THIS WORLD OF HUMANS

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This World of Humans: Episode #14
Guide for Educators

Breast cancer proliferation and metastasis in mice

These activities address specific Cross-Cutting Concepts and Science and Engineering Practices (see page 6). Many are also suitable for courses designated as "Writing-Intensive."

About the Article

This article the role of two proteins, MDMX (MDM4) and MDM2, in the growth and spread of highly aggressive breast cancer. Findings identify a relationship between the two proteins and provide insight into the roles of each in metastasis. In this interview, Dr. Bargonetti discusses the origin of this research, its methodologies, and its findings.

About the interview

In this interview, Dr. Bargonetti discusses the origin of her research on breast cancer in mice, its methodologies, and its findings. Her lab specifically explores proteins such as MDM2 and MDMX that influence the spreading of triple-negative breast cancer cells.

Both the article and the interview can be found here: https://www.visionlearning.com/en/twoh#ep14

Recommended: pair these materials with the Visionlearning modules: *Experimentation in Scientific Research* and *Using Graphs and Visual Data in Science*. For students needing a refresher in scientific research, the Visionlearning module *The Practice of Science* is also a useful accompaniment. (www.visionlearning.com)

Use in the Classroom

These materials are useful for helping students visualize the process of experimental research and inquiry. The article itself is reading-level appropriate for a wide variety of audiences, though students may benefit from listening to the interview before reading the article.

1. **Pre-reading and pre-listening activities** are provided to prompt prior knowledge and help students make connections between their own lives and the research they are learning about. Materials may be used in the classroom to generate discussion, or as homework if the article or interview will be read/listened to in-class. Having students write before speaking helps focus discussions and reading.
2. The **worksheets** are explicitly designed to walk students through the process of reading a scholarly paper, as well as building disciplinary vocabulary. They serve as excellent homework assignments (if the article is read outside of class) and will direct students toward identifying important information about the research. While the answers provided can be used to check student reading, it is really an opportunity to assist students in how to read scientific material. Completed worksheets are excellent for small group discussions, allowing students to solve any discrepancies themselves, or as a debrief with the entire class.

3. **Post-reading and -listening activities** are designed to extend student thinking and engage them more deeply with the text and interview. These questions are great for small groups, for large class discussions, or for short-answer writing assignments.

Pre-reading and –listening activities

1. **Vocabulary preparation:** Provide students with the Vocabulary Worksheet and ask them to offer definitions. Clarifying terminology as a class is recommended. This worksheet is suitable for a 20-minute in-class activity if students have access to dictionaries or the internet. Many of the terms are specific to social psychology, thus *context* is critical to reinforce when assigning this activity.

2. **Problem-Solving Activities**: Ask students to work in small groups to resolve the predicaments below. Give each group one problem to solve. Ask them to be as creative as possible in finding their resolutions.

    1. *You are driving a train down a track when you realize that the brakes are no longer working. Even worse, the train seems to be accelerating, even though you have shut off the gas lever. How do you get the train to stop?*
    2. *You are a chef in a bakery. Your bread recipe calls for many different ingredients, some of which cause the bread to rise, others that make it soft. You want to slow down the speed at which the bread rises to see if the speed has an effect on texture or flavor, but you are not sure how each ingredient functions in the recipe. How might you go about learning how each ingredient works?*

3. **Visualizing data:** Give each student the Data Sheet handout. Tell them that this is data from a class that shows how well students are meeting specific learning goals. Ask them to come up with a way to organize the data visually so that a viewer can quickly understand how students are performing for each of the learning goals for the course.

Post-reading and –listening activities

1. **Revisiting vocabulary:** Using the vocabulary sheet students completed at the start, clarify as a group/class how the authors used the terms. Were they used the same? Differently? Explain.

2. **Short writing assignments**: Using short, expository writing assignments can help students work through their understanding of what they have read and heard, particularly research methodologies and findings. Use either/both of these prompts to help students engage with the research article and articulate what they have learned. If used as a graded assignment, assessment should be based on clarity of thought, justification of claims, and understanding of the research article. Do not assess for grammar/mechanics.

   Prompt 1: In *Experimentation in Scientific Research*, Carpi and Egger note:

   (*https://www.visionlearning.com/en/library/Process-of-Science/49/Experimentation-in-Scientific-Research/150*)

   > In the experimental method, a condition or a parameter, generally referred to as a variable, is consciously manipulated (often referred to as a treatment) and the outcome or effect of that manipulation is observed on other variables.

   In 500 - 800 words, explain how Dr. Bargonetti's study uses experimentation to identify the role of MDMX and MDM2 in breast cancer metastasis. What were they able to find when they compared controls to the suppressed variables? Use examples from the research article to support your claims.

   Prompt 2: Animal models are often used in research when it would be unethical to conduct an experiment on human research participants. Consider the research design and questions Bargonetti's team pursued. Why might they have used mice rather than humans for this study? Why did they choose to study cancer metastasizing in the lungs rather than the bones? Use examples from the article and interview to support your claims. (Approximately 500 words.)

3. **Data Visualization**: Group/class discussion or independent writing assignment. Revisit the data visualization exercise from the pre-reading/listening activities. How did students choose to organize the data? Compare their visualization choices with the images in the article. Did they take the same approaches? How do Western blot and histogram presentations of the data help readers understand the findings? Why might the researchers have chosen to include multiple visual presentations of the data? Why are microscopic photographs included? How does the illustration in Figure 7, particularly, help our understanding of the research findings?

Extension activities

Vocabulary Worksheet

Below are a list of terms and phrases that you will encounter while reading the article and listening to the interview. Using a dictionary, provide definitions for each term or phrase. If you cannot find a formal definition, write down what you *think* the term or phrase might mean. Keep in mind that the meanings of these terms *in science* may be different from the way we used them in common speech.

(For expected answers to these questions, see https://www.visionlearning.com/en/twoh/request)

Metastasis

Animal Model

Cancer Mass

Guardian Capacity

Triple-Negative Breast Cancer

Dual-Inhibition

Guide for Educators

Data Sheet

Below is data collected from a science course. Students are scored on a scale of 1 to 4. The instructor wants to be able to see how students are performing with regard to these different objectives so they know where to do more instruction. They have asked you to create a visualization of this data.

Pair with this reading: https://www.visionlearning.com/en/library/Process-of-Science/49/Using-Graphs-and-Visual-Data-in-Science/156

Design a visual representation of the information you see below. When you are done, write a brief sentence or two about why you chose to organize the data in the way that you did.

	Understands how to quantify relationship between two or more variables	**Understands the similarities and differences between various scientific methods**
Student 1	1	2
Student 2	3	2
Student 3	4	3
Student 4	4	4
Student 5	3	1
Student 6	2	1
Student 7	2	1
Student 8	4	3
Student 9	3	2
Student 10	1	2
Student 11	3	4
Student 12	3	4
Student 13	4	4
Student 14	2	1
Student 15	2	3

Targeted NGSS, Cross-Cutting Concepts, and Science and Engineering Practices

The activities in this guide can be used to address the following standards, concepts, and practices.

Science and Engineering Practices	
Asking Questions and Defining Problems	• Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. • Ask questions to determine relationships, including quantitative relationships, between independent and dependent variables
Obtaining, Evaluating, and Communicating Information	• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
Planning and Carrying Out Investigations	• Select appropriate tools to collect, record, analyze, and evaluate data.
Cross-Cutting Concepts	
Cause and Effect: Mechanism and Prediction: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.	• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Systems can be designed to cause a desired effect. • Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them	• Empirical evidence is needed to identify patterns. • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.