Cancer Warriors: A Personal Story of Translational Medicine

Vocabulary:
- **Acute Myeloid Leukemia (AML):** Acute myeloid leukemia (AML) is cancer that starts inside bone marrow, the soft tissue inside bones that helps form blood cells. The cancer grows from cells that would normally turn into white blood cells. Acute means the disease develops quickly.
- **Angiogenesis:** The physiological process involving the growth of new blood vessels from pre-existing vessels.
- **Metastasis:** The spread of a cancer from one organ or part to another non-adjacent organ or part. The plural is metastases.
- **Chemotherapy:** Chemotherapy (also called chemo) is a type of cancer treatment that uses drugs to destroy cancer cells. Chemotherapy works by stopping or slowing the growth of cancer cells, which grow and divide quickly. But it can also harm healthy cells that divide quickly, such as those that line the mouth and intestines or cause hair to grow.
- **Angiostatin:** Is a naturally occurring protein found in several animal species, including humans. It is an endogenous angiogenesis inhibitor (i.e., it blocks the growth of new blood vessels).
- **Endostatin:** A broad-spectrum angiogenesis inhibitor and may interfere with the pro-angiogenic action of growth factors.

Lesson Summary:
Students will reflect upon their own knowledge and experiences with cancer by completing the Cancer: Truth or Myth survey and responding to three short journal prompts. Students will then screen the PBS video: Cancer Warrior, answering discussion questions at particular moments in the film to introduce clinical trials. Finally, students will read the story of Barbara Bradfield from *The Emperor of All Maladies: A Biography of Cancer* to hook student interest in cancer biology and translational medicine.

Student Learning Objectives:
The student will be able to...
1. Propose the causes and treatments of cancer
2. Predict the phases of clinical trials
3. Describe translational medicine

Standards:
- SC.912.L.16.8
- SC.912.L.16.10
- SC.912.N.1.1
- SC.912.N.1.2
- SC.912.N.1.3
- SC.912.N.1.4
- SC.912.N.1.6
- SC.912.N.1.7
- SC.912.N.2.4
- SC.912.N.2.5
- SC.912.N.4.1

**Questions:**
- Why is studying the mechanisms of cancer important?
- Why would testing possible drugs for cancer treatment be important?
- What is translational medicine?

**Time Estimate:**
- Advanced Preparation: ~1.5 hours (55 minutes will be devoted to screening and familiarizing yourself with the PBS video Cancer Warrior in preparation for the class discussion questions)
- Student Procedure: Three 50 minute periods

**Learning Styles:**
- Visual and auditory
Materials:
Student Page: Cancer Survey: Myth or Truth? data collection worksheet
PBS NOVA Film: Cancer Warrior
Student Page: Cancer Warrior Discussion Guide
Teacher Page: Cancer Warrior Discussion Guide
Computers with internet access or phones with texting capabilities

Background Information:
For more detailed information about what cancer is and information on specific cancer types see the National Cancer Institute website at http://www.cancer.gov/cancertopics
For more information on telomeres and their relationship to cancer visit the University of Utah Learn Genetics page at http://learn.genetics.utah.edu/content/begin/traits/telomeres/
If you want even more information about telomeres you can listen to this University of Utah Learn Genetics podcast http://learn.genetics.utah.edu/content/begin/traits/telomeres/bbcawthon050929.mp3

Advance Preparation:
1. Watch Cancer Warrior and familiarize yourself with the Discussion Questions
2. Read through the Barbara Bradfield story
3. Print the student handout: Cancer Warrior-Discussion Questions (one per student)
4. Print the Clinical Trial-A Personal Story of Translational Medicine to read aloud during class time.
5. Print Student Page: Cancer Survey: Myth or Truth? Data worksheet (one per student)
6. Create an account at polleverywhere.com (accounts are free)
7. Type questions for the cancer survey in as 15 different polls. (Note polls are automatically deleted after 30 days)

Procedure and Discussion Questions with Time Estimates:

Day ONE:
1. (1-2 min) Ask students the following questions (give students a moment to look around/count classmates with hands raised after each question):
   a. Raise your hand if you know/have an idea of what cancer is. (Ask students to share what they know)
   b. Raise your hand if you know some who has cancer/has lost their life to cancer.
   c. Raise your hand if that someone is a family member
2. (1-2 min) Read and/or display the following quote from The Emperor of all Maladies on the board:
   “In 2010, about six hundred thousand Americans, and more than 7 million humans around the world, will die of cancer. In the United States, one in three women and one in two men will develop cancer during their lifetime. A quarter of all American deaths, and about 15 percent of all deaths worldwide, will be attributed to cancer. In some nations, cancer will surpass heart disease to become the most common cause of death.”
3. (1-3 min) Ask students the following questions, in response to the quote:
   a. If any of the statistics in the quote are shocking or surprising to you, raise your hand. (give students a moment to look around/count classmates with hands raised)
   b. If you just raised your hand, what part of the quote surprised you and why? (call on a few students to share their responses)
4. **(25 min)** Have the students vote on the 15 questions by texting or sending their answers in over the internet. **Note before the lesson you must create a free account at polleverywhere.com and type in each question as a separate poll.** You will need to clear the data after every class if you are doing this lesson with multiple sections. See the figures below for instructions on how to have students vote. Student should record their own personal answer and class data on their student answer sheet which will be used again in lesson seven.

**You may also choose to complete this activity using the Four Corners Polling Method if your students do not have the appropriate electronic devices or if your room does not have a good wireless signal **

**Four Corners Polling Directions**
1. Assign one number to each corner of the room to represent the numbers on the scale in the survey. Students stand in the middle of the room.
2. As you read a statement students move to the corner of the room they believe represents the correct answer.
3. Ask one student from each corner to share ideas with the whole class.
4. After the discussion is complete students then return to the center of the room and the next statement is read. This continues for all 15 statements.

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![How To Vote via Texting](image1)

![How To Vote via Pollev.com](image2)
**Day TWO:**

1. **(5-7 min)** Pass out Student Page: Cancer Warrior Discussion Question Guide.
   - a. Give students 3-4 minutes to answer the pre-questions about translational medicine and angiogenesis.
   - b. Ask for student volunteers to share their responses to the pre-questions.

2. **(54 min)** NOTE: may carry over to Day THREE depending on class lengths
   - Watch the PBS NOVA film Cancer Warrior. Encourage students to ask questions, pausing the film for clarification, understanding checks and informal discussion as necessary.

3. Ask students to retain the Student Page: Cancer Warrior Discussion Question Guide to use during Day THREE.

**Day THREE:**

1. Finish any of the film that was not screened during Day TWO and give students time to finish any questions they did not complete during the film.

2. **(12-15 min)** Lead the students in a group review of the Cancer Warrior Discussion Questions. This could be done in several ways: allow individual students to respond to each question, assign questions to groups of students to compare answers and then share out their collective response, etc.

3. **(3-5 min)** Pass out Student Page: A Personal Story of Translational Medicine and read together as a class. Ask students for their reactions, etc.

4. **(10-15 min)** Project the following journal questions on the board and ask students to write a response for each one (3-4 sentences minimum). Collect the journals and keep them to be reviewed by the students again during Lesson 7.

**Day THREE Journal Questions:**

1. How has cancer impacted your life personally?
2. Starting in 1971 Richard Nixon declared a war on cancer, allocating five million dollars to research. Do you think the government should continue to fund this type of research? Why or why not?
3. Based on your current knowledge, the screening of Cancer Warrior and Barbara Bradfield’s story what questions would be essential for a scientist researching cancer to focus on? Why?

**Assessment Suggestions:**

- Collect Student Page: Cancer Warrior Discussion Question Guide
- Collect Journal Questions
- In lesson seven students will examine how their answers and the class answers have changed as a result of this unit.

**Resources/References:**

- Cancer Survey: Myth or Truth? activity adopted from the University of Rochester
  [http://lifesciences.envmed.rochester.edu/lessonsCancer.html](http://lifesciences.envmed.rochester.edu/lessonsCancer.html)
- PBS NOVA: Cancer Warrior
Cancer Truth or Myth Survey Data

Below is a survey of 15 statements about cancer. For the purposes of this survey, a cancer "Truth" is defined as a statement that you believe is supported by scientific evidence. A cancer “Myth” is defined as a statement that you believe is an opinion or an idea that is not supported by scientific evidence.

Vote using the following scale for each “Statement about Cancer”
1 = I’m sure this is true.
2 = I think this might be true.
3 = I think this might be a myth.
4 = I’m sure this is a myth.

<table>
<thead>
<tr>
<th>STATEMENTS ABOUT CANCER</th>
<th>YOUR RESPONSE (1, 2, 3, or 4)</th>
<th>CLASS RESPONSE (record the number of students who responded with each number above the number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If your parents had cancer, you may be at a higher risk of developing cancer.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>2. All cancers are caused by same genetic mutations.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>3. Everyone who participates in a clinical trial for a new drug or treatment benefits.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>4. Young peoples’ lifestyles affect their chances of getting cancer later in life.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>5. Cancer is caused by changes in genetic material.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>6. Everyone with the same type of cancer gets the same kind of treatment.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>7. The only treatments for cancer are surgery, radiation, and chemotherapy.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>8. Some types of cancer are contagious.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>9. Cancer patients involved in clinical trials always receive the investigational drug or treatment.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>10. Cancer is caused by changes in genetic material.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>
### CANCER TRUTH OR MYTH SURVEY DATA (PAGE 2)

<table>
<thead>
<tr>
<th>STATEMENTS ABOUT CANCER</th>
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<th>CLASS RESPONSE (record the number of students who responded with each number above the number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Tumors must have a blood supply to survive.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>12. Age is a risk factor for cancer.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>13. New cancer fighting drugs move through clinical trials quickly.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>14. Many mutations are required for someone to develop cancer.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>15. Cancer is the leading cause of death in the United States.</td>
<td></td>
<td>1 2 3 4</td>
</tr>
</tbody>
</table>
Cancer Warrior
Discussion Question Guide

Pre Questions: Answer the following based on your current knowledge.
1. What is translational medicine?

2. Using prefixes/suffixes, what does angiogenesis mean?

Answer the following questions based on information provided in the film: Cancer Warrior
3. What does Dr. Folkman mean by “we all have a clock, theirs is just running faster?” Do you think this is a philosophical statement, or biological one? Why?

4. Do you think patients who are entering a Phase I clinical trial (which looks at the side effects of the drug, not its effectiveness) are setting themselves up for failure? Why or why not?

5. Why do some chemotherapies stop working in patients?

6. Use your knowledge of cellular requirements to explain why Dr. Folkman’s hypothesis of angiogenesis could be valid, in spite of the resistance and criticism he received from his fellow researchers.

7. If science is based on observation, why did researchers still criticize Dr. Folkman’s hypothesis of angiogenesis after the rabbit eye experiments?
8. The discovery of what molecule proved angiogenesis? How was it discovered?

9. Why did Robert Demato think thalidomide could be used to treat cancer? Give specific reasons.

10. Tim is in remission but still on thalidomide; why does he have the side effect of numbness/tingling in his fingers and toes?

11. Why was the inhibitor protein searched for in mouse urine?

12. Explain the naming of angiostatin; do you think it’s a good name? Why?

13. What is the relationship between angiostatin and endostatin?

14. Why was Duane Gay removed from the clinical trial? What is the benefit of having strict protocols during clinical trials if it means patients must be taken off them, thus losing access to the medication?
Pre Questions: Answer the following based on your current knowledge.

1. What is translational medicine?
   The process of turning biological discoveries “at the bench” into drugs and medical devices that can be used in the treatment of patients “at the bedside”

2. Using prefixes/suffixes, what does angiogenesis mean?
   Angio= blood, genesis=new

Answer the following questions based on information provided in the film: Cancer Warrior

3. What does Dr. Folkman mean by “we all have a clock, theirs is just running faster?” Do you think this is a philosophical statement, or biological one? Why?
   All living organisms have a predetermined lifespan, those people with terminal illnesses will have a shorter lifespan, thus a “faster running clock.”
   NOTE: Some students will say this is philosophical, but studies of telomeres have indicated this is also biological. Students may not know this, so be sure to bring it up during group discussion.

4. Do you think patients who are entering a Phase I clinical trial (which looks at the side effects of the drug, not its effectiveness) are setting themselves up for failure? Why or why not?
   Student answers will vary.

5. Why do some chemotherapies stop working in patients?
   Their cancer cells develop mutations that cause resistance to the drugs.

6. Use your knowledge of cellular requirements to explain why Dr. Folkman’s hypothesis of angiogenesis could be valid, in spite of the resistance and criticism he received from his fellow researchers.
   His hypothesis could be valid because all cell types need a source of blood for nutrient and gas exchange. If a tumor is a collection of “new cells” they would need a “new blood source.”

7. If science is based on observation, why did researchers still criticize Dr. Folkman’s hypothesis of angiogenesis after the rabbit eye experiments?
   Fellow researchers needed to see the biological mechanism behind the observations he made with the rabbit’s eye, because they still felt his idea was too “out there.”
8. The discovery of what molecule proved angiogenesis? How was it discovered?
A heparin binding protein proved angiogenesis, which was discovered using liquid column chromatography of tissue from a lab rat tumor.

9. Why did Robert Demato think thalidomide could be used to treat cancer? Give specific reasons.
Demato thought that thalidomide could treat cancer because it stops blood vessel growth. (causing birth defects in children whose mothers took the drug while pregnant.)

10. Tim is in remission but still on thalidomide; why does he have the side effect of numbness/tingling in his fingers and toes?
Tim likely experiences the numbness because no new blood vessels are being formed in his extremities.

11. Why was the inhibitor protein searched for in mouse urine?
The inhibitor protein was searched for in mouse urine because it was hypothesized to be a biological molecule the body naturally produces. Substances that are not used by the body get excreted.

12. Explain the naming of angiostatin; do you think it’s a good name? Why?
Statin means “to stop”, so yes, “stop blood” is a good name.

13. What is the relationship between angiostatin and endostatin?
Angiostatin and Endostatin are both angiogenesis inhibiting molecules.

14. Why was Duane Gay removed from the clinical trial? What is the benefit of having strict protocols during clinical trials if it means patients must be taken off them, thus losing access to the medication?
Duane Gay’s tumors had grown beyond the strict limits allowed by the University of Wisconsin’s Endostatin protocol. 
A clinical trial is a highly controlled experiment; you can only test one variable at a time.