

# The Aging Brain: A Lesson on Alzheimer's Disease

Laura Stiles  
Wakefield High School  
Raleigh, North Carolina

Jessica Ogulnik  
Niles West High School  
Skokie, Illinois

Acknowledgement: The authors appreciate contributions  
from David Thurman<sup>1</sup> and Sarah Collier<sup>2</sup>

<sup>1</sup> National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention

<sup>2</sup> National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention

*Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.*

## The Aging Brain: A Lesson on Alzheimer's Disease

Laura Stiles  
Wakefield High School  
Raleigh, North Carolina

Jessica Ogulnik  
Niles West High School  
Skokie, Illinois

### **Summary**

This lesson is for a standard-level high school biology course and is meant to review and strengthen the concepts of brain anatomy and memory and link these concepts to Alzheimer's disease. To complete the activities in this lesson, students should have prior knowledge of nervous system terminology and function.

### **Learning Outcomes**

- Students will be able to label and draw a brain and all of the general lobes and regions, including temporal, occipital, parietal, frontal, amygdala, hippocampus, brain stem, and cerebellum.
- Students will be able to describe the symptoms of Alzheimer's disease.
- Students will be able to explain and illustrate the differences between a healthy brain and a brain with Alzheimer's disease.
- Students will be able to list ways to reduce their risk of developing Alzheimer's disease.

### **Materials**

1. Copies of all handouts listed below (note: some should be laminated if possible)
2. Molding clay – 1.5 lbs per 4 students
3. Computer with Internet access, projection capabilities, and speakers
4. Objects for optional memory activity

### **Total Duration**

3 hours, 30 minutes–4 hours, 15 minutes

---

**Note to teachers:** Because of the prevalence of Alzheimer's disease and cognitive decline in older adults, students might have family members or relatives with these problems. This lesson plan can be modified to be sensitive to student needs. Because this lesson plan is on a topic that can be very personal, sensitivity to students should be an important consideration.

### Procedures

#### **Teacher Preparation**

Prepare photocopies of handouts:

- "Pretest – Alzheimer's Disease Lesson Plan" (Introduction)
- "The Effects of Alzheimer's Disease as Seen in the Lobes of the Brain" (Step 2)
- "Cell Changes in the Alzheimer's Patient's Brain" transparencies (Step 3)
- "Alzheimer's Disease: Lowering Your Risk" (Step 4)
- "Case Studies of Alzheimer's Disease" (Conclusion)

The page with brain figures from the "Case Studies of Alzheimer's Disease" in the Conclusion should be laminated before the clay activity. These can be used again in the future.

Review the exercises described in the “Memory Activities” document and on the PBS website “The Forgetting: A Portrait of Alzheimer’s.” Gather and prepare any materials needed for the activity you select.

### **Introduction**

**Duration: 15–30 minutes**

To begin the lesson, have the students reflect on the last time they could not remember something important. Ask questions such as “When was the last time you forgot something important?” “What did you forget?” “How did you feel about forgetting?”

If students have a hard time recalling an event or are not willing to share, have the class complete a memory activity from the “Memory Activities” document or the PBS website “The Forgetting: A Portrait of Alzheimer’s.” If a supplemental memory activity is completed, have the students take a minute or two to write about their experience. Ask some students to share. It is important to point out that the common instances of forgetting that students relate are normal, even though they might cause occasional minor problems or frustrations. In contrast, however, the memory problems associated with Alzheimer’s disease are much more serious, especially as the disease progresses. Eventually, for example, people with Alzheimer’s disease might have trouble finding their way home in their own neighborhood or might not even remember or recognize loved ones.

Tell the students that this lesson will involve a disease that has a lot of different signs and symptoms, including having difficulty remembering things, getting lost in familiar places, behaving oddly or inappropriately, and experiencing some loss of language abilities. In this lesson, they will learn about the changes in brain structure and function as a result of Alzheimer’s disease. To assess students’ current knowledge about Alzheimer’s, have them complete the handout “Pretest – Alzheimer’s Disease Lesson Plan.”

Go over the answers to the pretest and tell the students that in the next steps they will be linking these symptoms to the specific regions of the brain.

### **Web Resource**

Title: The Forgetting: A Portrait of Alzheimer’s

URL: [www.pbs.org/theforgetting/symptoms/memory.html](http://www.pbs.org/theforgetting/symptoms/memory.html)

Description: This website provides memory activities that can be used to introduce the lesson.

### **Supplemental Documents**

Title: Memory Activities

Description: This document describes memory activities that can be used to introduce the lesson.

Title: Pretest – Alzheimer’s Disease Lesson Plan

Description: This document will be used to assess students’ prior knowledge of the brain and Alzheimer’s disease.

Title: Pretest – Alzheimer’s Disease Lesson Plan – Answer Key

Description: This document is the answer key for the “Pretest – Alzheimer’s disease Lesson Plan.”

**Step 2****Duration: 30–45 minutes**

Now that the students have tested their memories and discussed some of the symptoms of Alzheimer’s disease, they will identify the location and function of the lobes of the brain and note the effects of Alzheimer’s disease on the brain.

Direct students to the PBS web page “The Forgetting: A Portrait of Alzheimer’s – Symptoms,” listed in the Web Resources section. Have them work through the interactive portion, clicking on each lobe of the brain. As they are doing this, have them use the worksheet “The Effects of Alzheimer’s Disease as Seen in the Lobes of the Brain” to record the normal functions of the brain and the symptoms of Alzheimer’s disease that will develop when that lobe of the brain is affected by the disease process. After students complete the worksheet, ask them to share their answers as part of a discussion about the brain.

**Web Resources**

Title: The Forgetting: A Portrait of Alzheimer’s – Symptoms

URL: [www.pbs.org/theforgetting/symptoms/index.html](http://www.pbs.org/theforgetting/symptoms/index.html)

Description: This website provides many details on the symptoms, risk factors, experience, and other factors concerning Alzheimer’s disease. This specific page will be used as students investigate the functions of the lobes of the brain.

Title: Lobes of the Brain, Neuroscience for Kids

URL: <http://faculty.washington.edu/chudler/lobe.html>

Description: This neuroscience site for students, maintained by a University of Washington faculty member, could serve as an additional resource for this step. The site includes also online puzzles and quizzes.

**Supplemental Documents**

Title: The Effects of Alzheimer’s Disease as Seen in the Lobes of the Brain

Description: This document is the student worksheet to be used with the brain activity from the PBS website “The Forgetting: A Portrait of Alzheimer’s – Symptoms.” Students will complete the table as they view the information on the website.

Title: Answer Key – The Effects of Alzheimer’s Disease as Seen in the Lobes of the Brain

Description: This is the answer key for “The Effects of Alzheimer’s Disease as Seen in the Lobes of the Brain.”

**Step 3****Duration: 30 minutes**

Students are now able to identify the regions of the brain that are affected by Alzheimer’s disease. This part of the lesson will explain the changes occurring at the cellular level.

First, show the video “How Alzheimer’s Affects Neurons in the Brain,” found on the National Institutes of Health Senior Health website listed in the Web Resources section. After the video, review the explanation of neurofibrillary tangles and amyloid plaques using the lecture notes, “Cell Changes in the Alzheimer’s Patient’s Brain.” When discussing the changes caused by Alzheimer’s disease, be sure to mention that these changes are also seen in the brains of older adults; they are just more obvious and in greater amounts in brains affected by Alzheimer’s disease. Check for understanding by asking students questions during this part of the lesson.

### **Web Resources**

Title: National Institutes of Health Senior Health

URL: <http://nihseniorhealth.gov/videolist.html>

Description: This website contains many short videos about Alzheimer's disease and other topics of concern to older adults and their families. Transcripts are also included. This part of the lesson will use the video on "How Alzheimer's Affects Neurons in the Brain." Teachers should preview the video to ensure that they have the correct video player required.

Title: Inside the Brain: An Interactive Tour

URL: [www.alz.org/brain/overview.asp](http://www.alz.org/brain/overview.asp)

Description: This website from the Alzheimer's Association has an interactive overview of brain anatomy and the changes in the brain that happen in people with Alzheimer's disease. Slides 8–16 show the specific changes that happen in the brain. This website could be used as an alternative or additional activity for this step.

### **Supplemental Document**

Title: Lecture– Cell Changes in the Alzheimer's Patient's Brain

Description: This document contains lecture notes detailing the changes that take place in the cells of a brain affected by Alzheimer's disease.

### **Step 4**

**Duration: 90 minutes**

The students have learned that there are physical changes in the brain of older adults and people with Alzheimer's disease. In this part of the lesson, students will discuss ways to delay the onset of Alzheimer's disease and age-related dementia.

Ask students if they think there are behaviors that can influence their risk of developing Alzheimer's disease. For example, are there behaviors that can lower a person's risk of developing Alzheimer's disease? Are there behaviors that can increase a person's risk? Call on some students and list their ideas on the board, adding to them as needed. Instruct the students to select three of the risks from the list and determine behaviors that can minimize these risks. They can do this individually or in pairs, using the worksheet "Alzheimer's Disease – Lowering Your Risks." Refer to the answer key or to the "Alzheimer Causes and Risk Factors" website for a complete list of behaviors that can influence a person's risk of developing Alzheimer's disease. Call on a few students to share, and add behavior modifications to the list as needed so that all behaviors listed on the answer key are included. Optional: To help students gain an appreciation of what caring for a person with Alzheimer's disease is like, students could do web research using the websites listed in the Web Resources section. Students could also be asked to list three to four different resources available for people who care for patients with Alzheimer's disease.

### **Web Resources**

Title: The Forgetting: A Portrait of Alzheimer's

URL: [www.pbs.org/theforgetting/risk/reducing.html](http://www.pbs.org/theforgetting/risk/reducing.html)

Description: This website suggests some behaviors that may delay the onset and reduce the effects of Alzheimer's disease.

Title: Alzheimer Causes and Risk Factors

URL: [www.alz.org/AboutAD/causes.asp](http://www.alz.org/AboutAD/causes.asp)

Description: This website discusses possible causes and risk factors for Alzheimer's disease. It lists some behaviors that may lower the risk of developing the disease.

Title: National Institutes of Health Senior Health

URL: <http://nihseniorhealth.gov/videolist.html>

Description: This website contains short videos and transcripts of senior health issues. Included are videos for the caregiver of an Alzheimer's patient. This is a site that can be used by the students to find resources available people who care for patients with Alzheimer's disease.

Title: Alzheimer's Disease

URL: [www.pueblo.gsa.gov/cic\\_text/health/alzheim/alzheim.htm](http://www.pueblo.gsa.gov/cic_text/health/alzheim/alzheim.htm)

Description: This website provides information about Alzheimer's disease, including symptoms and treatments. This site could be used by students to explore a day in the life of a person with Alzheimer's or a caregiver for a person with the disease.

Title: National Institute on Aging – Alzheimer's Disease Fact Sheet

URL: [www.nia.nih.gov/Alzheimers/Publications/adfact.htm](http://www.nia.nih.gov/Alzheimers/Publications/adfact.htm)

Description: This website contains information about the causes, symptoms, and treatment of Alzheimer's disease. It also has information designed for caregivers. This site could be used by students to explore a day in the life of a person with Alzheimer's disease or a caregiver for a person with Alzheimer's disease.

Title: Medline Plus

URL: [www.nlm.nih.gov/medlineplus/alzheimersdisease.html](http://www.nlm.nih.gov/medlineplus/alzheimersdisease.html)

Description: This website provides information on Alzheimer's disease, including cause, symptoms, treatment, and help for caregivers. This site could be used by students to explore a day in the life of a person with Alzheimer's or a caregiver for a person with the disease.

### **Supplemental Documents**

Title: Alzheimer's Disease – Lowering Your Risks

Description: This worksheet is for the students to identify and explain behaviors that might lower the risk of developing Alzheimer's disease.

Title: Answer Key – Alzheimer's Disease – Lowering Your Risks

Description: This is the answer key for the "Alzheimer's Disease – Lowering Your Risks" worksheet.

### **Conclusion**

**Duration: 45–60 minutes**

Now that students understand brain anatomy as well as the signs and symptoms of Alzheimer's disease, they will create models of a healthy brain and the brain of an individual with Alzheimer's.

Split students into groups of four. Give students copies of "Case Studies of Alzheimer's Disease" and supply them with the laminated templates of the brain and the specified amount of molding clay. Assign each group one of the four possible case studies. Have each group read the case studies to determine which areas of the brain were affected as the disease progressed. Next, using the templates, students should roll out the clay into ropes and build one half of the human brain; half of the students will make a healthy brain, and half will make a brain affected

by Alzheimer's disease. Note that the hippocampus and amygdala are on the interior of the brain and are not labeled on the templates provided. Students should remember this information from previous activities. Remind students that most human activities are regulated by multiple portions of the brain and that this activity is simplified for the sake of time. It is also important to remind students that the size difference between the brain that is not affected by Alzheimer's disease and the brain with Alzheimer's disease is exaggerated for the sake of the lesson plan.

### **Web Resources**

Title: Alzheimer's Disease Fact Sheet

URL: [www.nia.nih.gov/Alzheimers/Publications/adfact.htm](http://www.nia.nih.gov/Alzheimers/Publications/adfact.htm)

Description: This website describes the typical progression of Alzheimer's disease in a patient.

Title: The Forgetting: A Portrait of Alzheimer's

URL: [www.pbs.org/theforgetting/symptoms/index.html](http://www.pbs.org/theforgetting/symptoms/index.html)

Description: This website shows symptoms of Alzheimer's disease and brain anatomy, as well as risk factors for the disease, ways of reducing those risks, and ways of coping for the immediate family of the individual with Alzheimer's disease.

Title: Some Examples of Diagnostic Images on Alzheimer's Disease

URL: [www.csua.berkeley.edu/~wuhsi/bap\\_vis\\_std.gif](http://www.csua.berkeley.edu/~wuhsi/bap_vis_std.gif)

Description: This image illustrates the differences in brain anatomy as the disease progresses. It can be used as an illustration for the teacher or made into a transparency for the class.

### **Supplemental Documents**

Title: Case Studies of Alzheimer's Disease

Description: This document is the student worksheet to be used with this conclusion activity. The actual case studies are fictitious, but they are based on a logical progression of Alzheimer's disease.

Title: Answer Key – Case Studies of Alzheimer's Disease

Description: This is the answer key for “Case Studies of Alzheimer's Disease”

### **Assessment**

Students will be evaluated as they complete the worksheet “The Effects of Alzheimer's Disease as Seen in the Lobes of the Brain” in Step 2. Their understanding of the cellular changes will be assessed through teacher-led discussion and question and answer during the lecture in Step 3. The worksheet “Alzheimer's Disease – Lowering Your Risks” will be used in Step 4 to evaluate students' knowledge of Alzheimer's risks and behavior modifications to minimize the effects of the disease. The conclusion activity “Case Studies of Alzheimer's Disease” and the brain models built will evaluate the total understanding of the material presented in the lesson.

---

## **Modifications**

### **Extensions**

#### **Gelatin Brain Mold**

An extension of the brain model would involve students making a gelatin brain mold and using it to describe the changes in the brain due to Alzheimer's disease. The students could be asked to develop a way to modify the mold to produce a brain that was affected by Alzheimer's disease. Starting with the molded gelatin they could also create cross sections, carving out the ventricles, etc. See the web resources listed in the body of the lesson for diagrams of a healthy and Alzheimer's-affected brain. The teacher should note that the gelatin models are very simplistic and are not anatomically correct. This activity could be used as an introductory activity or for students who are struggling with the concepts. Teachers should explain the models' limitations.

#### **Alzheimer's Disease Research**

Upper-level students could be given the challenge of researching findings and treatments for Alzheimer's disease. There are questions about the presence of amyloid plaques—are they the cause of the cell problems or just a contributing factor? Students could also research other disease that cause dementia in older people.

#### **Alzheimer's Disease at the Cellular Level**

To take the lecture on the cell changes a bit further, students could be asked to identify the cell organelles and functions that are affected by neurofibrillary tangles and amyloid plaques. They would have to support their answer and then propose treatments to address these problems. What step in the process should be targeted by medications?

#### **Diagnosing Alzheimer's Disease**

Students could be asked to address the challenges in accurately diagnosing Alzheimer's disease in a living patient. They could assess the tests that are currently used and design something that might be more effective in monitoring the progression of the disease.

#### **Web Resource**

Title: Yankee Halloween – Qwiggle! Realistic Body Parts Gelatin Molds

URL: [www.yankeehalloween.com/qwiggle.html#prod1](http://www.yankeehalloween.com/qwiggle.html#prod1)

Description: This is one of several websites that sell gelatin molds for body parts, including adult- and child-size brains. The molds could also be found locally, especially around Halloween.

Title: PubMed

URL: [www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=PubMed)

Description: This website is a search engine for primary scientific research. The students will find current abstracts, and in some cases, links to free copies of the full article.

Title: Alzheimer's Association Fact Sheet: Experimental Alzheimer's drugs targeting beta-amyloid and the "amyloid hypothesis"

URL: [www.alz.org/Resources/FactSheets/FSBetaAmyloid.pdf](http://www.alz.org/Resources/FactSheets/FSBetaAmyloid.pdf)

Description: This website has information about amyloid plaques and could be used by students to determine which part of cell structure and function are affected.

Title: Plaques and Tangles: The Hallmarks of AD

URL:

[www.nia.nih.gov/Alzheimers/Publications/UnravelingTheMystery/Part1/Hallmarks.htm](http://www.nia.nih.gov/Alzheimers/Publications/UnravelingTheMystery/Part1/Hallmarks.htm)

Description: This website has information on the formation of amyloid plaques and neurofibrillary tangles. The images included are those in the lecture notes and can be used by students to identify what cell organelles/functions are involved.

Title: Alzheimer's Association Fact Sheet: Experimental Alzheimer's drugs targeting beta-amyloid and the "amyloid hypothesis"

URL: [www.alz.org/Resources/FactSheets/FSBetaAmyloid.pdf](http://www.alz.org/Resources/FactSheets/FSBetaAmyloid.pdf)

Description: This website has information about amyloid plaques and could be used by students to determine which part of cell structure and function are affected.

Title: The Forgetting: A Portrait of Alzheimer's

URL: [www.pbs.org/theforgetting/](http://www.pbs.org/theforgetting/)

Description: This website shows symptoms of Alzheimer's disease and ways to test for it.

Title: National Institutes of Health Senior Health

URL: <http://nihseniorhealth.gov/videolist.html>

Description: This website contains short videos and transcripts of senior health issues. Included are videos on cognitive testing and diagnosing the disease.

---

## Education Standards

### **National Science Education Standards**

LIFE SCIENCE, CONTENT STANDARD C:

As a result of their activities in grades 9–12, all students should develop understanding of

- **The cell**
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- **Behavior of organisms**

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:

As a result of activities in grades 9–12, all students should develop understanding of

- **Personal and community health**
- **Population growth**
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

## **State Standards**

### **Illinois**

IL.22.A.5c > Explain how health and safety problems have been altered by technology, media, and medicine (e.g., product testing; control of polio; advanced surgical techniques; improved treatments for cancer, diabetes, and heart disease; worksite safety management).

IL.23.A STANDARD: Describe and explain the structure and functions of the human body systems and how they interrelate.

### **North Carolina**

NC-SCOS-05-06.SC.BIO.4.02.2 > Transport, excretion, respiration, regulation, nutrition, synthesis, reproduction, and growth and development.

## Pretest – Alzheimer’s Disease Lesson Plan

The Aging Brain: A Lesson on Alzheimer’s Disease  
Laura Stiles and Jessica Ogulnik, CDC’s 2006 Science Ambassador Program

Name \_\_\_\_\_

Class \_\_\_\_\_

Match the function with the correct lobe of the brain; the lobes may be used more than once.

- |  |                   |
|--|-------------------|
| _____ 1. sensing temperature             | A. frontal lobe   |
| _____ 2. creation of memory              | B. occipital lobe |
| _____ 3. problem solving                 | C. parietal lobe  |
| _____ 4. vision                          | D. temporal lobe  |
| _____ 5. processing auditory stimuli     |                   |
| _____ 6. sensing touch and pressure      |                   |
| _____ 7. reasoning and critical thinking |                   |

Indicate if the symptoms listed are common in Alzheimer’s disease (YES) or not (NO).

- \_\_\_\_\_ 8. Difficulty remembering names of family members
- \_\_\_\_\_ 9. Difficulty walking
- \_\_\_\_\_ 10. Difficulty performing common tasks such as tying a necktie
- \_\_\_\_\_ 11. Forgetting the names of common items
- \_\_\_\_\_ 12. Experiencing angry outbursts
- \_\_\_\_\_ 13. Getting easily frustrated
- \_\_\_\_\_ 14. Getting lost in own neighborhood
- \_\_\_\_\_ 15. Clearly remembering events from distant past, but not recent past

## Pretest – Alzheimer’s Disease Lesson Plan – Answer Key

The Aging Brain: A Lesson on Alzheimer’s Disease  
Laura Stiles and Jessica Ogulnik, CDC’s 2006 Science Ambassador Program

Match the function with the correct lobe of the brain; the lobes may be used more than once.

- |   |                   |
|---|-------------------|
| <u>C</u> 1. sensing temperature             | A. frontal lobe   |
| <u>D</u> 2. creation of memory              | B. occipital lobe |
| <u>A</u> 3. problem solving                 | C. parietal lobe  |
| <u>B</u> 4. vision                          | D. temporal lobe  |
| <u>D</u> 5. processing auditory stimuli     |                   |
| <u>C</u> 6. sensing touch and pressure      |                   |
| <u>A</u> 7. reasoning and critical thinking |                   |

Indicate if the symptoms listed are common in Alzheimer’s disease (YES) or not (NO).

- |                  |   |
|------------------|---|
| <u>YES</u> _____ | 8. Difficulty remembering names of family members                     |
| <u>YES</u> _____ | 9. Difficulty walking   |
| <u>YES</u> _____ | 10. Difficulty performing common tasks such as tying a necktie        |
| <u>YES</u> _____ | 11. Forgetting the names of common items                              |
| <u>YES</u> _____ | 12. Experiencing angry outbursts                                      |
| <u>YES</u> _____ | 13. Getting easily frustrated   |
| <u>YES</u> _____ | 14. Getting lost in own neighborhood                                  |
| <u>YES</u> _____ | 15. Clearly remembering events from distant past, but not recent past |

## **Memory Activities**

The Aging Brain: A Lesson on Alzheimer's Disease  
Laura Stiles and Jessica Ogulnik, CDC's 2006 Science Ambassador Program

The following activities are options for the introduction to this lesson. You may choose one or more activities.

1. What words can you remember?  
Create a transparency of 15 common words arranged in two or three columns. The words should all be approximately the same length and may or may not be related to one another. Instruct students to look at the list and to remember as many as they can. They will need to have ready a pen or a pencil and a piece of paper, but they are not to use them during the initial viewing of the list. When the class is ready, show the list of terms for 90 seconds. Then cover or remove the list and instruct the students to write down as many of the terms as they can. Allow 2 minutes for them to remember and write their lists. Finally, share the original list and have the students check their accuracy.
2. What items can you remember?  
This is a variation on the first activity. Place 15 items on a table and ask students to remember as many items as possible.
3. What pictures can you remember?  
This is a variation on the first activity. Ask students to view 15 pictures, then list as many as possible.
4. How well can you remember novel things?  
This is a variation on the first activity. Create a list of symbol combinations (three symbols) or nonsense letter combinations (three letters). The list should have 10–15 symbol or letter combinations arranged in two or three columns. Ask students to view the list of symbols, then list as many as they can.

There are more memory activities at the PBS website "The Forgetting: A Portrait of Alzheimer's – Symptoms: How Memory Works," [www.pbs.org/theforgetting/symptoms/memory.html](http://www.pbs.org/theforgetting/symptoms/memory.html).

## The Effects of Alzheimer's Disease as Seen in the Lobes of the Brain

The Aging Brain: A Lesson on Alzheimer's Disease  
Laura Stiles and Jessica Ogulnik, CDC's 2006 Science Ambassador Program

Name \_\_\_\_\_

Class \_\_\_\_\_

Complete this table as you work through the information found on the website "The Forgetting: A Portrait of Alzheimer's," [www.pbs.org/theforgetting/symptoms/index.html](http://www.pbs.org/theforgetting/symptoms/index.html).

<b>Region of Brain</b>	<b>Normal Function</b>	<b>Behaviors Affected by Alzheimer's Disease</b>
Frontal lobe		
Parietal lobe		
Occipital lobe		
Temporal lobe		
Brain stem		
Hippocampus		
Amygdala		

**Answer Key – The Effects of Alzheimer’s Disease  
as Seen in the Lobes of the Brain**

The Aging Brain: A Lesson on Alzheimer’s Disease  
Laura Stiles and Jessica Ogulnik, CDC’s 2006 Science Ambassador Program

Complete this table as you work through the information found on the website “The Forgetting: A Portrait of Alzheimer’s,” [www.pbs.org/theforgetting/symptoms/index.html](http://www.pbs.org/theforgetting/symptoms/index.html).

<b>Region of Brain</b>	<b>Normal Function</b>	<b>Behaviors Affected by Alzheimer’s Disease</b>
Frontal lobe	complex and social behaviors, speaking, reasoning, planning, making decisions	can no longer plan and start tasks with multiple steps  difficulty reasoning, will appear to be stubborn  loss of inhibition, may do things that are inappropriate
Parietal lobe	aids in orienting the body and figuring out what objects are	become disoriented – can’t find way around familiar locations  easily confuse common items
Occipital lobe	interpreting visual stimuli	difficulty with visual cues such as facial expressions and body language  not recognizing people you know
Temporal lobe	memory, understanding speech	difficulty remembering words and naming objects  hallucinations
Brain stem	controls automatic body functions such as breathing, digestion, heart rate; also involved with sleep	disruption of sleep  difficulties with behaviors such as swallowing
Hippocampus	creating memories	loss of short-term memory  inability to judge time and place or to understand what is going on  contributes to paranoia
Amygdala	controls emotion	Irrational emotions, paranoia, inappropriate sexual behaviors, apathy, hostility

## **Lecture – Cell Changes in the Alzheimer’s Patient’s Brain**

The Aging Brain: A Lesson on Alzheimer’s Disease  
Laura Stiles and Jessica Ogulnik, CDC’s 2006 Science Ambassador Program

### **I. Major changes in brain anatomy**

- a. The brain of a person with Alzheimer’s is smaller than the brain of a person without Alzheimer’s disease.
  - i. The sulci, fissures in the brain, enlarge
  - ii. The gyri, folds in the brain, shrink
- b. The changes in brain size are due to changes in the neurons
  - i. The affected neurons stop working
  - ii. The affected neurons are unable to communicate with each other
  - iii. The affected neurons eventually die, resulting in the change in size of the brain

### **II. Beta amyloid plaques**

- a. Amyloid Precursor Protein (APP)
  - i. This protein is involved in the normal functioning of the neuron
  - ii. APP is located in the cell membrane with part extending into the cell and part outside of the cell
  - iii. Under normal conditions, part of APP sticking out of the cell is cut off, forming beta amyloid
- b. Accumulation of beta amyloid
  - i. Beta amyloid is a “sticky” protein piece
  - ii. In brains affected by Alzheimer’s disease, the beta amyloid pieces collect outside the cell and associate with other proteins and cell materials, forming plaques
  - iii. It is hypothesized that the plaques interfere with cellular communication and stimulate the immune response resulting in the death of the cells

### **III. Neurofibrillary Tangles**

- a. Microtubules in healthy neurons
  - i. Used as structural support
  - ii. Act like a circulatory system, carrying materials along the axon to and from the cell body
  - iii. The tau protein is involved in the stability of the microtubules
- b. Microtubules in Alzheimer’s neurons
  - i. The tau protein is chemically altered, changing its properties
  - ii. Chains of tau proteins get tangled, leading to the breakdown of the microtubules
  - iii. The microtubules are no longer able to transport materials, resulting in problems with cellular communication and cell death

Images and more information about the process of amyloid plaque and neurofibrillary tangle formation can be found at the National Institutes of Health website “Plaques and Tangles: The Hallmarks of AD,”

[www.nia.nih.gov/Alzheimers/Publications/UnravelingTheMystery/Part1/Hallmarks.htm](http://www.nia.nih.gov/Alzheimers/Publications/UnravelingTheMystery/Part1/Hallmarks.htm).

## References

1. Plaques and Tangles: The Hallmarks of AD [online]. [cited 2006 June 15]. Available from URL:  
<http://www.nia.nih.gov/Alzheimers/Publications/UnravelingTheMystery/Part1/Hallmarks.htm>.
2. Alzheimer's Association. Fact Sheet: Experimental Alzheimer's drugs targeting beta-amyloid and the "amyloid hypothesis" [online]. 2006. [cited 2006 June 15]. Available from URL:  
<http://www.alz.org/Resources/FactSheets/FSBetaAmyloid.pdf>.
3. "Alzheimer's Disease, Dementia, and Brain Function." Power point presentation by David J. Thurman, MD, MPH, CDC Science Ambassador Program, June 2006.

## Alzheimer's Disease – Lowering Your Risk

The Aging Brain: A Lesson on Alzheimer's Disease  
Laura Stiles and Jessica Ogulnik, CDC's 2006 Science Ambassador Program

Name \_\_\_\_\_

Class \_\_\_\_\_

### Part 1 – Minimizing the Risks

In the table below, list three behaviors that could lower your risk of developing Alzheimer's disease and explain why you think these behaviors might lower your risk.

<b>Behavior</b>	<b>Why do you think this behavior might lower your risk of developing Alzheimer's disease?</b>

## Answer Key – Alzheimer’s disease – Lowering Your Risk

The Aging Brain: A Lesson on Alzheimer’s Disease  
Laura Stiles and Jessica Ogulnik, CDC’s 2006 Science Ambassador Program

### Part 1 – Minimizing the Risks

In the table below, list three behaviors that could lower your risk of developing Alzheimer’s disease and explain why you think these behaviors might lower your risk.

Behavior	Why do you think this behavior might lower your risk of developing Alzheimer’s disease?
Answers may vary. See the list below for some behaviors that researchers think might lower the risk of developing Alzheimer’s disease or minimize the effects of the disease.	Accept any reasonable answer.

Although there are many things that are still unknown about Alzheimer’s disease, there is evidence that some potentially modifiable risk factors for the disease exist. Behaviors that may reduce these risks include:

- **Protecting against head injury.** There appears to be a strong link between serious and repeated head injuries and Alzheimer’s disease, so using seat belts and wearing helmets during sports activity are two things that students can do now that may reduce their chances of developing Alzheimer’s disease in the future.
- **Maintaining overall health** by being physically active, eating a healthy diet, and avoiding tobacco and excess alcohol. These behaviors are good strategies for overall healthy aging and may help reduce the risk of developing dementias like Alzheimer’s disease as well.
- **Keeping the mind in the best shape possible** by being socially active and challenging the mind might help minimize the effects of Alzheimer’s disease.
- **Keeping the heart and blood vessels healthy.** People with heart and blood vessel problems due to conditions like high blood pressure, high cholesterol, and diabetes appear to be at increased risk of developing brain diseases such as Alzheimer’s disease and stroke. People can minimize the risk of damage to their heart and blood vessels by maintaining a healthy lifestyle and working with their health care provider to monitor their heart health and treating any problems.

### References

1. Alzheimer’s Association. Causes and risk factors [online]. 2006. [cited 2006 June 26]. Available from URL: [www.alz.org/AboutAD/causes.asp](http://www.alz.org/AboutAD/causes.asp).

## Case Studies of Alzheimer's Disease

The Aging Brain: A Lesson on Alzheimer's Disease  
Laura Stiles and Jessica Ogulnik, CDC's 2006 Science Ambassador Program

Name \_\_\_\_\_

Class \_\_\_\_\_

### **Directions**

You will be assigned **one** of the case studies below. Using the symptoms of the patients as clues, list the different areas of the brain that are affected for each symptom. Make sure that you list them in the order that the symptoms appear! Remember that these are just the centralized locations for these behaviors, and multiple regions of the brain affect most behaviors.

**Your assigned patient is:** \_\_\_\_\_

### **Patient 1**

This 75-year-old female patient comes in with her 40-year-old son. The son reports that Patient 1 began by forgetting recent events. She also began experiencing irrational emotions. Later on, she would confuse the names of relatives and would become confused while doing simple tasks such as brushing her hair.

**What areas of the brain are affected and why?**

---

---

---

### **Patient 2**

An 80-year-old man comes in with a journal. In this journal he has kept records of his thoughts on Alzheimer's disease. The man used to be a mathematician and is now unable to perform basic arithmetic. He first noticed changes when he often could not find commonplace personal items such as keys or glasses, which was seldom a problem before. He then was unable to recognize people who knew who he was. He has come in for Alzheimer's screening.

**What areas of the brain are affected and why?**

---

---

---

### **Patient 3**

An 83-year-old man comes in with his wife. She has been his caregiver for the past few years. She describes him now as angry and moody and easily upset by trivial things. He began having problems reading and speaking, and later was unable to behave himself appropriately in public settings.

**What areas of the brain are affected and why?**

---

---

---

**Patient 4**

A 73-year-old woman comes in with her husband. He claims her first signs were inability to sleep at night, and then progressed into other non-specific symptoms such as forgetting to pay bills, difficulty doing taxes, and stumbling over her words. He is concerned because he recently came home to find his wife trying to use a cordless phone as a remote control.

**What areas of the brain are affected and why?**

---

---

---

---

**Directions**

Working in your group of four, choose two students who will build a model of a healthy brain and two students who will build a model of a brain affected by Alzheimer’s disease –using your assigned case study. Follow the directions, and make sure to label the parts of the brain as well as their functions.

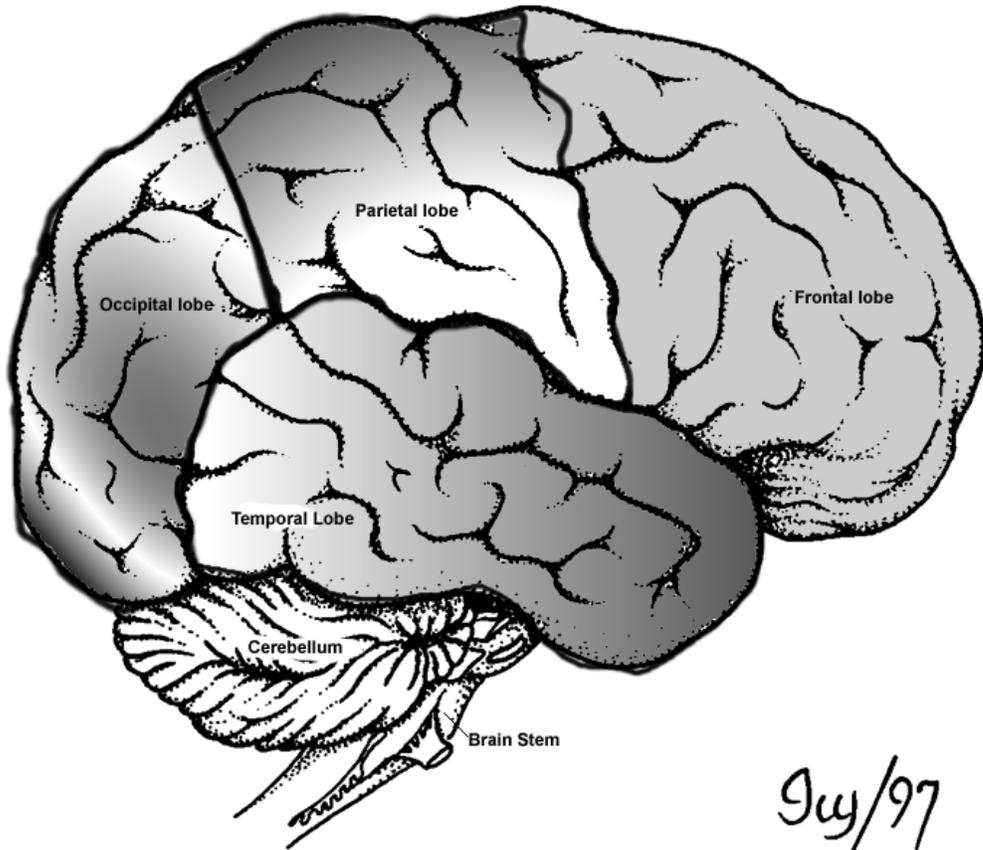
**Your assigned patient is:** \_\_\_\_\_

**Healthy Brain**

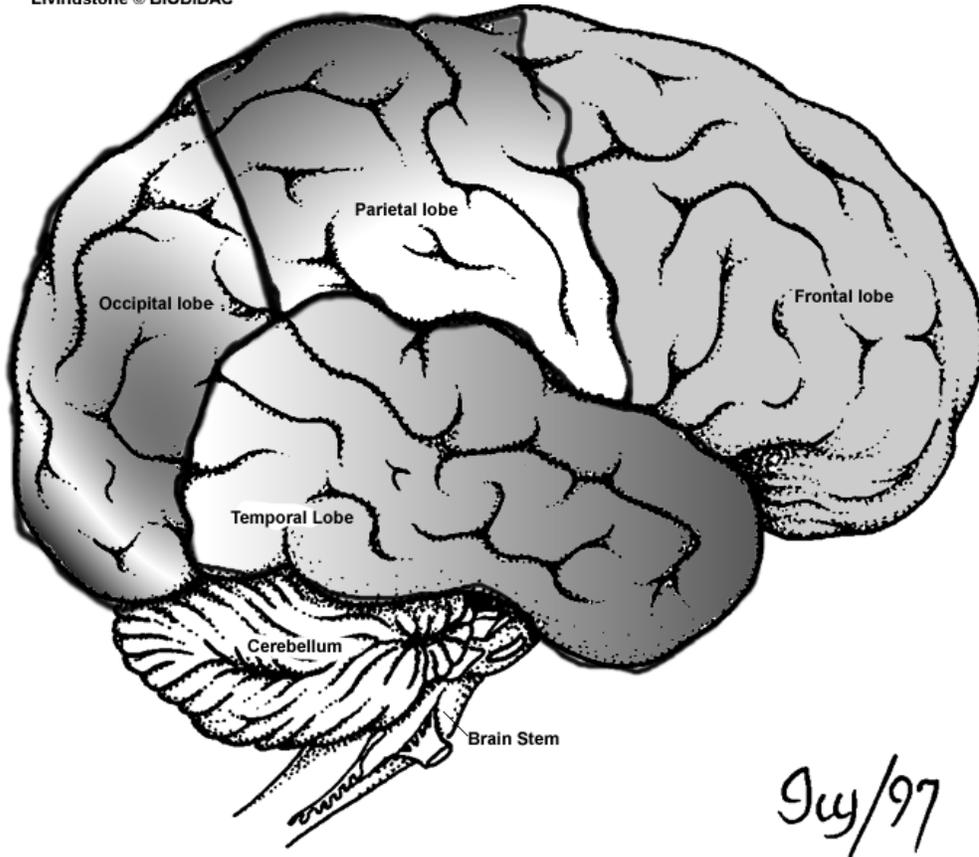
Obtain 1 lb of clay. Using the laminated brain model sheet, roll out clay rope with a ½” diameter. Lay the clay down along the template on the following page. Make an effort to simulate the folds of the brain shown. If there is extra clay, feel free to make your model more three-dimensional by stacking on top of the other ropes. Using toothpicks and paper, label the different areas of the brain.

**Brain with Alzheimer’s Disease**

Obtain ½ lb of clay. Using the laminated brain model sheet, roll out clay rope with a ¼” diameter. Lay the clay down along the template on the following page. Make an effort to simulate the folds of the brain shown. If there is extra clay, feel free to make your model more three-dimensional by stacking on top of the other ropes. Using toothpicks and paper, label the different areas of the brain that were affected in your individual patient.



Livingstone © BIODIDAC



Livingstone © BIODIDAC

“External morphology of the human brain - lateral view.” Image from <http://biodidac.bio.uottawa.ca/>, used with permission.

## **Answer Key – Case Studies of Alzheimer’s Disease**

The Aging Brain: A Lesson on Alzheimer’s Disease  
Laura Stiles and Jessica Ogulnik, CDC’s 2006 Science Ambassador Program

### **Patient 1**

This 75-year-old woman came in with her 40-year-old son. The son reports that she began by forgetting recent events. She also began experiencing irrational emotion. Later on, she would confuse the names of relatives and would become confused while doing simple tasks such as brushing her hair.

The hippocampus is the memory center, the amygdala is responsible for controlling basic emotion, the occipital lobe is used for visual interpretations, and the frontal lobe is responsible for coordinating complex tasks. Answers may vary due to most activities using more than one specific portion of the brain.

### **Patient 2**

An 80-year-old man comes in with a journal. In this journal he has kept records of his thoughts on Alzheimer’s disease. The man used to be a mathematician and is now unable to perform basic arithmetic. He first noticed changes when he often could not find commonplace personal items such as keys or glasses which was seldom a problem before. He then was unable to recognize people who knew who he was. He has come in for Alzheimer’s screening.

The parietal lobe is used for math processing, the hippocampus is affected for memory as well as the parietal lobe for orientation, and finally the occipital lobe is used to recognize people and/or objects.

### **Patient 3**

An 83-year-old man comes in with his wife. She has been his caregiver for the past few years. She describes him now as angry and moody and easily upset by trivial things. He began having problems reading and speaking, and later was unable to behave himself appropriately in public settings.

The temporal lobe is used for remembering and recalling verbal language, the frontal lobe affects inhibition, and finally the amygdala is responsible for controlling basic emotion.

### **Patient 4**

A 73-year-old woman comes in with her husband. He claims her first signs were inability to sleep at night, and then progressed into other non-specific symptoms such as forgetting to pay bills, difficulty doing taxes, and stumbling over her words. He is concerned because he recently came home to find his wife trying to use a cordless phone as a remote control.

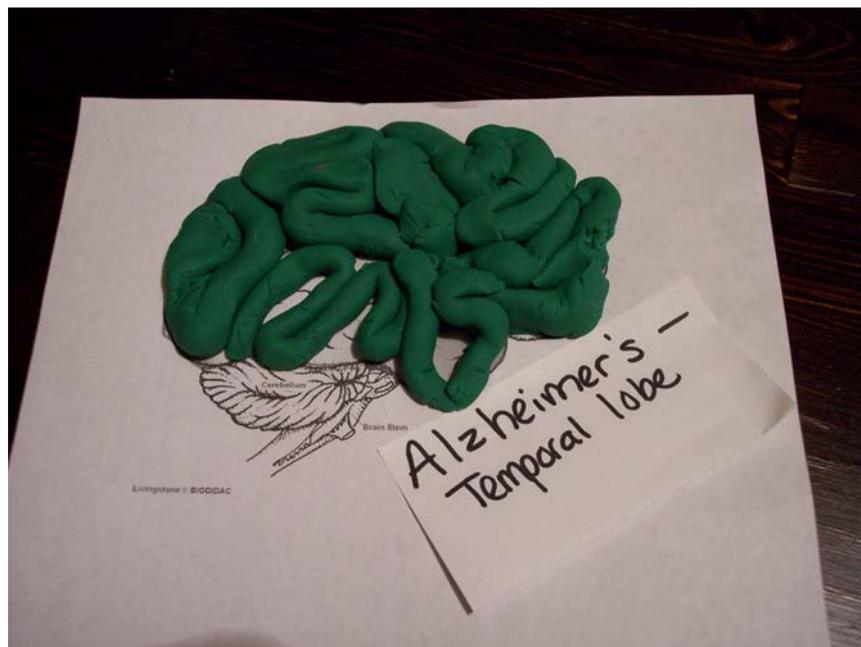
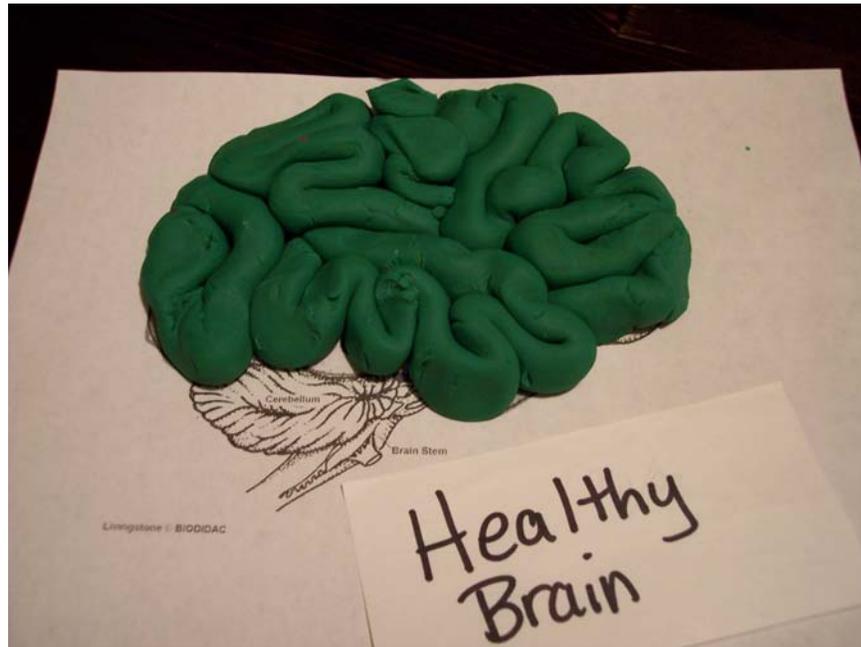
The brain stem is responsible for sleep patterns, the hippocampus is used for remembering, the parietal lobe is responsible for math processing, the temporal lobe is responsible for speech, and finally the parietal lobe is responsible for recognizing familiar objects.

### **References**

1. U.S. National Institutes of Health. National Institute on Aging. Alzheimer’s Disease Fact Sheet. 2006. [cited 2006 Jun 15]. Available from URL: <http://www.nia.nih.gov/Alzheimers/Publications/adfact.htm>.
2. Public Broadcasting Service. The Forgetting: A Portrait of Alzheimer’s. 2003. [cited 2006 Jun 15]. Available from URL: <http://www.pbs.org/theforgetting/symptoms/index.html>.
3. BIODIDAC. External morphology of the human brain - lateral view. 2006. [cited 2006 Jun 15]. Available from URL: <http://biodidac.bio.uottawa.ca/>.

**Photographs of Clay Models of a  
Healthy Brain and a Brain with Alzheimer's Disease**

The Aging Brain: A Lesson on Alzheimer's Disease  
Laura Stiles and Jessica Ogulnik, CDC's 2006 Science Ambassador Program



Photographs by Laura Stiles