THIS WORLD OF HUMANS

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This World of Humans: Episode #10
Guide for Educators

Taurine, Addiction, and the Brain

These activities address NGSS LS1.C AND LS1.D as well as specific Cross-Cutting Concepts and Science and Engineering Practices (see page 7). Many are also suitable for courses designated as "Writing-Intensive."

About the Article

This article describes a study in which groups of rats were exposed to taurine and cocaine in order to observe the potential protective effects of taurine against cocaine addiction. Findings suggest that taurine could prevent or enhance reward-seeking behavior and that there are observable differences in protective effects between male and female brains.

About the interview

In this interview, Dr. Kaliris Salas-Ramirez discusses the potential for taurine—commonly found in popular energy drinks—to help overcome or counteract effects of addiction in the brain and considers what effects sex differences might have on the protective effects of taurine.

Both the article and the interview can be found here: https://www.visionlearning.com/en/twoh#ep10

Recommended: Pair these materials with the Visionlearning modules: *Absorption, Distribution, and Storage of Chemicals*. For a refresher in how cells break down fuel for energy, see the Visionlearning modules on *Energy Metabolism I and II*. (www.visionlearning.com)

Use in the Classroom

These materials are useful for exploring ways in which scientists design studies to address gaps in research that will help find new solutions for diseases like addiction. These materials also assist in building understanding of how scientists make sense of data and communicate their findings to various audiences. 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 the research they are learning about and their own lives. 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 scientific paper and build disciplinary vocabulary. Worksheets 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 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 biology, thus *context* is critical to reinforce when assigning this activity.

2. **Reflective pre-writing exercise:** Prompt students to get out a pen and paper and reflect on their experiences with energy drinks. Ask students to name their favorite energy drink and free-associate "feeling" adjectives that they associate with consuming this drink (ex. "excited," "jittery," "alert"). If students have never consumed an energy drink (or if you would like to use an alternative prompt), ask students to write down words that they think of when they hear brand names like "RedBull" or "Monster." Provide five minutes of uninterrupted writing time. Then, use this as an entry-point into the interview and article.

3. **Visual pre-reading exercise:** For a creative and hands-on introduction to the topic, provide students with the Pre-reading Worksheet and have them design their own energy drink advertisement using keywords that promote the type of feeling/"high" a consumer might seek to experience through consumption of their drink. There are no right or wrong answers; instead, this is meant to get students thinking about the nature of addiction as well as provide real-world context for the article.

   For an added writing-intensive element: Instruct students to write a short response essay outlining why they chose to include certain supplements, design elements, and/or language. This can be assigned as in-class writing or as homework.

Post-reading and –listening activities

1. **Revisiting vocabulary in small groups:** Using the vocabulary sheet students completed at the start, clarify in groups how the authors used terms. Does everyone in the group have matching definitions? If not, which definitions are most appropriate in context? Why? Share any disparate definitions in a full class discussion and explain how your group decided which definitions were ultimately most appropriate.

2. **Discussion/Debate:** Construct a "debate" to engage students in thinking more critically about research implications. Structured debate and discussion through an open-ended question can also help reinforce concepts from the article and the interview, and help students connect content to the real world. This can be assigned as a short-essay prompt, used for small-group or whole-class discussion, or used to frame a classroom activity in which students debate the relative merits of two sides of an argument. Ask students to refer directly to the paper or interview to support their answers.

   > *Should teenagers be allowed to consume energy drinks that have high concentrations of taurine? Why or why not?*

3. **Visual Mapping Worksheet:** Use the worksheet as a take-home assignment for students. It should be paired with the Visionlearning module *Experimentation in Scientific Research*. (https://www.visionlearning.com/en/library/Process-of-Science/49/Experimentation-in-Scientific-Research/150)

4. **Experiment Design Worksheet:** Use the worksheet as a take-home assignment for students. It should also be paired with the Visionlearning module *Experimentation in Scientific Research* (link above).

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)

Acute

Cessation

Hedonic value

Glial cells

Implications

Intact

Neuroprotectant

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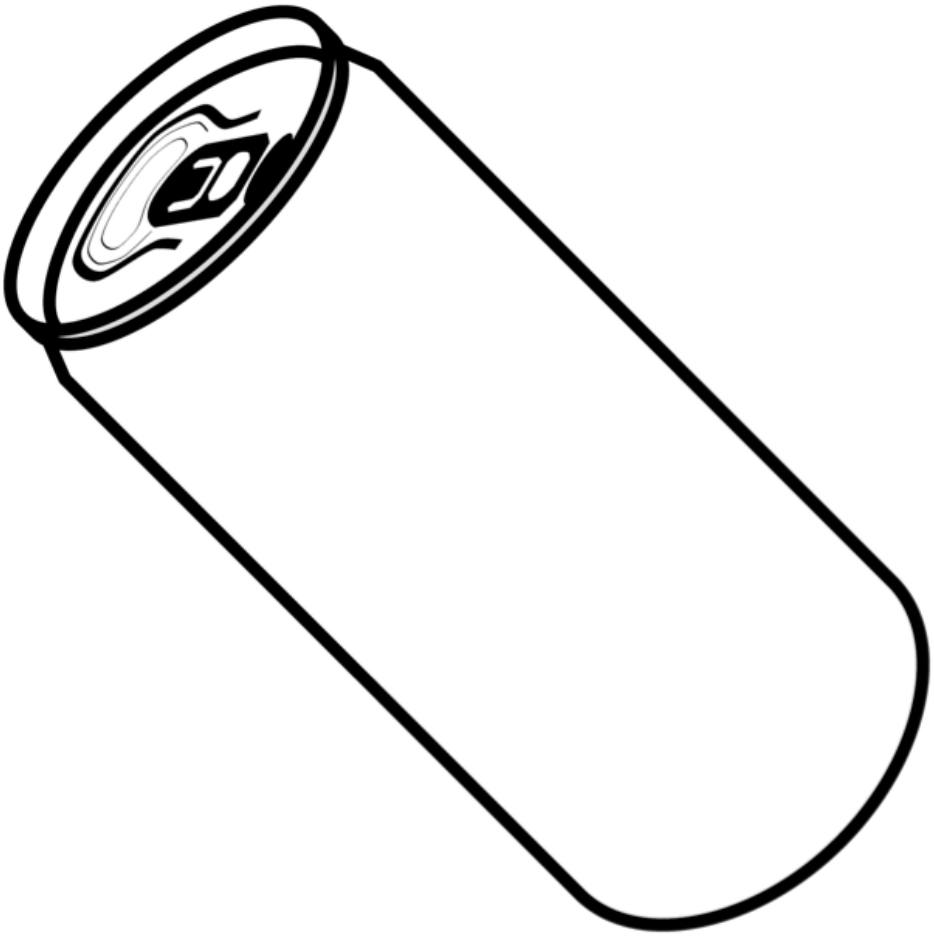
Instructions: Design your own energy drink advertisement using keywords that promote the type of feeling/"high" a consumer might seek to experience through consumption of your drink. Come up with a name and advertise using supplements known to enhance energy and performance. What are some vitamins/supplements you typically see on energy drink cans? How do you think consumers want these drinks to make them feel?



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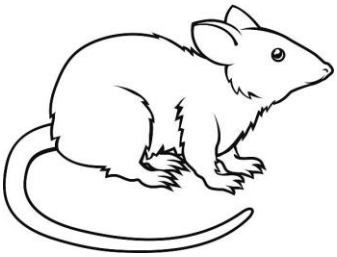
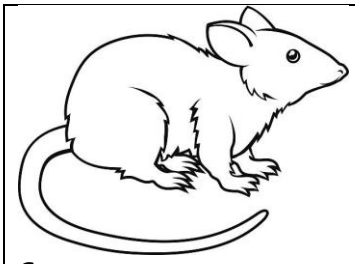
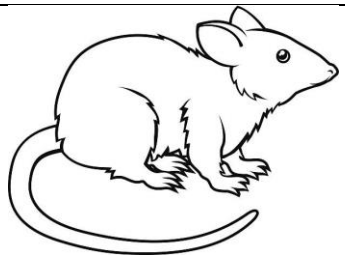
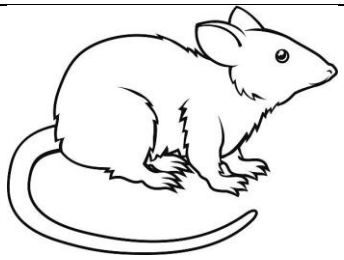
Visual Mapping: Experiment Findings

Instructions: To help you make sense of the experiment's design and findings, identify and list the results of each experimental group below.



Control Group:

Findings:

 **Group:** **Findings:**	 **Group:** **Findings:**	 **Group:** **Findings:**

Experiment Design Worksheet

Use this worksheet in connection with the Visionlearning module *Experimentation in Scientific Research*.

1. What is the hypothesis of Dr. Salas' experiment?

2. What is the dependent variable in the experiment?

3. What is/are the independent variable(s) in the experiment?

4. Identify a limitation of the experiment.

5. Identify at least one area of potential for future research related to Dr. Salas' findings.

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.

Next Generation Science Standards	
LS1.C: Organization for Matter and Energy Flow in Organisms	• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)
LS1.D: Information Processing	• Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)
Science and Engineering Practices	
Asking Questions and Defining Problems	• Ask questions to determine relationships between independent and dependent variables and relationships in models. • Ask questions that arise from careful observations of phenomena, or unexpected results, to clarify and/or seek additional information. • Ask and/or identify questions that can be answered by an investigation.
Developing and Using Models	• Identify limitations of models. • Develop a diagram or simple physical prototype to convey a proposed object, tool, or process.
Analyzing and Interpreting Data	• Analyze and interpret data to determine similarities and differences in findings.
Obtaining, Evaluating, and Communicating Information	• Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas. • Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patters in and/or evidence about the natural and designed world(s). • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).
Cross-Cutting Concepts	
Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them	• Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence. • Patterns can be used as evidence to support an explanation. • Patterns can be used to identify cause and effect relationships. • Empirical evidence is needed to identify patterns.
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	• Events have causes that generate observable patterns. • Cause and effect relationships may be used to predict phenomena in natural or designed systems. • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
Systems and System Models: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.	• Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. • Models are limited in that they only represent certain aspects of the system under study.