



uBEATS Teacher's Guide:

Hallmarks of Cancer

This teacher guide is a supplementary text to support the use of the uBEATS “Hallmarks of Cancer” module.

To help students develop the knowledge necessary for an incredible future in health care, we created UNMC Building Excellence in Academics Through STEM (uBEATS), an online health science resource for Nebraska students.

UNMC uBEATS modules are short (15 minutes or less), interactive online health science modules to supplement curriculum taught in grades 6 – 12. These do not replace curriculum but are a supplement for teachers and students incorporating evidence-based information and UNMC expert guided material. Each module is chunked into sections with formative and summative assessments with immediate feedback provided.

Tips on how to utilize uBEATS modules:

- Internet access is required to view uBEATS modules.
- For those who have access to one-to-one technology, modules can be used in or outside of the classroom as a topic introduction, extension, or review.
- For classrooms without individual student devices modules can be used in whole group instruction. Formative assessment questions can use the teacher's preferred call and response method and summative assessment questions can be displayed on the board and answered individually by students or printed and distributed to students after viewing the module.

Objectives

- Recognize the six hallmarks (characteristics) of cancer.
 - Describe emerging hallmarks and be able to explain the enabling characteristics.
 - Create and correlate hallmark analogies.
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Introduction

One of the first steps in learning about cancer is understanding what doctors and researchers call the “Hallmarks of Cancer.” In the year 2000, cancer researchers Douglas Hanahan and Robert Weinberg identified six characteristics of cancer. They called them the “Hallmarks of Cancer.” In this module you will learn more about the significance of Hanahan and Weinberg’s discovery.

Why would you want to learn about cancer? Cancer is a disease that affects many people—perhaps people in your own family, or even you. By learning about cancer, we can design and choose effective treatments for cancer. When we understand more about cancer, we can care for cancer patients in the best ways possible.

Prior Knowledge

Before beginning this module, the student should understand the Next Generation Science Standards (NGSS) featuring [Three-Dimensional Learning](#).

Core Idea LS1.A. Structure and Function

- **By the end of grade 8.** Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features (such as attractively colored flowers) for reproduction. Plant growth can continue throughout the plant’s life through production of plant matter in photosynthesis. Genetic factors as well as local conditions affect the size of the adult plant. The growth of an animal is controlled by genetic factors, food intake, and interactions with other organisms, and each species has a typical adult size range. [A Framework for K-12 Education](#).

Science and Engineering Practices [NGSS](#)

- Developing and using models

Crosscutting Concepts [NGSS](#)

- Systems and system models



Key Terms/Vocabulary

Cancer, abnormal gene, inheritance, diagnosis, detection, treatment, hallmarks of cancer, emerging hallmarks, enabling traits, lifecycle, apoptosis, proliferative signaling, chronic reproduction, receptor, growth factor, mutation, growth suppressor, invasion, metastasis, tumor, proliferation, replicative immortality, chromosome, telomerase, angiogenesis, nutrients, immune response, deregulating cellular energetics, glucose, oxygen, tumor-promoting inflammation.

Science Standards

This module is related to the content of **UNMC High School Alliance: Introduction to Pathology and Microbiology**

Pathology is the study of disease processes. The field lays the foundation for all clinical medicine and medical research. All diseases begin at the cellular level and changes in the structure and function of tissues ultimately lead to symptoms that health care providers see daily. This course will introduce students to medical terminology, normal histology and gross/microscopic pathology, allowing students to correlate the findings they see into basic clinical concepts.

Nebraska's College and Career Ready Standards for Science 2017 [Nebraska Science Standards](#)

Engineering in Health Sciences SC.HSP.17.1.C

- Evaluate a solution to a complex real-world human health problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Extensions of the lesson

- To help students become more familiar with the Key Terms of this module, the teacher can use the vocabulary list for a classroom Word Wall or integrate the vocabulary into classroom word games during review sessions.
- To help the students see personal relevance, suggest that they have a **private** conversation with family members regarding someone who has had a tumor, attempting to apply this module's vocabulary terms as appropriate.
- As student misconceptions become apparent, the teacher may need to reinforce these important concepts:
 - Cancer involves too much growth. Some people believe that cancer makes a person's hair fall out, but that is not the case. The treatment of cancer—the attempt to stop rapid growth—is what can interfere with normal cell activities throughout the body.
 - Cancer itself is not inherited. Cancer is genetic, considering the fact that it involves changes to the DNA that controls cell functions. However, what can be



inherited is a predisposition to develop certain cancers. If a person does carry such a genetic predisposition, it does not necessarily cause that person to have cancerous cells. ([NIH: The Genetics of Cancer](#))

- Cancer can occur at any age, but the risk increases as a person gets older.
- Cancers can behave differently in every patient.
- The medical community does not have a cure for cancer, but research is leading to better treatments that can stop the growth of cancer and improve the quality of life for the patient.
- Research has identified the major characteristics (hallmarks) of cancer:
 - Resisting the normal process of cell death (apoptosis).
 - Continuing rapid cell reproduction.
 - Evading the signals that normally slow down rapid reproduction.
 - Invading surrounding tissue or traveling to distant organs or tissue.
 - Enabling the cells to reproduce indefinitely.
 - Building new blood vessels to serve the needs of the tumor cells.
- As research continues, more characteristics have been added to the list:
 - Avoiding the immune system.
 - Changing how energy is used, giving advantage to the cancer cells.
 - Increasing blood flow and sending macrophages to stimulate growth.
 - Changing DNA sequences sometimes results in cancerous growth.

Enrichment

- For information about career opportunities, see UNMC's [Careers in Healthcare](#).
- Students should be watchful in current events for recent articles about cancer.
- For an interactive module that shows how mutations in genes can lead to the development of cancer, see [The Eukaryotic Cell Cycle and Cancer](#).
- Students can develop "Analogies for Hallmarks of Cancer" poster presentations illustrating the analogies used in this e-learning module.
- Students can research each Hallmark of Cancer and create a children's book using analogies to explain each Hallmark of Cancer.
- To make connections in your community, contact local hospitals, healthcare clinics, nurses, doctors, medical laboratories.