

Autism and the Brain

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

Autism and the Brain

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Summary

This lesson may be used to introduce the concept of autism spectrum disorders in middle school and introductory high school biology or life science classes. It will allow students to explore brain structure and function, investigate emerging research, and write a letter to the Centers for Disease Control and Prevention (CDC) identifying new research they think is needed in the area of autism. To complete these activities, the students should be familiar with basic biology and the scientific method.

Learning Outcomes

- Students will be able to identify anatomical structures of the human brain and their corresponding functions.
- Students will be able to identify the areas of the brain that are associated with behaviors that may be affected by autism spectrum disorders.
- Students will be able to complete a web quest to explore different facets of autism spectrum disorders.
- Student will be able to write a letter to CDC detailing what new research the student feels would further the current understanding of autism spectrum disorders.

Materials

1. One of the following books or videos for the introduction:
Books:
 - Schnurr R, Strachan J. *Asperger's Huh? A Child's Perspective*. Anisor Pub;1999.
 - Gartenberg Z. *Mori's Story: A Book about a Boy with Autism*. Lerner Publications;1998.Video:
 - *Normal People Scare Me* from <http://normalfilms.com>
2. Teacher access to Internet and projection ability
3. Student access to computers
4. Photocopies of the following documents:
 - "Autism: What Do You know?" (Step 1)
 - "This Is Your Brain" graphic (Step 2)
 - "Let's Talk About the Brain" (Step 2)
 - "Autism: Quest for Answers" (Step 3)
 - "CDC Letter Template" (Conclusion)
 - "Autism: You Are the Expert Now" (Conclusion)

Total Duration

2.5 hours

Procedures

Teacher Preparation

Familiarize yourself with autism spectrum disorders (ASDs) and brain anatomy and function before introducing this lesson to students. It is important to be aware of the facts and myths about autism for the purpose of this lesson.

In addition, arrange to have the video and/or books mentioned previously available to the students. If this is not possible, read excerpts from the book or request permission from the publisher to copy excerpts of the book.

To complete certain portions of the lesson, students will need computers with Internet access. You may need to assign more than one student per computer. Arrange for a projection unit connected to a computer with Internet capability to complete Step 1. If a projection unit is not available, you may draw the needed diagrams on the board in front of the room and use colored markers or chalk.

Prepare copies of the handouts to be used in the lesson, as noted in the Materials section. Copies will need to be made of the following handouts: "Autism: What Do You know," "This is Your Brain" graphic, "Let's Talk about the Brain," "Autism: Quest for Answers," "Autism: You Are the Expert Now," and the "CDC Letter Template." The "This is Your Brain" graphic can be downloaded from the *Neuroscience for Kids* website.

Web Resources

Title: Autism

URL: www.cdc.gov/ncbddd/autism/

Description: This website provides background information about autism and associated disorders.

Title: Facts about Autism

URL: www.nichd.nih.gov/publications/pubs/autism1.htm

Description: This website provides facts about autism and links to other resources.

Step 1: Introduction

Duration: 30 minutes

Before starting the lesson, have students complete "Autism: What Do You Know?" This handout is a pretest to assess students' prior knowledge about autism spectrum disorders (ASDs). The pretest answer key is provided for the teacher's reference.

After the pretest, introduce students to the reality of living with an ASD. Read one of the following books out loud to the class or show part of the video *Normal People Scare Me*.

Books:

- Schnurr R, Strachan J. *Asperger's Huh? A Child's Perspective*. Anisor Pub;1999.
- Gartenberg Z. *Mori's Story: A Book about a Boy with Autism*. Lerner Publications;1998.

Video: *Normal People Scare Me* from <http://normalfilms.com>

Supplemental Documents

Title: Autism: What Do You Know?

Description: This document is the pretest to determine how much students already know about autism spectrum disorders.

Title: Autism: What Do You Know? – Answer Key

Description: This document is the answer key to the pretest.

Step 2

Duration: 30 minutes

Hand out the “This is Your Brain” graphic and access the *Neuroscience for Kids* website to facilitate a discussion on the structure and function of different areas of the brain. Show the website with the projector to the whole class. As stated previously, if no projector is available, draw a similar diagram on the board and use colored markers or chalk to illustrate different areas of the brain and their function. Discuss each part of the brain and have students take notes on the graphic or another sheet of paper. Be sure to review the function of different areas of the brain identified on the website diagrams. Use the questions from the “Let’s Talk About the Brain” handout to help students recall and rehearse what they have just learned.

After discussion, have students create a KWL chart on the back of the graphic. As a class, discuss what they now know about autism and what they would like to know about the topic. Have them come up with at least one question that they would like to know the answer to.

Web Resources

Title: Neuroscience for Kids (brain diagram)

URL: <http://faculty.washington.edu/chudler/colorb7.html>

Description: A diagram of the brain that is suitable for printing can be found at this site.

Title: Neuroscience for Kids (brain lobes and functions)

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

Description: This website contains a diagram of the brain with the lobes labeled and describes the function of each lobe.

Title: Neuroscience for Kids (cortical areas of the brain)

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

Description: This website explains general functions of different cortical areas of the brain.

Title: KidsHealth Organization – Brain

URL: www.kidshealth.org/kid/body/brain_SW.html

Description: This site has many age-appropriate articles and animations about the human body and kids’ health.

Supplemental Documents

Title: Let’s Talk About the Brain

Description: This document is a list of questions for the teacher to ask the class in the form of a discussion. The discussion takes place after reviewing basic brain anatomy and function.

Title: Let’s Talk about the Brain – Answer Key

Description: Answer key to “Let’s Talk About the Brain” discussion questions.

Title: KWL Chart

Description: Chart allows students to note what they already know (K), what they want to learn (W), and what they have learned (L).

Step 3

Duration: 45 minutes

Have students complete “Autism: Quest for Answers” individually or in groups using the website that follows. Have students brainstorm more questions for their KWL and write them in the “Want to Learn” column. Answers for the web quest are in the “Autism: Quest for Answers” answer key.

Web Resources

Title: Kids’ Quest on disability and health – Autism

URL: www.cdc.gov/ncbddd/kids/kautismpage.htm

Description: This site sends students on a web quest to learn about autism.

Supplemental Documents

Title: Autism: Quest for Answers

Description: This document helps students investigate ASDs by having them answer questions about autism and normal brain function.

Title: Autism: Quest for Answers – Answer Key

Description: Answer key for “Autism: Quest for Answers.”

Conclusion

Duration: 45 minutes

Have students complete the KWL chart by writing what they learned in the lesson. Students might have several questions that remain unanswered (in the “Want to Learn” column). Given that research is still ongoing with autism, ask students to pair up and write a letter to CDC listing at least one question they feel is important to research at this time. A template is provided to help students get started.

After students complete their letters, have them complete the posttest, “Autism: You Are the Expert Now.”

Supplemental Documents

Title: CDC Letter Template

Description: This template will guide students in drafting a letter to CDC suggesting areas of further research.

Title: Autism: You Are the Expert Now

Description: This document is a posttest to determine if the students’ knowledge of autism has changed since the beginning of the lesson.

Title: Autism: You Are the Expert Now – Answer Key

Description: Answer key to “Autism: You Are the Expert Now.”

Assessment

Students will be evaluated during the lesson by using the KWL chart in step 2, “Autism: Quest for Answers” in step 3, and “Autism: You Are the Expert Now” posttest and the letter written to CDC in the conclusion.

Modifications

Extension

For high school students (grades 9–12), have students use the same questions as listed on the web quest but use the following more advanced web resources to answer the questions.

Web Resource(s)

Title: National Institute of Mental Health, Autism Spectrum Disorders

URL: www.nimh.nih.gov/publicat/autism.cfm

Description: Information about autism from the National Institutes of Health (NIH).

Title: Centers For Disease Control and Prevention, Autism Information Center

URL: www.cdc.gov/ncbddd/dd/ddautism.htm

Description: Information about autism from CDC.

Education Standards

National Science Education Standards

SCIENCE AS INQUIRY, CONTENT STANDARD A:

As a result of activities in grades 5–8, all students should develop

- **Abilities necessary to do scientific inquiry**
- **Understandings about scientific inquiry**

LIFE SCIENCE, CONTENT STANDARD C:

As a result of their activities in grades 5–8, all students should develop understanding of

- **Structure and function in living systems**
- Reproduction and heredity
- **Regulation and behavior**
- Populations and ecosystems
- Diversity and adaptations of organisms

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:

As a result of activities in grades 5–8, all students should develop understanding of

- **Personal health**
- Populations, resources, and environments
- Natural hazards
- Risks and benefits
- Science and technology in society

HISTORY AND NATURE OF SCIENCE, CONTENT STANDARD G:

As a result of activities in grades 5–8, all students should develop understanding of

- Science as a human endeavor
- **Nature of science**
- History of science

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**

Autism: What Do You Know?

Autism and the Brain
Jill Bailer and Barbara Behnke, 2006 Science Ambassador Program

Name _____ Date _____

Answer True or False for each of the following questions about autism spectrum disorders and the brain.

- _____ 1. All kids with autism spectrum disorders cannot talk.
- _____ 2. People with autism spectrum disorders look different from other people.
- _____ 3. Kids with autism spectrum disorders are mean and do not like to be hugged.
- _____ 4. Scientists know what causes autism spectrum disorders.
- _____ 5. There is a cure for autism spectrum disorders.
- _____ 6. Kids with autism spectrum disorders can learn new things.
- _____ 7. The brain is made up of more than 100 billion nerve cells.
- _____ 8. Kids who have problems hearing may have difficulties in speaking.
- _____ 9. The part of the brain that controls voluntary movement is the cerebellum.
- _____ 10. The part of the brain that keeps you from falling off your skateboard or bicycle is the occipital lobe.

Autism: What Do You Know? Answer key

Autism and the Brain
Jill Bailer and Barbara Behnke, 2006 Science Ambassador Program

Name _____ Date _____

1. All kids with autism spectrum disorders cannot talk.

False - According to KidsHealth Organization, 40% of children with ASDs do not talk at all. Other children talk but often repeat back something that was said to them. (1)

2. People with autism spectrum disorders look different from other people.

False - According to KidsHealth Organization, people with ASDs look the same as other people but may act differently than what is expected. (1)

3. Kids with autism spectrum disorders are mean and do not like to be hugged.

False - According to KidsHealth Organization, kids with autism spectrum disorders (ASDs) often don't make the same emotional connections as other people do, so they might appear unhappy, mean, or unfriendly. (1)

4. Scientists know what causes autism spectrum disorders.

False - Scientists do not know what causes ASDs. According to KidsHealth Organization, scientists think that the autism spectrum disorders might have a connection with brain function. However, there is little scientific evidence to support any conclusions. (1)

5. There is a cure for autism spectrum disorders.

False - There are no treatments to cure autism spectrum disorders at this time but there are methods and technologies to help people with ASDs in living their lives. (1)

6. Kids with autism spectrum disorders can learn new things.

True - According to KidsHealth Organization, people with ASDs are affected to different degrees. Some may have only a little trouble learning or might be severely affected and need a great deal of help. (1)

7. The brain is made up of more than 100 billion nerve cells.

True - The brain contains more than 100 billion nerve cells. Each one of the nerve cells may have thousands of connections. (1)

8. Kids who have problems hearing may have difficulties in speaking.

True - According to Kids Health Organization, difficulties in hearing might affect the development of speech in children. (1)

9. The part of the brain that controls voluntary movement is the cerebellum.

False - The frontal lobe is associated with voluntary movement because it contains the primary motor cortex. (2)

10. The part of the brain that keeps you from falling off your skateboard or bicycle is the occipital lobe.

False - The cerebellum controls balance and coordination. (2)

1. Burdo-Hartman WA (reviewer). Autism [online]. 2004. [cited 2006 Aug 21]. Available from URL: http://www.kidshealth.org/kid/health_problems/brain/autism.html.

2. Chudler E. Neuroscience for Kids [online]. [cited 2006 Aug 21]. Available from URL: <http://faculty.washington.edu/chudler/functional.html>.

KWL Chart

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Name _____ Date _____

K (what I already know)	W (what I want to learn)	L (what I learned)

Let's Talk About the Brain

Autism and the Brain

Jill Bailer and Barbara Behnke, 2006 Science Ambassador Program

Name _____ Date _____

1. Children with autism sometimes have problems with speech. What lobe of the brain is associated with speech?
2. Children with autism sometimes have problems with memory. What lobe of the brain is associated with memory?
3. Children with autism sometimes react differently to pain. What lobe of the brain is associated with sensory messages such as pain?
4. Children with autism sometimes respond differently to being hugged and touched. What lobe of the brain is associated with sensory messages such as touch?
5. Some children with autism experience difficulty with balance, and some children with autism have extremely good balance. What lobe of the brain is associated with balance?

Let's Talk About Brain – Answer Key

Autism and the Brain
Jill Bailer and Barbara Behnke, 2006 Science Ambassador Program

Name _____ Date _____

1. Children with autism sometimes have problems with speech. What lobe of the brain is associated with speech?
Frontal
2. Children with autism sometimes have problems with memory. What lobe of the brain is associated with memory?
Temporal
3. Children with autism sometimes react differently to pain. What lobe of the brain is associated with sensory messages such as pain?
Parietal
4. Children with autism sometimes respond differently to being hugged and touched. What lobe of the brain is associated with sensory messages such as touch?
Parietal
5. Some children with autism experience difficulty with balance, and some children with autism have extremely good balance. What lobe of the brain is associated with balance?
Cerebellum

Source: Chudler E. Neuroscience for Kids [online]. [cited 2006 August 21]. Available from URL: <http://faculty.washington.edu/chudler/lobe.html>.

Autism: Quest for Answers

Autism and the Brain
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Name _____ Date _____

Go to the following website to answer the first three questions.

www.cdc.gov/ncbddd/kids/kautismpage.htm#Fast

1. Do all children with autism spectrum disorders (ASDs) have the same behaviors and abilities?
2. Name three examples of behaviors in children with ASDs.
3. What is echolalia?

At the bottom of the page, click on the purple heading KidsHealth Organization: Autism to answer the remaining questions. Your web address will be the following:

www.kidshealth.org/kid/health_problems/brain/autism.html

4. How many kids are affected by autism?
5. What are neurons and how do they help you function?
6. What are the symptoms of autism?
7. What kinds of tests do doctors do to make sure that kids with autism don't have other problems?
8. What kinds of specialists or doctors are in the team that works with a child with autism?
9. What are the treatments for autism?
10. Can children with autism go to school?

Autism: Quest for Answers

Autism and the Brain
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1. Do all children with ASD have the same behaviors and abilities?

According to Kids' Quest CDC, not all children with ASDs have the same behaviors or abilities. It is unlikely that two children with ASDs will have exactly the same symptoms. (1)

2. Name three examples of behaviors in children with ASDs.

According to Kids' Quest CDC:

1. Some children might have problems being friendly. Children might have trouble making eye contact and may just want to be alone. (1)
2. Children with ASDs might have problems speaking; 40% of children with ASDs do not speak, and some have echolalia (repeating back what someone has said to them). (1)
3. Some children might have problems with dealing with changes to their daily routines. They might not like changes and may want to have consistency and know what to expect. (1)

3. What is echolalia?

According to Kids' Quest CDC, echolalia is repeating back what is said. (1)

4. How many kids are affected by autism?

According to KidsHealth Organization, autism affects approximately 2 to 6 out of 1,000 children. (2)

5. What are neurons and how do they help you function?

Neurons are brain cells. Each neuron contains hundreds of thousands of connections to other parts of the brain and the body. (2)

6. What are the symptoms of autism?

According to KidsHealth Organization, determining whether a child has the symptoms of ASDs can be difficult. The first possible indication is that the child is old enough to speak but does not. The child might not be interested in other people or might behave in inappropriate ways. However, ASDs are not the only problem that can exhibit these symptoms. Doctors might order medical tests to rule out other possibilities. (2)

7. What kinds of tests do doctors do to make sure that kids with autism don't have other problems?

According to KidsHealth Organization, doctors might order blood, urine, and hearing tests; an MRI; and intelligence tests. (2)

8. What kinds of specialists or doctors are in the team that works with the child with autism?

According to KidsHealth Organization, the team might include a pediatric neurologist, pediatrician, pediatric developmentalist, child psychiatrist, child psychologist, and speech and language therapist. (2)

9. What are possible treatments for autism?

According to KidsHealth Organization, there is no cure for autism, but doctors, therapists, and special teachers can help kids with autism overcome or adjust to many difficulties. The earlier a kid starts treatment for autism, the better. Different kids need different kinds of help, but learning how to communicate is always an important first step. Therapists also help kids learn social skills, such as how to greet people, wait for a turn, and follow directions. Some kids need special help with living skills (like brushing teeth or making a bed). Others have trouble sitting still or controlling their tempers and need therapy to help them control their behavior. Some kids take medications to help their moods and behavior, but there's no medicine for autism. (2)

10. Can children with autism go to school?

According to KidsHealth Organization, since children are affected differently by autism, some children will be able to go to school and one day live on their own. Students might need special help in areas of learning and social development that they are struggling with. Teachers need to be trained to use these supports for the total development of the child. (2)

1. NCBDDD, CDC. Kids' Quest on Disability and Health: Autism [online]. 2006. [cited 2006 Aug 21]. Available from URL: <http://www.cdc.gov/ncbddd/kids/kautismpage.htm>.
2. Burdo-Hartman WA (reviewer). Autism [online]. 2004. [cited 2006 Aug 21]. Available from URL: http://www.kidshealth.org/kid/health_problems/brain/autism.html.

Disclaimer: There is limited conclusive, scientific evidence about autism spectrum disorders. The information in this worksheet is meant to provide general background information and is accurate to the authors' best knowledge.

CDC Letter Template

Autism and the Brain
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Name of School
Street Address
City and State
Date

Centers for Disease Control and Prevention
National Center on Birth Defects and Developmental Disabilities
1600 Clifton Road, MS E-86
Atlanta, GA 30333

Dear Scientist,

My name is _____ and I am in [name of teacher]'s [name of class]. We have been studying autism spectrum disorders (ASDs). I learned a lot of different things including

- List something learned
- List something learned
- List something learned.

But I still want to know more about the following:

- List something students want more information on
- List something students want more information on
- List something students want more information on.

I would like to recommend that you begin researching some of these things. I look forward to learning about what you have done.

Sincerely,

Your name

Autism: You Are the Expert Now

Autism and the Brain
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Name _____ Date _____

Answer True or False for each of the following questions about autism and the brain.

- _____ 1. All kids with autism spectrum disorders cannot talk.
- _____ 2. People with autism spectrum disorders look different from other people.
- _____ 3. Kids with autism spectrum disorders are mean and do not like to be hugged.
- _____ 4. Scientists know what causes autism spectrum disorders.
- _____ 5. There is a cure for autism spectrum disorders.
- _____ 6. Kids with autism spectrum disorders can learn new things.
- _____ 7. The brain is made up of more than 100 billion nerve cells.
- _____ 8. Kids who have problems hearing may have difficulties in speaking.
- _____ 9. The part of the brain that controls voluntary movement is the cerebellum.
- _____ 10. The part of the brain that keeps you from falling off your skateboard or bicycle is the occipital lobe.

Autism: You Are the Expert Now – Answer Key

Autism and the Brain
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Name _____ Date _____

1. All kids with autism spectrum disorders cannot talk.

False - According to KidsHealth Organization, 40% of children with ASDs do not talk at all. Other children talk but often repeat back something that was said to them. (1)

2. People with autism spectrum disorders look different from other people.

False - According to KidsHealth Organization, people with ASDs look the same as other people but may act differently than what is expected. (1)

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False - According to KidsHealth Organization, kids with autism spectrum disorders (ASDs) often don't make the same emotional connections as other people do, so they might appear unhappy, mean, or unfriendly. (1)

4. Scientists know what causes autism spectrum disorders.

False - Scientists do not know what causes ASDs. According to KidsHealth Organization, scientists think that the autism spectrum disorders might have a connection with brain function. However, there is little scientific evidence to support any conclusions. (1)

5. There is a cure for autism spectrum disorders.

False - There are no treatments to cure autism spectrum disorders at this time, but there are methods and technologies to help people with autism ASD in living their lives. (1)

6. Kids with autism spectrum disorders can learn new things.

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True - The brain contains more than 100 billion nerve cells. Each one of the nerve cells may have thousands of connections. (1)

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True - According to KidsHealth Organization, difficulties in hearing might affect the development of speech in children. (1)

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False - The cerebellum controls balance and coordination. (2)

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2. Chudler E. Neuroscience for Kids [online]. [cited 2006 Aug 21]. Available from URL: <http://faculty.washington.edu/chudler/functional.html>.