

Standard B-2.7 :

Summarize how cell regulation controls and coordinates cell growth and division and allows cells to respond to the environment, and recognize the consequences of uncontrolled cell division.

Key Concepts

Chemical Control System

Internal vs. External Signals

Checkpoints

Cancer Cells

Malignant vs. Benign Tumors

It is essential for you to know:

- ✧ The cell cycle is driven by a *chemical control system* that both triggers and coordinates key events in the cell cycle.
- ✧ Recognize consequences of uncontrolled cell division.

Objectives

Identify internal and external factors that regulate cell division.

Explain cancer in terms of the cell cycle.

Vocabulary Words

Define the following vocabulary words:

1. Growth factor
2. Apoptosis
3. Cancer
4. Benign
5. Malignant
6. Metastasize
7. Carcinogens

You've already learned that cells in different parts of the body divide at different rates. For example, cells in the lining of the stomach divide at much faster rates than most of the other cells in your body. Some cells, like neurons, will not divide at all. Signals from within the cell and from the cell's environment control a cell's division.

Internal and External Factors Regulate Cell Division

External Factors come from the **outside** of the cell.

They may be messages from nearby cells or from distant **parts** of the body.

Internal factors come from the **inside** of the cell.

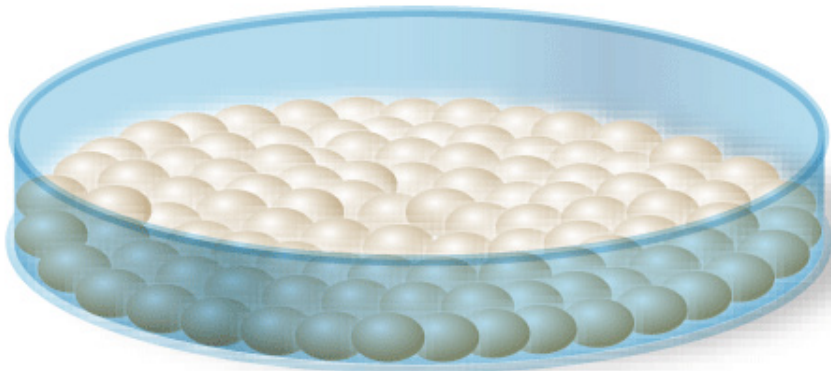
They include several types of molecules found in the **cytoplasm** of the cell.

External Factors

Includes both physical and chemical signals.

A physical signal would be cell to cell contact.

Normal cell growth

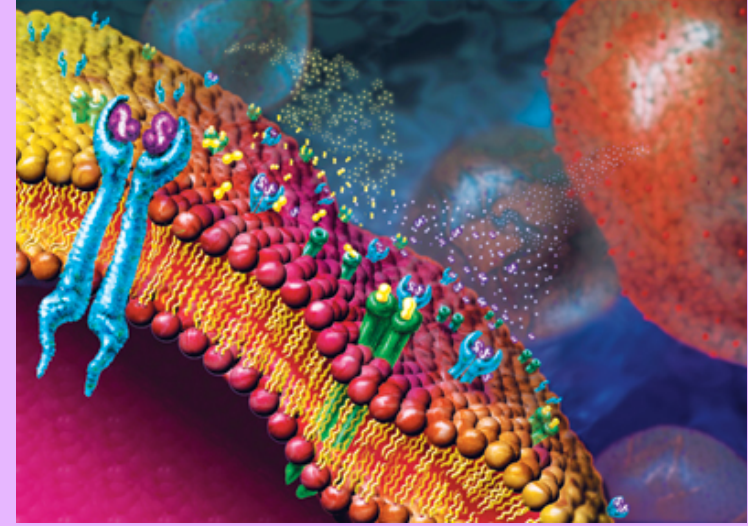


Most mammal cells grown in the lab for a single layer on the bottom of a culture or Petri dish. Once a cell touches another cell, it stops dividing. The exact reason for this phenomenon is unknown.

External Factors

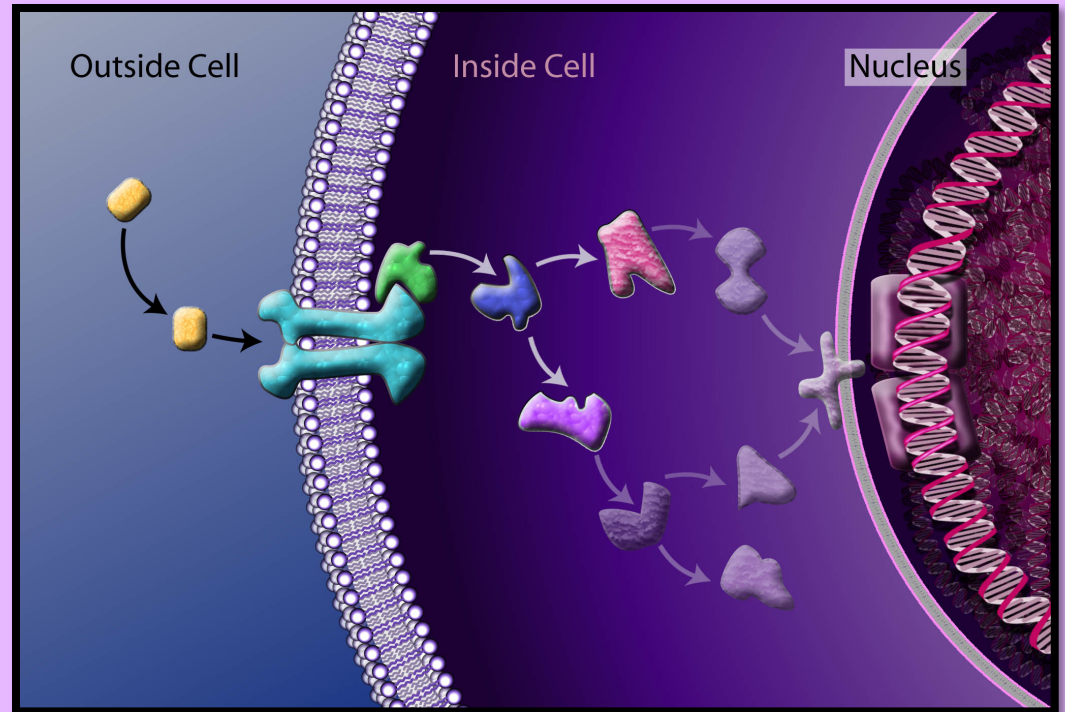
Many cells release chemical signals that tell other cells to grow. This would include

growth factors, a group of proteins that stimulate cell division. In general, cells growth and divide in response to a combination of different growth factors, not just one. Various hormones may also stimulate the growth of certain cell types. In particular, growth hormones results in bone growth and also affects your protein and fat metabolism.



Internal Factors

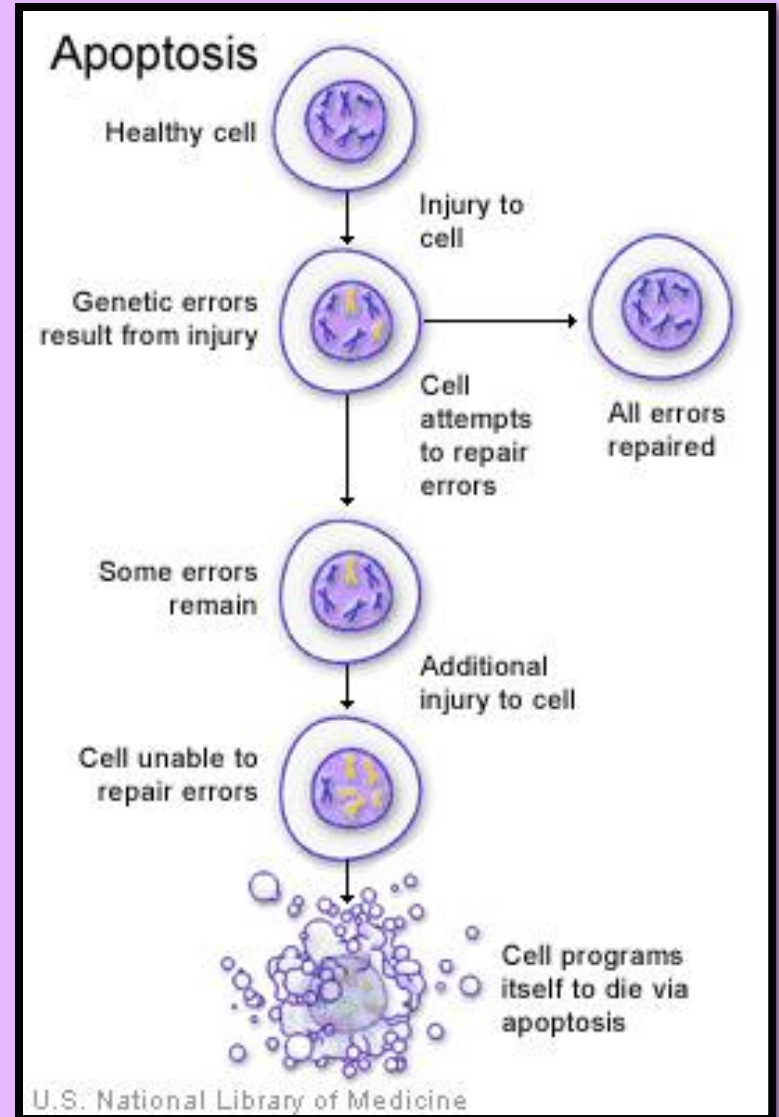
When external factors bind to their receptors, they can trigger internal factors. There are two main types in eukaryotic cells: Kinases and Cyclins



Apoptosis

Just as some cells need to grow and divide, other cells need to die.

Apoptosis is programmed cell death. It occurs when internal or external signals activate genes that help produce self-destructive enzymes.



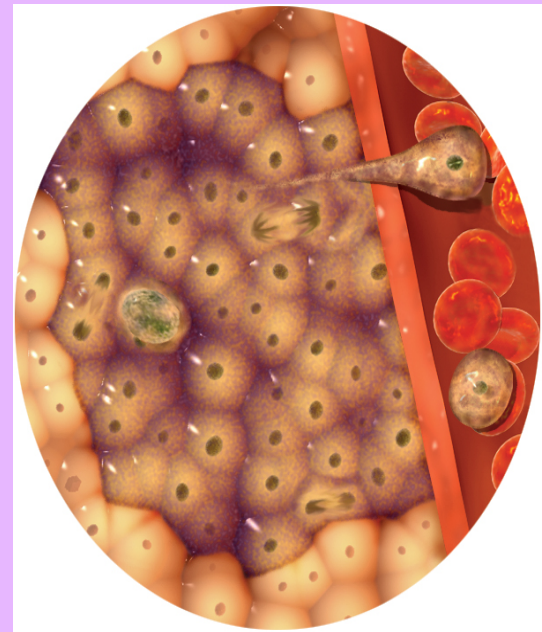
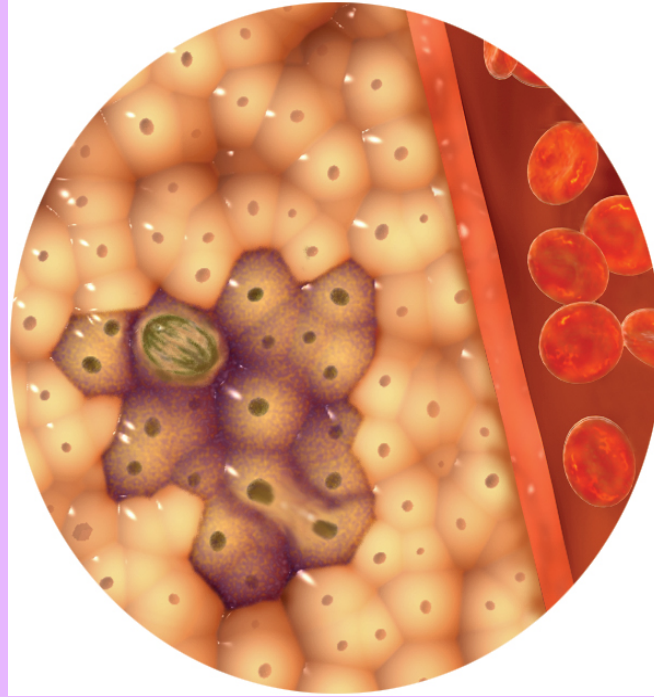
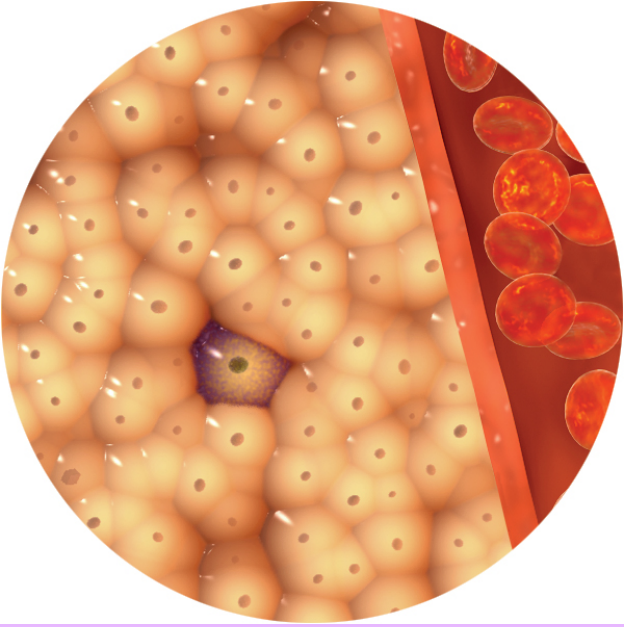
Apoptosis



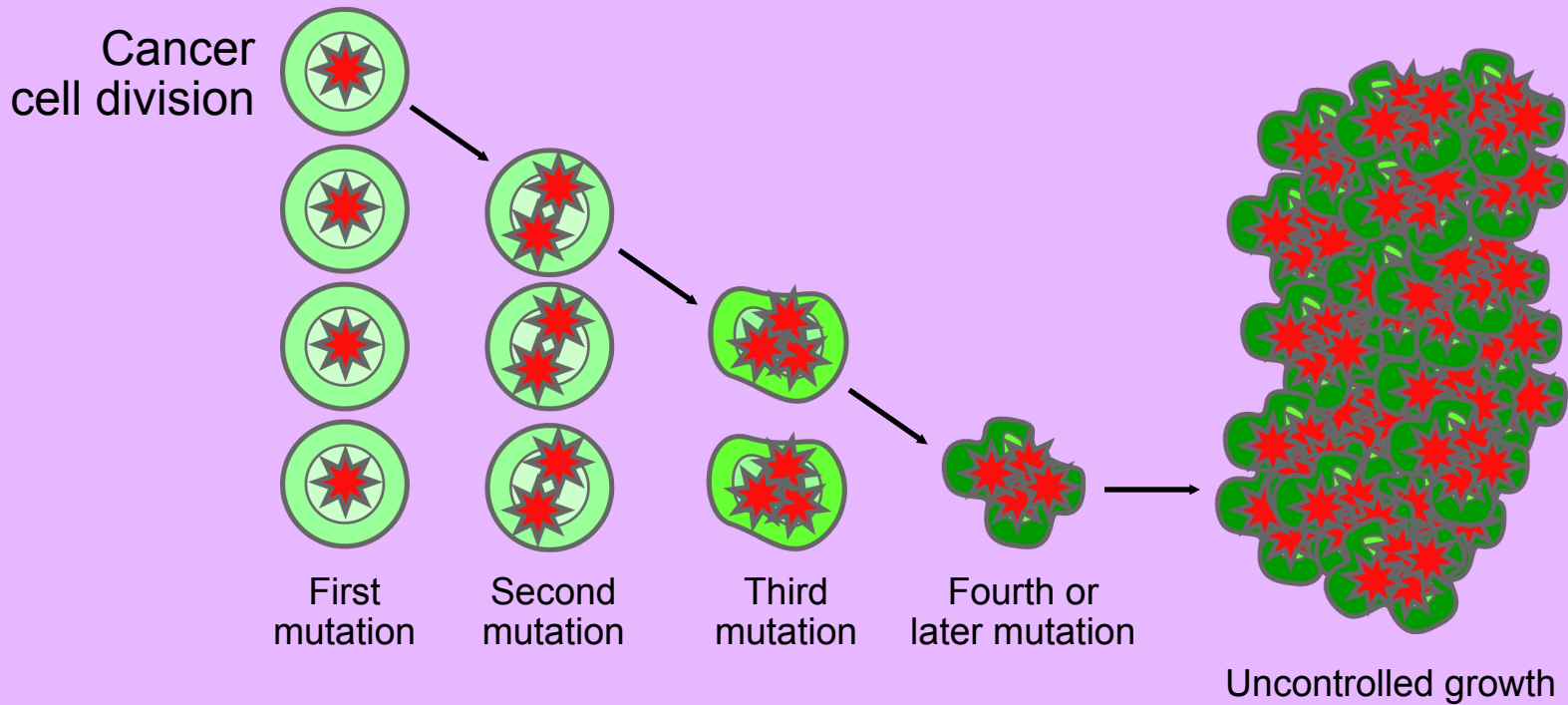
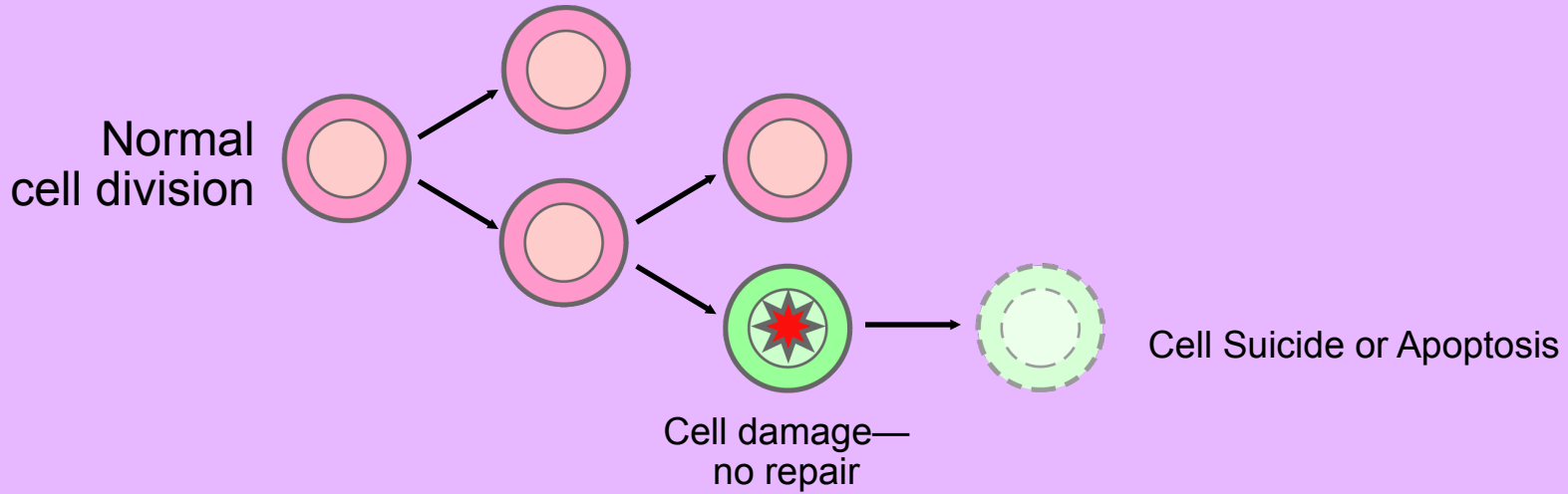
The picture to the left shows a classic example of apoptosis. In the early stages of development, human embryos have webbing between their fingers and toes. Before the baby is born, those cells typically go through apoptosis. Most babies are born with little, unwebbed fingers and toes.

Cell Division is Uncontrolled in Cancer

Cancer is the common name for a class of diseases characterized by uncontrolled cell division. Unlike healthy cells, **cancer** cells grown in a culture (Petri) dish continue to divide even when surrounded by neighboring cells. Cancer cells form disorganized clumps called **tumors**. Tumors can be either **benign** or **malignant**. If they are benign, they tend to stay in one place and are relatively **harmless**. They can usually be cured by **removing** them. If they are malignant, some of the cancer cells can **break away** or metastasize. This means they can leave their original place of origin and travel elsewhere in the body. They can be carried via the **blood stream** or the **lymph system**.



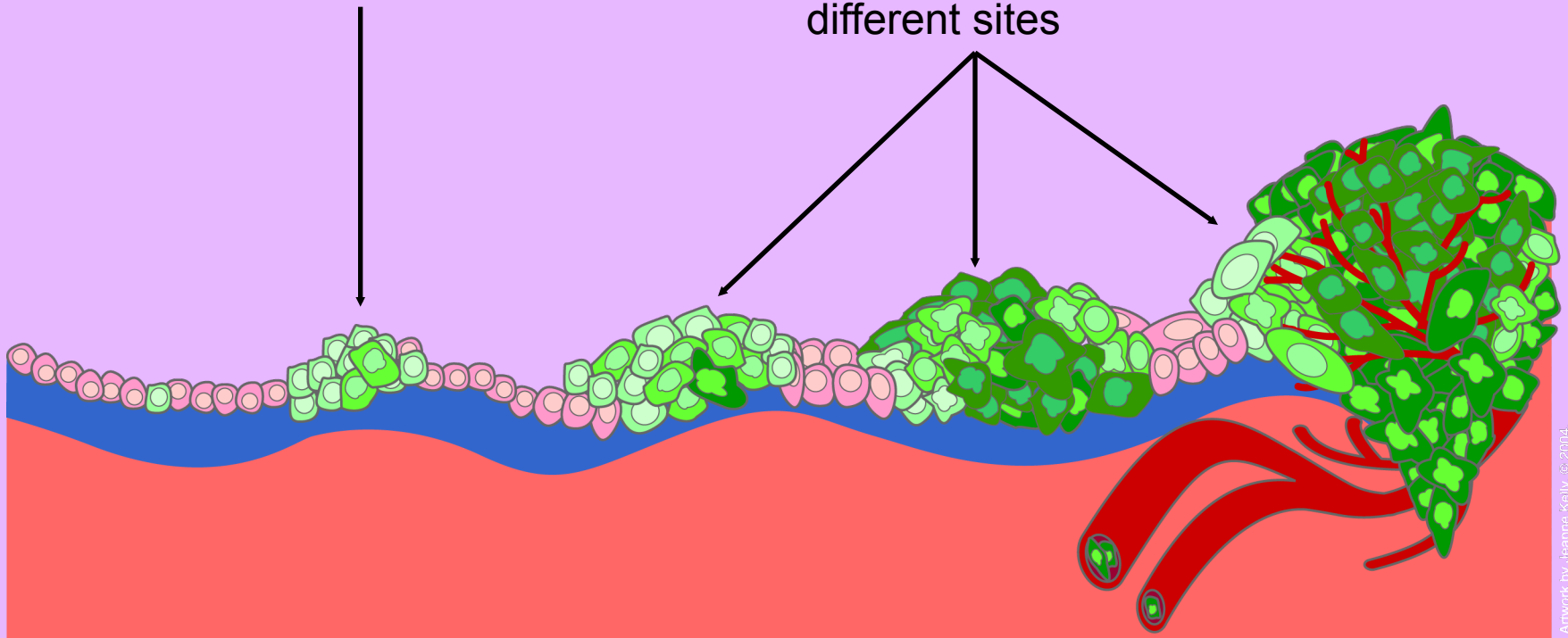
Loss of Normal Growth Control



Malignant versus Benign Tumors

Benign (not cancer)
tumor cells grow
only locally and cannot
spread by invasion or
metastasis

Malignant (cancer)
cells invade
neighboring tissues,
enter blood vessels,
and metastasize to
different sites



Cancerous Cell Growth

Cancer cells do not perform specialized functions by the body. For example, if there is cancer in the lungs, they will not exchange oxygen and carbon dioxide. Cancer cells come from normal cells that have suffered damage to the genes that help make proteins involved in cell cycle regulation. There can be many reasons why a cell turns cancerous. Substances known to produce or promote the development of cancer are called carcinogens. These include tobacco smoke and certain air pollutants, which are both associated with lung cancer. Sometimes they can be carried by a virus, such as the one known to cause cervical cancer. Standard cancer treatment involves both radiation and chemotherapy.

