How Alzheimer's Affects the Brain

Introduction

This lesson introduces students to the ways in which Alzheimer's disease damages the brain. They'll see visual examples of how brain changes affect behavior and how damage to neurons and neural connections progress.

It would be ideal if you could show students the entire program, but if you don't have time, the lesson lists segments that are particularly relevant to this topic.

Grade Levels

9-12

Estimated time

2-3 class periods

Lesson Objectives

Students will:

- Use the Alzheimer's Association Web site to see how Alzheimer's affects different parts of the brain.
- Sketch a healthy neuron and label its parts.
- View and answer questions about segments from *The Forgetting* related to changes in the brain caused by Alzheimer's disease.
- Diagram brain changes during the early and late stages of Alzheimer's.

Materials Needed

- Computers with Internet access
- TV and VCR or DVD player or Internet access (*The Forgetting* is available online at http://www.pbs.org/theforgetting)
- *The Forgetting* video (To order visit Shop PBS for Teachers)
- Drawing materials (blank paper, pencils)

Standards

National Science Standards:

5. Understands the structure and function of cells and organisms

Teaching Strategy

1. Ask students to consider what they already know about the human brain. They may have already learned that different parts of the brain control different functions, such as vision, movement, and complex thinking. They are also probably aware that the brain consists of cells, just like all other parts of the body. Explain that these cells are called neurons and that they're shaped differently than cells in most other parts of the body. Ask students to hypothesize in a brief class discussion the ways in which damage to various parts of the brain might affect a person's behavior and abilities.
2. Ask students to go to the Alzheimer's Association Web site (at http://alz.org) and link to "Inside the Brain" under Alzheimer's disease (at http://www.alz.org/alzheimers_disease_4719.asp). Have them take the tour to see how Alzheimer's affects each of these brain sections.
3. Using the brain diagram on the Web site as a model, ask students to draw diagrams of brains on their own papers. Have them draw lines from each brain section to a line or box outside of the brain. On each outside line (or in each box), ask them to summarize the way in which that brain area is affected by Alzheimer's.
4. Have students look at screen 9 of the tour titled "More Brain Changes, and ask them to scroll down and look at the brain slices. These diagrams show a slight difference in the size of the hippocampus, which is affected early in the progression of Alzheimer's disease.
5. Explain that, in the process of affecting entire parts of the brain, Alzheimer's disease affects individual neurons. To see what a neuron looks like, have students go to "Types of Neurons (Nerve Cells)" (http://faculty.washington.edu/chudler/cells.html) and scroll about one quarter of the way down the page. Explain that the two main parts of a neuron are the dendrites, which receive information from other neurons, and the axon, which carries information through the neuron to be emitted by the presynaptic terminals (also called the terminal buttons) to another nearby neuron. About 100 billion neurons are connected in this way throughout the brain and the rest of the nervous system. The spaces between brain cells are called synapses; students will hear this word when they watch the video.
6. Have students sketch two healthy neurons on their own paper and label these parts: axon, dendrites, presynaptic terminals, cell body, synapse.
7. Ask students to imagine the possible consequences of part of a neuron becoming damaged. They should recognize that, with so many interacting parts, if even one part of a neuron or synapse becomes damaged, there could be serious consequences for normal brain operations and therefore for the individual.
8. Show the following segments of *The Forgetting*:
    - 00:11:17 - 00:14:58 (Dr. Alzheimer's discovery of deposits in the brain)
    - 00:22:13 00:26:00 (changes in the brain during Alzheimer's progression)
    - 00:31:42 00:36:27 (research into delaying the disease, focusing on plaque deposits) *before showing this segment, define the term "MR scan": magnetic resonance scan (same as MRI), that uses magnets to take "pictures" of the inside of the body
    - 00:58:29 01:03:49 (loss of synapses; beta amyloid; genetic relationship to Alzheimer's)

- 01:08:36 01:09:19 (viewing amyloid plaques under a microscope)

As they watch, have students take notes to help answer these questions:

- What specific damage does Alzheimer's disease cause to the brain and its neurons?
- How are specific parts of the neurons, and their connections, affected by Alzheimer's?
- How does this damage progress over time?
- How does this damage show up in the individual's memory and behavior?

9. Discuss the answers to the above questions as a class.

Assessment

Have students use two additional pieces of paper to diagram the impact of Alzheimer's disease on neurons at the early and later stages of the disease. The first page should show approximately ten neurons and the way they would look under a microscope during the early stages of Alzheimer's. The second page should show the same number of neurons as they might look under a microscope during the late, severe stage of Alzheimer's.

Have students write captions for each drawing. Their captions should describe what is happening at each stage and should specifically state the ways in which neurons have been damaged.

Extension Ideas

- Have students use craft materials such as construction paper or pipe cleaners to create models of healthy neurons and neurons damaged by Alzheimer's disease. Ask them to label their models to show the major parts of the neuron and the ways these cells are affected by the disease.
- Have students browse through the "Diagnosis" section of The Forgetting Web site to learn more about how Alzheimer's is detected and diagnosed and how memory works. Ask them to imagine that they're doctors who are visited by a 70-year-old who claims to be experiencing memory problems. Have them write lists of the steps they might take and the things they might do to help determine whether this person has Alzheimer's.
- Either review the topics covered in the video segments students have already seen or show those parts again. Also show these segments:
  - 01:05:41 – 01:10:11 (experiments with mice)
  - 01:14:57 – 01:18:53 (experiments to see if the "Pittsburgh Compound" works in humans)

  Ask students to take notes to answer these questions:

  - What specific studies and experiments have been undertaken recently in the field of Alzheimer's research, according to what you see in this video?
  - Why have scientists focused on these particular areas of research?
  - What have scientists discovered as a result of the research shown in the video?

- What have been some obstacles to this research; why is it challenging?

Discuss students' answers as a class. Then ask students, either individually or in small groups, to imagine that they're Alzheimer's researchers and to choose one area of research that they feel is particularly important or interesting. Have them prepare written and/or oral reports describing the research process, explaining why it's important, describing research results so far, and predicting how this research might help Alzheimer's patients or people who hope to prevent Alzheimer's in the future.

Online Resources

PBS *The Forgetting* : "Symptoms"

PBS *The Secret Life of the Brain*:
http://www.pbs.org/wnet/brain/episode5/index.html

Types of Neurons (Nerve Cells):
http://faculty.washington.edu/chudler/cells.html

The Whole Brain Atlas:
http://www.med.harvard.edu/AANLIB/home.html (scroll down to "Degenerative Disease," link to one of the Alzheimer's cases, look at the brain segments, and read the clinical evaluations by linking to "Clinical")

The Alzheimer's Association Interactive Brain
http://www.alz.org - link to "Inside the Brain" under "Alzheimer's Disease"

Cross-Section of Normal and Alzheimer's Brain:
http://www.ahaf.org/alzdis/about/BrainAlzheimer.htm

About the Author

Betsy Hedberg is a teacher and freelance curriculum writer who has published lesson plans on a variety of subjects. She received her Secondary Teaching Credential in Social Studies from Loyola Marymount University and her Master of Arts in Geography from UCLA. In addition to curriculum writing, she presents seminars and training sessions to help teachers incorporate the Internet into their classrooms.