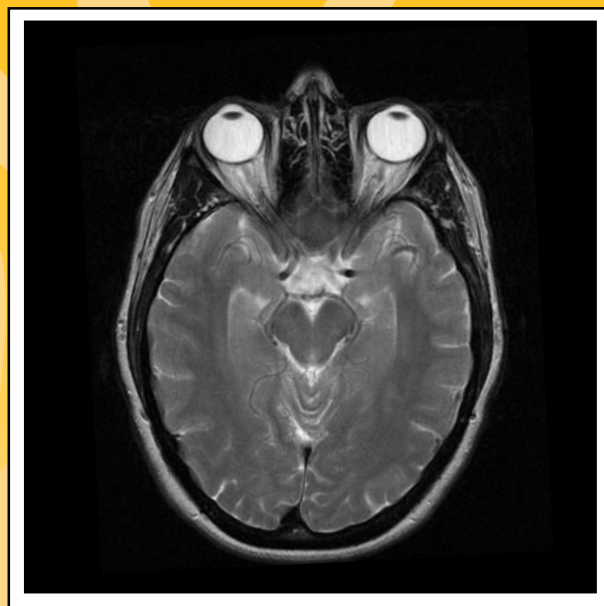
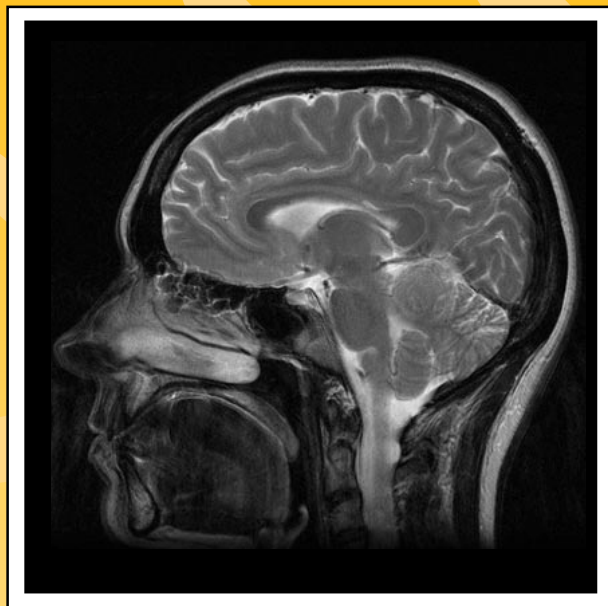


OVERVIEW

HUMAN BRAIN AND SENSES COURSE



Just about every human thought, emotion, and physical action is initiated and controlled by the brain. The brain is a 1.5-kg mass of some 60 billion parts that are in constant communication with each other at all times. The brain has been compared to a modern computer. There are similarities. Both operate on electricity. Both direct and redirect signals through complex pathways. Both reach outcomes and compare them to previous outcomes. Both are marvels of computing power. But modern computers are not brains. The human brain has the awesome ability to redesign itself as it goes about its business, adding components, disconnecting unproductive circuits, and reconfiguring the network of connections between parts. The brain is alive, and the architecture is flexible, making it one of the wonders of the

world. And each brain is ultimately different from every other in its detail and finish. Hence the dramatic diversity in humanity.

In this course students will have the opportunity to think about the fact that they have a brain, and to engage in activities that explore some of their routine, but outlandishly complex, brain activities—seeing, feeling, hearing, smelling, tasting, remembering. A deep current running through the curriculum is the message that proper brain function requires a supportive environment. The old adage, you are what you eat, takes on new meaning. Restated it might be, you are what you bathe your brain in. Students who take this message to heart will hopefully take conscious action to ensure a happy, healthy, productive brain.

FOSS AND NATIONAL STANDARDS

The **Human Brain and Senses Course** for grades 7–8 emphasizes the use of knowledge and evidence to construct explanations for the relationship between structure and function in the human sensory and nervous system. This course supports the following National Science Education Standards.

SCIENCE AS INQUIRY

Develop students' abilities to do and understand scientific inquiry.

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the connections between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in scientific inquiry.
- Understand that different kinds of questions suggest different kinds of scientific investigations; current knowledge guides scientific investigations; mathematics and technology are important scientific tools.
- Understand that scientific explanations emphasize evidence.

CONTENT: LIFE SCIENCE

Develop students' understanding of structure and function in living systems.

- Living systems at all levels of organization demonstrate the complementary nature of structure and function.
- Specialized cells perform specialized functions in multicellular organisms. Each type of cell, tissue, and organ has a distinct structure and a set of functions that serve the organism as a whole.
- Disease is a breakdown in structures or functions of an organism.

CONTENT: PHYSICAL SCIENCE

Develop students' understanding of transfer of energy.

- Light interacts with matter by transmission, absorption, or scattering. To see an object, the eye must gather light emitted by or scattered from that object.

SCIENCE IN PERSONAL PERSPECTIVES

Develop students' understanding of personal health.

- Safe living involves the development and use of safety precautions and the recognition of risk in decisions.

FOSS MIDDLE SCHOOL PROGRAM COMPONENTS

FOSS Middle School is a general science curriculum for students and their teachers in grades 6–8. The curriculum is organized into topical courses under three strands: **Earth and Space Science**, **Life Science**, and **Physical Science and Technology**. Each course is an in-depth unit requiring 9–12 weeks to teach.

This course, designed for students in grades 7–8, includes the following interconnected components:

- A detailed *Human Brain and Senses Teacher Guide* in a three-ring binder, including overview, materials preparation, goals and objectives, at-a-glance investigation chart, science background, lesson plans, transparency masters, teacher answer sheets, assessments with masters and scoring guides, CD-ROM user guide, and references (books, multimedia, websites). Each chapter of the teacher guide is separated by tabs for easy use. **Human Brain and Senses** has nine investigations, each with two to four parts.
- **Kit of student laboratory equipment** packaged for multiple classes of 32 students each. The kit also contains class resource materials such as posters and videos. Each course is designed for one teacher working with five sections of students per day. The kit also includes 50 **transparencies** for the investigations.
- *FOSS Human Brain and Senses Resources book* (79 pages) containing images, data, and readings for each student.
- *FOSS Human Brain and Senses Lab Notebook* containing 55 student sheets and organizers for the investigations. This can be a consumable book for each student or serve as a set of duplication masters for the teacher.
- *FOSS Human Brain and Senses CD-ROM* for use as a whole-class demonstration tool as well as an individual or small-group interactive instructional tool. The CD-ROM is woven into the instruction and is linked to each investigation through the on-line Teacher Guide.



**SYNOPSIS****SCIENCE CONCEPTS****PROCESSES****1****Learning and Memory (4 sessions)**

Students investigate learning by trying to learn mirror writing. They test their ability to memorize a set of objects using various single and complex input modes—hearing, seeing, hearing and seeing, and so forth. They explore mnemonics to enhance memory.

- Learning is a skill enhanced by repetition.
- The sensory input that results in the most effective memory retention is different for different people.
- Memory is enhanced by firsthand experience and associations.

- Conduct experiments.
- Compare results of techniques for enhancing memory.
- Practice a skill and monitor improvement.

2**Eyes: Inside and Out (3 sessions)**

Students study the external structures of the eye by inspecting their own and a partner's eyes. They study pupil response to light. They study the anatomy of a cow eye, first externally and then internally by dissection.

- The mammalian eye has predictable parts, like cornea, iris, pupil, lens, optic nerve, retina, and sclera.
- The cornea bulges out from the surface of the eye.
- The pupil is an opening into the eye that changes size in response to light.

- Compare structures found in different kinds of eyes.
- Investigate the pupil to discover if it is a hole or a dot.
- Determine the relationship between light and pupil response.

3**Lenses (3–4 sessions)**

Students investigate the lens found in the eye. They explore containers of water and glass marbles, followed by commercial lenses, to discover the characteristics of lenses and images. They make cameras obscura and model eyeballs.

- Lenses bend (refract) light; lenses with greater curvature bend light more.
- Lenses can project images on surfaces like screens and retinas.
- The cornea and lens in the eye are convex lenses.
- The number and shape of lenses affect where an image will focus.

- Investigate objects and materials to determine lens characteristics.
- Conduct experiments with lenses.
- Discover the relationship between lens curvature and image focus distance.
- Explain how a model eye is like a real eye.

4**Retina (3–4 sessions)**

Students investigate the quality of vision in their field of vision. They observe motion, color, and detail regions, as well as a blind spot in each eye. They learn about photoreceptors and attribute visual variation to the rods and cones.

- A receptor cell responds to a stimulus and sends an electric message to the brain.
- Photoreceptors (rods and cones in the retina) are sensitive to different aspects of light. Rods function in dim light and cones in bright light.

- Collect, organize, and analyze data dealing with peripheral vision and field of view.
- Relate retina structure to visual function.
- Use mathematics to explain the blind spot on the retina.

5**Into the Brain (5–6 sessions)**

Students study MRI images to determine the connection between the eyes and the brain. They construct a model brain to explore the major structures and orientation. They analyze EEG data to locate the area of the brain active during vision.

- The brain has three major parts.
- The blind spot can be used to locate the connection of the optic nerve.
- An MRI is a cross-section picture showing the structure of a part of the body.
- An EEG is an image of the electric activity on the surface of the brain.

- Construct three-dimensional models to understand brain structure and imaging processes.
- Transform and analyze data.
- Sequence images using relational data.

4

**FOSS CD-ROM****FOSS READINGS****EXTENSIONS**

Teacher Guide

- Crime Scene

Games Room

- Memory Game

- *Learning and Memory*
- *Helen Keller and Anne Sullivan*
- *Excerpt from The Story of My Life*

- Write in a different way.
- Research mirror writing.
- Go on a trust walk.
- Study more about Helen Keller.
- Learn braille.
- Read for the blind.
- Learn to sign.

Vision: How the Eye Works

- Pupil Response

Vision: How the Eye Looks

- Human Eye, Fish Eye, Cow Eye
- Position of the Eye
- Light into the Eye

Teacher Guide

- Cow-Eye Dissection

- *The Mammalian Eye*

- Compare eyes of different animals.
- Dissect fish eyes.

Optics Bench

- Bending of Light in Materials
- Lenses
- A Visit to the Optometrist

- *Lenses and Light*
- *Corrective Lenses*

- Write about the role of light in vision.
- Dissect a disposable camera.
- Have a presentation on photography.
- Make a pinhole camera.
- View the FOSS CD-ROM.

Vision: What Can Go Wrong

Vision: How the Eye Works

- Field of View
- Receptor and Receptor Density

Vision: How the Eye Looks

- Human Eye
- Light into the Eye

- *The Retina*
- *Field of Vision*
- *The Eyes Have It*

- Investigate field of vision.
- Investigate high/low peripheral vision.
- Visit an eye doctor.
- Investigate problems of the retina.
- Investigate binocular vision.
- View the FOSS CD-ROM.

MRI Lab

EEG Lab

Brain

- Pull-Apart Brain

- *Vision and the Brain*
- *Structures of the Human Brain*
- *History of Brain Research*
- *Brain-Imaging Techniques*

- Tour an MRI facility.
- Develop brain questions.
- Assign mapping homework.

**SYNOPSIS****SCIENCE CONCEPTS****PROCESSES****6****Perception (4–5 sessions)**

Students investigate depth perception and are introduced to the brain's role in processing visual images. They explore a number of optical illusions and investigate the phenomenon of persistence of vision with flip books and zoetropes.

- Depth perception depends on the overlapping visual fields of two eyes.
- Optical illusions occur when visual information conflicts with what the brain “expects” to see.
- The perception of motion occurs when the brain receives a series of short-term still images.

- Conduct investigations.
- Construct apparatus to gather, analyze, and interpret data.
- Develop descriptions and explanations using evidence.

7**Touch (4–5 sessions)**

Students investigate the receptors for touch and the number of pain, pressure, and cold receptors on the back of their hands. They construct and analyze EEG color maps for touch and compare them to EEG maps of vision.

- Touch is expressed in at least four sensations: pressure, pain, hot, and cold.
- Each touch sensation has its own kind of receptor cell.
- Some locations on the skin's surface have no receptors for pain and temperature.

- Conduct experiments, organize data, and draw conclusions about touch receptors.
- Transform graphical data into an EEG color map.
- Compare structure and function of two sensory systems.

8**Sending a Message (2 sessions)**

Students test their reaction time to a visual stimulus. They are introduced to the neuron as the basic cell of the nervous system, and to the transmission of messages from neuron to neuron.

- Neurons are the cells that convey messages to and from the brain.
- Sensory neurons carry messages from the sense organs to the brain; motor neurons carry messages from the brain to the body.
- Messages travel through neurons as electricity and from neuron to neuron via neurotransmitter chemicals.

- Conduct experiments, organize data, and draw conclusions about reaction time.
- Relate a simulation to the functioning of the nervous system.

9**Sensory Investigations (6 sessions)**

Students use what they have learned about the brain and the senses of vision and touch to investigate other senses.

- All senses have specialized receptors.
- Sensory systems can decline or fail in many ways.

- Research and independent study.
- Collaboration and presentation skills.

**FOSS CD-ROM****FOSS READINGS****EXTENSIONS**

Games Room

- Optical Illusions

Vision: How the Eye Works

- Field of View

- *Depth Perception*
- *Optical Illusions*
- *Sensory Perception*

- Obtain a stereo viewer.
- Investigate stereograms.
- Learn about 3-D movies.
- Make an animated movie.
- Research computer animation.
- Do the math.
- Read Oliver Sacks on vision.

Touch: How the Skin Works

- Receptor Fields
- Receptors

Lab: EEG Lab

- Touch

- *Touch Receptor Fields*

- Look at receptors within one grid square.
- Display all data on one grid.
- Set the lip challenge.
- Research the skin further.

Games Room

- Reaction Timer

Brain

- Synapse Function
- Neuron Growth

- *Brain Messages*
- *Neurotransmission: Sending a Message*

- Conduct special projects.

All pedestal rooms

- *Sensory Systems*
- *Vision Overview*
- *Touch Overview*
- *Hearing Overview*
- *Taste Overview*
- *Smell Overview*
- *Brain Mapping*
- *How Can Our Senses Fail Us?*

FOSS TEACHER GUIDE

The *Human Brain and Senses Teacher Guide* is just that—a guide. It is designed to be an information and planning tool to help you understand and enjoy your visit to the human brain, much like an interpretive brochure might guide your visit to historic Williamsburg. A good guide will suggest the best path to follow, and will enrich your visit with history, facts, and lore as you proceed. Like any good guide it will also point out places to rest, where to stop for refreshments. You should feel comfortable and confident that you know what you are doing as you go along.

Like a good guide it may be pressed into service less as you become more and more familiar with the territory. On your third visit to Williamsburg you might head straight for the main street, passing by some of the introductory exhibits, and you might visit your favorite spots in a slightly different order than you did before. You might even leave the trail here and there to drink in some of the historical ambiance in a way quite different from that intended by the preparer of the guide brochure.

The first time you visit the **FOSS Human Brain and Senses Course**, we hope you will follow our suggested sequence to get the lay of the land. The guide is filled with information to help you have an excellent first use of the course. It may seem overwhelming at first, but in a short time you will discover how to use it effectively. Here's what we suggest.

Look at the **Table of Contents** to see how the teacher guide is assembled. You'll notice that the guide is subdivided into 18 chapters. Turn each tab to see how much information there is in each section.

Next read the **Overview** chapter completely. This describes the scope of the course content and discusses issues of instruction, assessment, management, and safety.

Now turn all the pages in the guide, pausing to read the **Goal and Objectives** of each investigation carefully. In this way you will be able to get a very good sense of the curriculum.

Finally digest Investigation 1, *Learning and Memory*, very thoroughly. Read the science background carefully and study the **investigation at-a-glance chart** to see how the investigation is subdivided. The chart also provides a dissected overview of the several days of classroom actions, including the use of media (CD-ROM, video, and readings) and the assessments. Project the actions you read about into your classroom. Visualize students grappling with the issues and working with materials in small groups. If you have the kit at hand, bring out the materials as you read, and do the investigations. Practice mirror writing. Then read Investigation 2 carefully, then 3, 4, 5,...Keep the *Human Brain and Senses Teacher Guide* close at hand (even in hand) during your first trip into the human brain to ensure a safe and productive adventure.