

Resources for Teaching Cancer Biology¹

Learning Activities

The first activity listed below provides a good introduction to cancer and the cellular and molecular changes that result in cancer. The second resource listed below provides activities that will foster in depth student understanding of cell cycle checkpoints and mutations that contribute to the development of cancer. The third resource provides activities that will help students understand the basic biology and health aspects of cancer. The fourth resource is a hands-on activity that focuses on UV damage to DNA and repair of damaged DNA, with a page relating these topics to skin cancer.

Melanoma, Mutations and Abnormal Cell Cycles

(<https://serendipstudio.org/exchange/bioactivities/melanoma>)

This minds-on, analysis and discussion activity introduces students to basic cancer biology, somatic mutations, and regulation of the cell cycle. After students view an introductory video about a teen with melanoma, they complete five sections: “What is a melanoma?”, “How does melanoma develop?”, “Why do melanoma cells divide more than normal cells?”, “Genes, Environment and Melanoma”, and a final section in which students summarize their major conclusions about melanoma and learn which of these generalize to other types of cancer. (NGSS)²

Teaching Cell Biology and Genetics Using Cancer (<https://www.biointeractive.org/planning-tools/resource-playlists/teaching-cell-biology-and-genetics-using-cancer>)

This resource includes six activities in English and Spanish. Probably the most generally useful is “2. The Eukaryotic Cell Cycle and Cancer” (<https://media.hhmi.org/biointeractive/click/cellcycle/>), an interactive with a great deal of information. I recommend that the students first click on the background and key concept tabs and then click on different parts of the cell cycle checkpoint diagram. To assess student learning, you may want to use the Overview Student Worksheet (<https://www.biointeractive.org/classroom-resources/eukaryotic-cell-cycle-and-cancer?playlist=181755>). Another useful resource for more advanced students is the 8.5-minute video of a 2013 lecture, “Mutations in Cancer” (<https://www.biointeractive.org/classroom-resources/mutations-cancer>), together with “Activity 2: Examining Cancer Patient Data” (<https://www.biointeractive.org/classroom-resources/classifying-cancer-genes-and-examining-patient-data?playlist=181755>).

Decoding Cancer (<https://www.decodingcancer.org/lesson-plans>)

This resource includes six activities, with an emphasis on health or medical aspects of cancer. Probably the most useful for a general biology class is “What Is Cancer?” which includes student identification of common misconceptions about cancer and application of student knowledge about cells and cell growth to understand the development of cancer.

UV, Mutations, and DNA Repair (https://serendipstudio.org/sci_edu/waldron/#uvmutations)

In this hands-on, minds-on activity, students learn about the effects of UV light, mutations and DNA repair on the survival of prokaryotes and the risk of skin cancer. In the first experiment, students evaluate the effects of different durations of UV exposure on survival and population growth of *Haloferax volcanii*. This experiment also tests for photorepair of DNA damage. Students design the second experiment, which evaluates the effectiveness of sunscreen. In addition, students answer analysis and discussion questions that promote their understanding of molecular biology, cancer, and the interpretation of experimental results. (NGSS)

¹ By Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania, 2022. These Teacher Notes are available at <https://serendipstudio.org/exchange/bioactivities/cancer>.

² “How Are Cancer Cells Different from Normal Cells?” (<https://www.nsta.org/lesson-plan/how-are-cancer-cells-different-normal-cells>) covers much of this content in a whole class discussion format.

Sources of Reliable Information³

What is cancer? (<https://www.cancer.gov/about-cancer/understanding/what-is-cancer>)

A good basic introduction

Cancer Biology (<https://www.cancerquest.org/cancer-biology>)

Includes an introductory 11.5-minute video, an amusing graphical guide, and informative articles on many aspects of cancer, including cancer epigenetics, cancer development (including cancer stem cells), apoptosis, tumor-host interactions (concerning the effects of the tumor microenvironment), and the immune system and cancer.

Cell Cycle (and cancer) [updated] (<https://www.yout-ube.com/watch?v=QVCjdNxJreE>)

A 9-minute video; the second half is especially helpful.

What is cancer? (<https://www.cancerresearchuk.org/about-cancer/what-is-cancer>)

Another good introduction to cancer

Cancer and the Cell Cycle (<https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/regulation-of-cell-cycle/a/cancer>, with a 12.5 minute video at the bottom of <https://openstax.org/books/biology-2e/pages/10-4-cancer-and-the-cell-cycle>)

A good explanation of how cancer can be linked to overactive positive cell cycle regulators (oncogenes) or inactive negative regulators (tumor suppressor genes).

Oncogenetics – Mechanism of Cancer (tumor suppressor genes and oncogenes)

(<https://www.yout-ube.com/watch?v=1mo80kTZgW4>)

An 11.5-minute video that includes the roles of cyclins and CDK's and detailed molecular biology

Understanding Your Diagnosis (<https://www.cancer.org/treatment/understanding-your-diagnosis/what-is-cancer.html>)

A more medically oriented introduction to cancer

Cancer Types (<https://www.cancer.gov/types>)

Information about causes, prevention and treatment for various types of cancer

³ You can convert these information sources to learning activities by providing your students with appropriate questions. A more ambitious approach would be to use the following steps to carry out a jigsaw activity using several of these articles.

- Tell your class that they will read one article in their small group, summarize the main conclusions and evidence, and then share this information with a group of students who have read other articles.
- As students complete the reading individually, each of them should prepare a summary and possibly annotate the article and/or answer any questions that you may have prepared.
- Have students who read the same article briefly share their findings with one another and discuss the article. This will help students prepare to briefly summarize their article in the mixed group.
- Regroup students so that one representative from each article is in each group. Ask students to briefly summarize their articles in their new groups. When sharing the summaries, students should make connections to what they have heard in the other students' summaries. They should talk through anything that is unclear or seems inconsistent from one article to the next. Students should take notes during this sharing, listening, and discussion process.
- The whole class then discusses the main takeaways from the jigsaw reading. Ask students what questions they are still wondering about and try to follow up.

(adapted from <https://www.nsta.org/science-teacher/science-teacher-march-2020/novel-coronavirus>)