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Mind Over Matter: How Does the Brain Work?

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Grade Level 9-12

Subject Area life science

Curriculum Focus

animal behavior, psychology

Duration 3-4 hours

Objective

Students will be able to

1. Ask questions that uncover various aspects of how the brain works.
2. Research previous attempts by scientists to answer these same questions, using both print and online resources.
3. Devise an experiment that sheds some scientific light on the questions.
4. Present their findings to the entire class in the form of an illustrated oral report or multimedia presentation.

Materials

Copies of thestudent handoutfor each student; large chart paper and markers*or*concept-mapping software such as Inspiration; print resources dealing

with the neurobiology and psychology of the brain; computer(s) with Internet access; camera (digital or conventional); presentation software such as PowerPoint or HyperStudio (if available); additional materials as necessary for each group's experiments.

Procedure

In this activity, students will be challenged by some of the greatest scientific mysteries that exist. More than any other part of the human body, the brain raises questions that scientists and psychologists throughout history haven't yet been able to answer: Why do we retain some memories and lose others? How do our senses affect memory? These and other questions will become the focus of student research during the activity. In small groups, students will tackle one question, focusing on any previous tests and experiments that may have been conducted. Students will then devise and conduct an experiment or series of experiments on their friends, fellow students, and family members that will shed some light on their question. As a finale to the activity, each group will present to the class an illustrated oral report or multimedia presentation detailing its findings.

1. Begin the activity by leading a class discussion about some of the many things we do not yet understand about the human brain. Encourage students to brainstorm a list of questions to which they don't know the answers. As the discussion unfolds, record these questions on chart paper or by using Inspiration software. The questions they come up with might include the following:

    - Why do we retain some memories and lose others?
    - How do our senses affect memory?
    - How do our brains learn things?
    - What makes one person's brain good at sculpture and another's good at chess?
    - Why do some people learn better by hearing things and others by doing things?
    - What changes does the brain undergo as a person ages, and how do these changes affect memory and learning?
    - Why do mnemonic devices help some people remember things?
    - How do a person's emotions and feelings affect the capacity to learn?
    - Can a computer mimic human intelligence?
    - How does the brain remember things of which it is not aware (such as subliminal advertising)?
    - How much brain does a person need? Why are some surgical patients able to function well with half of their brains removed?

2. Divide your students into groups and ask each group to select a question from the class list to work with. Once each group has chosen a question, the next task is for students to research previous attempts by scientists to answer the question they have chosen, focusing on any psychological tests that have been conducted. They may use available print resources in the classroom, take a trip to the school library, or conduct an Internet search. A list of student-friendly neurobiology sites and links to online experts is available in the Related Resources section below. Remind students to keep close track of bibliographic information for citations, regardless of the media they are using.

3. When their research is complete, ask each group to design an experiment or series of experiments by which they might shed some scientific light on their chosen problem. Before they begin, however, conduct theListening

Comprehension Experimentwith your students to give them an idea of the kind of project they should be developing.

4. Set students to work on their experiments. Remind them that their goal should be to develop new methods that have not yet been tried by scientists to the best of their knowledge and research. For example, if a group of students wanted to test whether the sense of smell or sense of touch is more strongly associated with memory, they could design an experiment in which participants are asked to memorize a sequence of 15 different common smells (oranges, peanut butter, dog food, etc.) and 15 common textures (carpeting, silk, water, etc.) Whichever sequence is easier to recall, on average, might indicate which sense is more closely associated with memory.

5. As early as possible at this stage, students need to identify what additional materials they will need for experiments, divide up responsibility for procuring these materials, and make sure they are collected. It will be the group's responsibility to decide each member's role in carrying out the actual experiment and recording their findings. If you have a camera available, you can encourage students to document their experiment trials with photos. If you are using a conventional 35-millimeter camera, you can digitize your pictures with a scanner or ask your developer about processing the film on a CD disk or online file. This will make it easier later for students to insert photos into multimedia presentations.

6. When their experiments are designed, ask each group to conduct them on at least 10 different participants, if not more. These participants may consist of family members, friends, and fellow students. Students should be sure to record the results of their experiments carefully and bring them to class.

7. After the experiments have been conducted, the members of each group should compare the results they obtained and attempt to draw a conclusion from their work. Make sure you warn them that not all experiments result in definitive conclusions. When they have collated their results and discussed any possible conclusions, each group should prepare a report for the rest of the class. Their reports may take the form of written descriptions with hand-drawn illustrations or PowerPoint or HyperStudio presentations with digital images. Make sure to leave plenty of time for other students to question the group about their experiments and findings.

Closure

Research and experimentation is fascinating, but how we actually benefit from the findings is the true measure of an experiment's success. Have students discuss how their research and findings might impact their lives. For example, you might ask the class to analyze how what they have learned about brain-based learning might improve their own academic achievement, and what changes they would have to make in habits or lifestyle to realize those benefits. Alternatively, you can have students write an essay on the same topic.

Extension

1. Before students embark on their own research, invite a research scientist to visit your class to discuss the scientific method and principles of quality research and experimentation. Alternately, you can arrange to make an on-site visit to a research lab in the psychology department of a nearby college or university.

2. Have groups correspond with the neuroscientists on Neuroscience for Kids (see Related Resources below). They can share the details of their experiments and findings, ask for the experts' interpretation of their data, and request leads for

findings, ask for the experts' interpretation of their data, and request leads for additional sources on their topics.

3. If time permits, encourage students to widen their experiment samples by including subjects of different ages, genders, occupations, and any other relevant categories they can devise. Analyze whether the original results stand up to the different test populations.

4. Suggest that students create an online questionnaire to supplement their experiments. The questionnaire can elicit information related to the experiment. Post it on an educational listserv and let students analyze the results they receive.

5. Discuss the findings of one of the student-designed experiments with another class and challenge them to devise a different experiment that seeks to answer the same question. Ask students to predict whether the second group's data will support their original results, then reevaluate their findings after the second experiment is conducted.

Related Links

Neuroscience for Kids
http://faculty.washington.edu/chudler/neurok.html

Neuroscience Laboratory and Classroom Activities
http://lshome.utsa.edu/programs/Neurobiology/nlca/NLCA.htm

About.com/Mining Company Neurosciences
http://neuroscience.miningco.com/mbody.htm?PID=2820&COB=home

Brain and Behavior
http://serendip.brynmawr.edu/bb/

Credits

Wendy Buchberg, instructional technology support specialist for the Corning-Painted Post (New York) Area School District.

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Kathy Schrock's Guide
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Science Curriculum Center
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