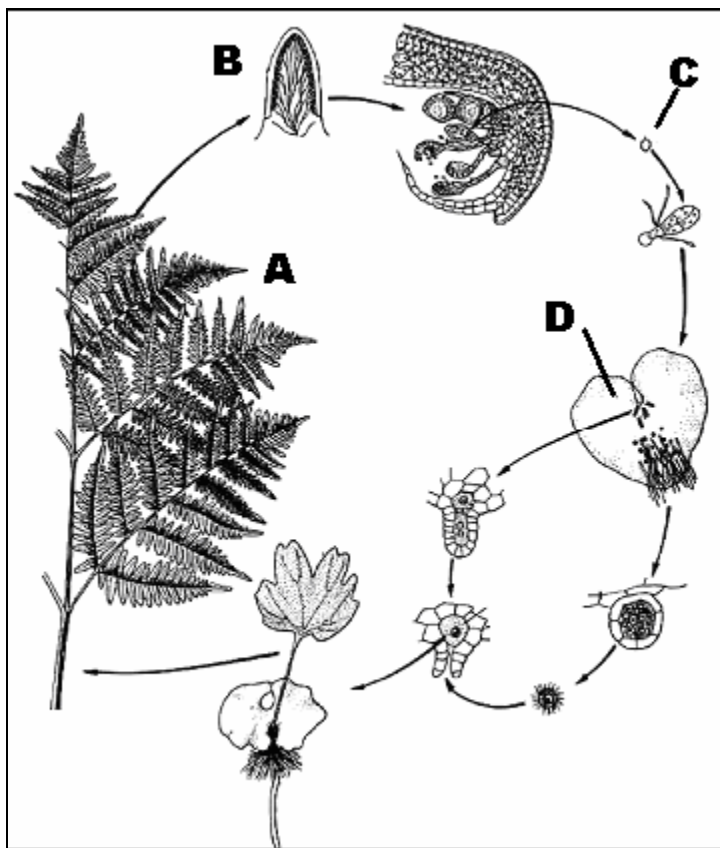
28. Which of the following statements is incorrect?

- a. Asexual reproduction often proceeds more quickly than sexual reproduction.
- b. Asexual reproduction usually requires less energy than sexual reproduction.
- c. Asexual reproduction allows for increasing genetic diversity in the population.
- d. Asexual reproduction does not require the presence of a second parent.

## ASSESSMENT

**Chapter 16 Test****BLM 16.5.1**

*Use the following illustration to answer the next two questions.*



29. Which of the following structures is correctly labelled?

- a. Structure A is the gametophyte.
- b. Structure B is the sporangium.
- c. Structure C is a gamete.
- d. Structure D is the sporophyte.

30. The life cycle of a fern illustrates the process of

- a. fragmentation.
- b. budding.
- c. alternation of generations.
- d. alternation of sexual cycles.



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### Numerical Response Questions

- Record your answer on the answer sheet provided.
  - If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- Species of polyploid coffee plants are known. Calculate the diploid, tetraploid, and octoploid number of chromosomes for this species if its haploid number is 11 chromosomes. Record your **6-digit answer** in the numerical response section of the answer sheet.

$$\underline{\quad\quad\quad}$$

**2n**

$$\underline{\quad\quad\quad}$$

**8n**

$$\underline{\quad\quad\quad}$$

**4n**

- The events of the cell cycle are identified below. These events are not necessarily in the correct order.
  - S phase – period of DNA synthesis
  - cytokinesis – the division of the cytoplasm
  - G1 phase – growth phase
  - mitosis – division of the nucleus
  - G2 phase – growth phase

The correct order of the events in the cell cycle are \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_, and \_\_\_\_\_. Record your **5-digit answer** in the numerical response section of the answer sheet.

- The major events in spermatogenesis in human males are listed below. These events are not necessarily in the correct order.
  - meiosis II
  - spermatids
  - spermatogonium
  - meiosis I
  - primary spermatocytes
  - secondary spermatocytes

The correct sequence in the production of sperm is \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_, and \_\_\_\_\_. Record your **6-digit answer** in the numerical response section of the answer sheet.

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### Written Response Questions

Answer each question in the space provided. Use complete sentences and include diagrams (with labels) when required.

*Use the following information to answer the next question.*

#### Needling Chromosomes Yields Insights into Cell Division

In the Dec. 14, 2004, issue of *Current Biology*, Leocadia Paliulis and Bruce Nicklas report their progress in understanding how the pairs of chromosomes in each cell manage to balance their adhesion to one another and their release during cell division. Their work was sponsored by the National Institutes of Health. Chromosomes are the tiny fibre structures in the cell that house its genes. They replicate and separate in the process of cell division.

The exquisite management of adhesion properties between newly divided chromosomes, called chromatids, is crucial if the cells are to divide properly. In this process chromatids are drawn apart to separate poles of the dividing cell so that each new “daughter” cell contains a single copy of each. The same basic process operates in normal cell division, called mitosis, as well as the proliferation of sperm and egg cells called meiosis.

“Chromosomes in mitosis and meiosis have to be held together, because otherwise they don’t attach to the apparatus called the spindle that distributes them to opposite poles,” explained Nicklas, who is a Research Professor of Biology. “If they’re held together, then one replicated chromatid can attach to one pole and the other to the opposite pole. But if they are not held together, they attach independently, and often both sister chromatids can go to the same pole rather than to opposite poles. This creates chromosome imbalances that can lead to cancer or chromosomal abnormalities that cause birth defects.”

According to Nicklas, it was known that the two sister chromatids adhered to one another and released at the appropriate time during cell division. However, that understanding was based on biochemical experiments that revealed when the “glue” protein called cohesin that holds chromatids was degraded during cell division. Also, microscopic studies had shown that there appeared to be two separate chromatids during an early stage of cell division, so it was believed that they had detached from one another at that time.

“What hadn’t been done was to attempt to separate chromatids to directly determine whether they, in fact, are held together or not,” said Nicklas. “So, Leocadia set out to use micromanipulation to distinguish between visible separateness and physical separateness.”

1. a) **Identify** the phase or phases in mitosis where the chromosomes must be held together. **Explain** why it is important that the chromosomes be held together during this phase(s). (4 marks)

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	<b>Chapter 16 Test</b>	<b>BLM 16.5.1</b>
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- b) **Sketch** the events in mitosis in an animal cell assuming that the diploid number is 4 chromosomes. Label your diagrams. (10 marks)

- c) Karyotyping is a technology that can be used to identify chromosome abnormalities.  
**Describe** the general process of making a karyotype. (2 marks)

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- d) **Identify** the substance that holds the sister chromatids together. (1 mark)

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*Use the additional information below to answer the following questions.*

### **Needling Chromosomes Yields Insights into Cell Division (continued)**

To study chromatid adhesion, Paliulis mastered the high art of manipulating two infinitesimal glass needles to impale each of two sister chromatids in cultured grasshopper cells at the appropriate time in cell division. Then, she would ever-so-gently apply force to pull them apart. Upon release, if they remained apart it revealed they were separated; but if they snapped back together the researchers would know the chromatids were still attached. Paliulis was a Duke graduate student when she performed the experiments, but is now a postdoctoral fellow at the University of North Carolina at Chapel Hill

The experiments revealed that the chromatids are attached to one another, but that they initially separate at their centers, zipping apart until they are entirely separate. Then, they can be drawn to the opposite poles of the dividing cell. The experiments also revealed that it is the erosion of linkages between the chromatids, and not any tension exerted by the spindle, that causes the chromatids to separate.

Also intriguing, found the researchers, was that the chromatids mysteriously remained stuck to one another at a time when biochemical analysis could not detect any cohesin proteins in the cell. Nicklas believes that the twin chromatids may still have some entanglements between the corresponding DNA strands on each chromatid. DNA, which makes up genes in the cell, replicates itself as a central process in chromosome duplication.

“So, we’re left with the mystery of what molecules hold the chromatids together at this point in cell division,” Nicklas said. “But that’s the usual outcome of work in my laboratory and a sign that we’re doing good science since we raise new questions. We lay the mechanistic groundwork for the molecular explanations that have to be made. So, our colleagues who do molecular work are both provoked and challenged by us,” he said.

Source: <http://www.sciencedaily.com/releases/2005/01/050111180610.htm>

- e) **Describe** how these scientists believe the sister chromatids are separated during mitosis. (2 marks)

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- f) **Explain** why these scientists think that they are doing “good science”. (2 marks)

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Use the following information to answer the next question.

### Fertility, Kinases, and Cancer

By Jason Socrates Bardi

In the world of fertility science, the last 25 years have been most productive. In the year 2000, the most recent for which the U.S. Centers for Disease Control and Prevention makes data available, more than 400 fertility clinics were operating in the United States alone, and nearly one out of every hundred children born in this country was born thanks to assisted reproductive technologies like *in vitro* fertilization. Yet infertility in both men and women still poses myriad problems, and some of its basic causes remain unexplained.

Now a team of scientists led by Professor Steven Reed and Research Associate Charles Spruck, both members of the Department of Molecular Biology at The Scripps Research Institute (TSRI), has identified a mammalian protein that seems to play a crucial role in “meiosis,” a biological process critical for fertility.

It seems strange that a single protein would have such a profound biological effect on the fertility of both men and women. After all, the ovaries and the testes are two very different organs, and the process of meiosis that occurs in both spermatocytes and oocytes is different in these two types of cells.

Nevertheless, a protein called “Cks2” that Reed, Spruck, and their colleagues describe in the April 25, 2003 issue of *Science* seems to be critical for both male and female fertility. Knocking out the protein *in vivo* blocked both spermatocyte meiosis in males and oocyte meiosis in females. “Any increase in our understanding of how meiotic divisions occur may help in addressing these fertility problems,” says Reed, though also cautioning, “it’s [too] early to say how.” Also, in knocking out Cks2 from mammals, the team has created *in vivo* models that can potentially serve for studying the process of human fertility disorders and meiosis.

Source: [http://www.scripps.edu/newsandviews/e\\_20030505/reed.html](http://www.scripps.edu/newsandviews/e_20030505/reed.html)

2. Write a unified response that addresses the following aspects of gametogenesis.
  - **Draw** a labelled diagram that **compares** and **contrasts** spermatogenesis in males to oogenesis in females. Assume that the haploid number is  $n = 2$  chromosomes.
  - **Predict** the phase or phases of meiosis that would be affected if the Cks2 protein is applied to primary spermatocytes or to primary oocytes. **Explain** how the failure of germ cells to progress past metaphase I would produce sterility.
  - **Describe** two societal issues related to this article. State your position on each issue and justify it using at least two well-developed arguments.

CLASS:

[illegible]