In 1988, doctors and patients hailed the discovery of a powerful new cancer-fighting drug then making its way through clinical trials. Known as taxol, the drug had remarkable effectiveness in treating advanced ovarian cancer. Some 30% of women with ovarian cancer who took taxol saw their tumors shrink, even after other drugs had failed to have any effect. Two years later, taxol was found to be even more effective at treating breast cancer: 50% of patients saw their tumors regress. For all these women, taxol was a lifesaver, and demand for the drug skyrocketed. There was just one problem: taxol was isolated from the bark of the Pacific yew tree, found only in old-growth forests of the Pacific Northwest. If every woman with ovarian cancer who needed the drug got it, it would mean harvesting 1.3 million pounds of bark and killing 360,000 trees. Add in the trees required to treat patients with breast cancer, and the numbers were staggering.

“You needed the bark from a fairly good-sized tree to treat one woman with breast cancer,” says Susan Band Horwitz, a molecular pharmacologist.
**CHAPTER 9 Test Your Knowledge**

### DRIVING QUESTION 1
When and how does normal cell division occur in the body?

By answering the questions below and studying Infographics 9.1 and 9.2, you should be able to generate an answer for the broader Driving Question above.

**KNOW IT**

1. Following mitosis and cytokinesis, daughter cells are a. genetically unique. b. genetically identical to each other. c. genetically identical to the parent cell. d. contain half of the parent cell’s chromosomes.

2. In the cell cycle, DNA is replicated during a. mitosis. b. G1. c. S. d. G2.

3. What process is critical for embryonic development, wound healing, and replacement of blood cells? | Hist: All these processes require new cells.

4. During which stage of the cell cycle do sister chromatids separate from each other?

5. During which stage of the cell cycle are sister chromatids initially produced?

**USE IT**

1. If a cell fails to replicate its DNA completely, what will happen? a. It will progress through G1 and mitosis. b. It will die by apoptosis. c. It will pause to allow DNA replication to complete. d. It will stop in S phase and never progress further through the cell cycle. e. It will stay in interphase indefinitely.

2. Many drugs interfere with cell division. Why shouldn’t pregnant women take these drugs?

3. What would be the result if a cell completed interphase and mitosis but failed to complete cytokinesis—how many cells would there be at that point, assuming the same chromosomes relative to the parent cell would those cells have?

### DRIVING QUESTION 2
How do normal cells and cancer cells differ with respect to cell division?

By answering the questions below and studying Infographics 9.3, 9.4, 9.5, and 9.6, you should be able to generate an answer for the broader Driving Question above.

**KNOW IT**

1. A normal cell that sustains irreparable DNA damage will most likely a. divide out of control. b. die by apoptosis. c. arrest in G0. d. immediately go back to S phase. e. stop in S phase and never progress through the cell cycle.

2. Which checkpoint prevents a normal cell from completing its cell cycle if it has not accurately replicated its DNA? a. interphase (G1-S) b. interphase (G2-M) c. mitotic (M) d. and b e. all of the above

3. Cancerous cells may not peel after a bad sunburn. What process has failed in this case? a. DNA replication d. checkpoints b. signaling to divide e. apoptosis c. cytokinesis

4. Complete the table below by placing a checkmark to indicate which cells will divide in which conditions. Growth factors (GFs) are molecules that signal normal cells to divide.

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>No GFs</th>
<th>GFs Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Skin Cell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melanoma Skin Cell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer Cell</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**USE IT**

1. After a bad sunburn, skin usually peels. What process best describes what has happened to the burned skin cells? a. skin cancer d. checkpoint failure b. metastasis e. cytokinesis c. apoptosis

2. For patients with breast cancer, what proportion will be disease free in 1 year if Taxol is added to their chemotherapy? a. if patients with stage 3 ovarian cancer have Taxol added to their chemotherapy regimen, what proportion of them will be alive after 4 years, relative to patients who do not have Taxol added to their chemotherapy regimen? b. For patients with breast cancer, what proportion will be disease free in 1 year in the absence of Taxol? How do these proportions compare to the same patients at 4 years?

3. Complete the following sentences with the options given. a. surgery d. chemotherapy without Taxol b. radiation e. Taxol c. none of the above

### INTERPRETING DATA

**DRIVING QUESTION 3**
**How are decisions about treatment made for a given cancer patient?**

By answering the questions below and studying Infographics 9.6 and 9.7, you should be able to generate an answer for the broader Driving Question above.

**KNOW IT**

1. A patient has metastatic melanoma—a skin cancer that has spread throughout the body. Is surgery a viable option for this patient? Why or why not?

2. Which of the following properties should a promising new ovarian cancer drug have? a. blocks mitosis in noncancerous cells b. blocks mitosis in cancerous cells c. prevents entry into S phase in normal cells d. enhances the activity of cell cycle checkpoints in noncancerous cells e. and b

3. Explain why chemotherapy can cause nausea, diarrhea, and hair loss.

### DRIVING QUESTION 4
**How are new cancer drugs developed?**

By studying Infographics 9.4, 9.5, and 9.6 and answering the questions below, you should be able to generate an answer for the broader Driving Question above.

**KNOW IT**

1. In the production of taxol: a. what plant was at risk from early demand? b. what animal was consequently put at risk?

2. If a medically valuable drug is isolated from a rare plant, which of the following steps can be taken to ensure that the drug is made available to patients in need and that the plant is protected from overuse? a. Try to cultivate the plant on a farm to ensure that there is sufficient supply independent of the plant in its native setting. b. Try to find a related (and less rare) plant that produces a related compound with similar pharmaceutical activity. c. Use the structure of the compound to try to make a completely synthetic version of the chemical compound in a laboratory.

3. Learn more about what the drug is doing in the body and try to design synthetic molecules that might have the same activity. a. all of the above

**USE IT**

1. You are a senator sitting on a committee to review cancer drug development. You have heard testimony from a patient with drug-resistant ovarian cancer, an environmentalist, a college student, and a cancer researcher. Summarize their testimony and explain how each witness contributed to your position on the conflict between saving trees and saving lives.

### MINI CASE
**BRING IT HOME**

1. You’re a college student, and you’ve heard that there aren’t more anticancer drugs for her mother’s breast cancer. She was treated with a generic version of Taxol, but her cancer was resistant, and continued to grow. Her doctors have let her know that there aren’t a lot of options for her beyond standard chemotherapy. She wonders why there aren’t more antitumor drugs for her doctors to choose from. What can you tell her about the process of drug discovery and development that would help to explain why there are few novel anticancer drugs?