Thinking about the brain:

The current focus on a Thinking Oriented Curriculum in secondary education encourages the use of open-ended tasks and problem solving and requires active engagement with the learning resources available. The Internet can be a great way to find information but it is so broad that for many topics it can be difficult to find material at an appropriate level for secondary students. The use of the Internet can be greatly limited by student inexperience and poor understanding of how to use search engines and key words. This is further limited if teachers set a task or question that is too broad, or if a framework for searching is not provided (eg. key questions, key terms).

Efficient use of the Internet is facilitated by providing students with websites known to contain the required information and structured questions to become familiar with the sites, leading into open-ended problem solving. Thus, teachers know the information is available, the class time is not wasted in fruitless searching and the old excuse 'Sir; I can't find any information so I'm just emailing my friend to see if they know anything'. Hmmm!

Characteristics of websites that contribute to useful learning in the classroom include:

- The information is accurate and comes from reliable and credited sources.
- The information is pitched at an appropriate level for the student group.
- It is easy to navigate.
- Graphics and images are used, rather than a large amount of text.
- Animation and interactivity are employed.
- It can be downloaded for offline use (relevant for using a website as a teaching tool or when wishing to download onto an intranet to restrict Internet access).

This article describes a problem based learning approach to brain structure and function using the Internet. It is based around a few websites each of which has most of the above characteristics. The range of issues that can be researched using these websites includes the senses (hearing, sight, touch), the structure of the brain and nervous system, the cells that make up the brain (neurons and glia) and functions of the brain and nervous system. The latter includes control of physical movements, learning, memory, emotion, mental illness, brain disease, brain injury and the effects of drugs. Specific examples are given within an outline that can be adapted to suit any topic.

Aims

- To use Internet sites as a tool for exploration about the brain and nervous system.
- To outline an approach for efficient use of the Internet.
- To explore problem based learning about the brain with ICT.

Before starting to explore specific issues about the brain, do some brainstorming around these questions to establish prior knowledge.

What does a brain look like?
Does the brain have different parts?
What does your brain do?
Can different parts of the brain do different things?
What are the building blocks of the brain?
What do brain cells look like?
How do brain cells work?
Where is memory kept in your brain?
Are there different sorts of memory?
What happens in your brain when you learn?

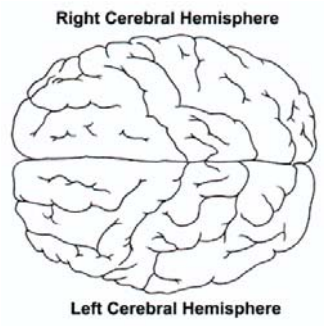
Problem based learning: providing a framework

When we give students a problem to solve, have we taught them how to go about solving it? Have we given students a scaffold to work with, to learn how to tease out the questions within a problem, identify the information they need and then find and collate it? One approach to this is outlined.

1. Give a question to be answered or a problem to solve.
2. Ask questions about the problem:
   a. What do I already know about it?
   b. What do I think I know and need to check?
   c. What is the problem really asking?
   d. What information do I need to solve this problem? List all questions.
3. Search for the answers to the questions.
4. Combine the information.
5. Does this information solve the problem?
6. If no,
   a. Keep looking; perhaps I haven't looked in the right place yet.
   b. Refine the questions; they might not be the right ones.
7. If yes, write the report, structured around the questions.

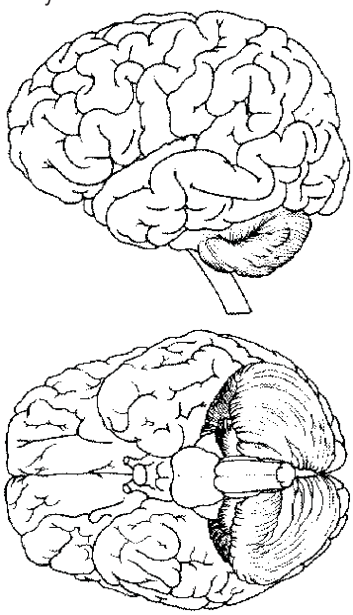
A. Structure questions for familiarization with the Internet sites

What does a brain look like? Does it have different parts? If you opened up your skull and looked at your head from the top what would you see? A vacant space? Hopefully you'd see your brain and it might look something like this, but with some blood added!



The brain has lots of different parts or structures, like the brain stem, mid brain, thalamus, cerebrum, frontal lobe, parietal lobe, occipital lobe, temporal lobe, corpus callosum, hippocampus, cerebellum, grey matter, white matter.

Label the brain diagrams. You might not find all the parts yet.



ICT and the thinking curriculum

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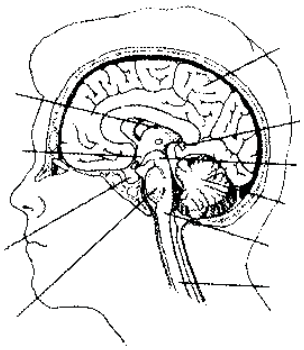
Explore these sites to find the brain parts listed above. Look for subheadings like brain structure or anatomy.

http://faculty.washington.edu./chudler/neurok.html
http://www.brainconnection.com/topics/ ?main=anim/lobes

Imagine your head is sliced open right down the middle between your eyes so that your face was sliced in two. What would your brain look like then? Some of the brain parts can only be seen when you slice the brain down the middle. How many more parts can you identify in the sliced brain? Label the next diagram.



Nervous System and Brain
Principle parts of middle section of brain

Real Brains

Have you ever seen a real human brain? Have you dissected a sheep's brain in science class? Go to http://www.exploratorium.edu/memory/braindissection/index.html to see what real human and sheep brains look like. You can also find lots of different brains from different animals at http://brainmuseum.org

a. How much bigger is the human brain than the sheep brain? Make an intelligent guess by comparing the sizes. At least 10 times larger.

b. How many neurons or nerve cells are in a human brain? About 100 billion neurons.

c. What is the outer layer of the brain called? The cortex. There are also pink or grey areas call grey matter and white areas called white matter. What is in each area? The grey matter contains the cell bodies of neurons (nerve cells). The white matter contains the long neuron processes called axons that are wrapped up in a fatty insulting layer called the myelin sheath.

Note: Answers are highlighted.

What does your brain do? Can different parts do different things?

The cerebrum has four main sections called lobes. Visit www.brainconnections.com/ topics/ ?main=anim/lobes to see examples of what different parts of the cerebrum do.

Constructing a matching task for this activity; the correct lobe function matches are listed below.

Frontal lobe - solving complex puzzles
Pariental lobe - raining a hand
Occipital lobe - looking at words or sentences
Temporal lobe - hearing a sound.

When you decide to stand or sit, open your mouth to speak or eat, or wink at your friend, your brain is controlling what your body does. Are there special parts of the brain to control different movements?

There is a section of your brain called the motor cortex. Motor means movement. The motor cortex controls your body movements.
Go to http://www.pbs.org/wgbh/aso/tryit/brain/

Link to 'A map of the motor cortex' to find out where the motor cortex is and what it does. Answer the following questions. Return to Figure 1 and colour the part of the cerebrum called the motor cortex.

Use the animation to answer these questions:

a. To bend your left knee, what part of the motor cortex needs to be activated?
b. To bend your right elbow, what part of the motor cortex needs to be activated?
c. Most of the time, activating one side of the brain controls movement on the (opposite) side of the body.
d. What part of the motor cortex needs activation so that you can shrug both your shoulders?

Student Task:
Quiz your partner. See how good they are at controlling their brain!

Use the animations to http://www.brainconnection.com/library/?main=explorehome/animations to find out.
Find more detailed information at:
http://www.hhmi.org/senses

Memory in your brain

Are there different sorts of memory? Find out what is meant by these terms:

a. Short term memory
b. Long term memory
c. Operational memory
d. Skill memory.

Go to http://www.exploratorium.edu/memory/braindissection/index.html to find out which parts of your brain are important for each type of memory. This is a good introduction to different types of memory. Teachers and students of psychology will be aware of other categories such as declarative, nondeclarative, semantic and episodic memory.

Student Task: Make up a 'matching task' to test your friends about which parts of the brain hold different sorts of memory.

B. Problem Solving

Some examples of problem solving about brain function are provided. All the information is available at the websites given in this article.

1. My teacher said we use nerve cells in our brains when we read, speak and learn. She also said that the left side of your brain talks to the right side of your brain and that we learn better if we are using both sides of the brain. Is she right?

What information do I need to solve this?
- What is the brain made of?
- What is a brain cell (neuron) like?
- Do brain cells send messages to each other?

How?
- What happens in the brain when we read and write?

2. Peter had a skateboard accident and is thrown through the air hitting a fence headfirst. A sharp metal bolt sticking out of the wall goes through his skull. After an MRI scan at the hospital, the doctor said there was damage to the right side of the 'motor cortex', just next to the midline of the brain. The doctor told Peter he might lose some movements. What movements might he lose as a result of this injury?

What information do I need to solve this problem?
- What part of the brain controls body movements?
- What is the motor cortex? Where is the motor cortex?
- What does the motor cortex do?
- What is important about the middle part of the motor cortex? Is it different to other parts of the motor cortex?

3. Katie is crossing the road but then sees a car speeding towards her. She runs quickly off the road. What happened inside Katie's brain to allow her to get out of the way?

Questions: What information do I need to solve this problem?
- Is the eye connected to the brain? How?
- What part of the brain receives information from our eyes?
- How does the eye send the message to the muscles?
- How does the brain send messages to the muscles?
- What part of the brain controls the legs so you can run?

Any problem could be approached in this manner. Other areas usually of great interest to Years 8-10 students involving the brain include effects of drugs, sporting injuries and why teenagers like to sleep. All of these topics can be explored with the websites given here. Each student should be encouraged to explore their own areas of interest, structuring their search around key questions in order to keep their searching focused.

Conclusion

This approach can help students learn how to dissect a problem, identify what they already know and what they need to find out. Teacher input is important in helping students to structure and refine their questions and searching for relevant answers. Use of selected websites identified as relevant for the topic and the student group can help to ensure that all students have a successful experience using the Internet to find relevant information, develop their thinking and problem solving skills and perhaps engage them is exploring further questions.

Resources

Science Art CD Rom, Cambridge University Press (Figures 1-4)

Eric H. Chudler. University of Washington, Seattle, USA. http://faculty.washington.edu/chudlerneurok.htmi
Neuroscience for Kids. A fantastic site with many topics on neoruonscience aimed at kids. Includes neuroscience in the news, drugs, anatomy, diseases, quizzes and games.

Public Broadcasting Service, WGBH Interactive Media, USA. http://www.pbs.org/wgbhlaso/tryitlbrainJ# http://www.pdb.org/wgbhlnove/mindl probe.html#
Probe the Brain activity. A fun activity for students to probe different parts of the motor cortex and see which part of the body moves. Can be downloaded for offline use. Also find mapping the motor cortex and introductions to CAT and MRI scanning at this site. Look for other science education materials at www.pbs.org

The Exploratorium, San Francisco, USA. http:l/www.exploratorium.edulmemory/braindissection.index/html
Learn brain anatomy by online sheep brain dissection. Can be downloaded for offline use. Look for other science education materials at the The Exploratorium.

Scientific Learning Corporation, Oakland, California, USA. http://www.brainconnection.com/ Excellent material, including animations, information articles, worksheets and activity templates, including and a 'brain hat'.

W. Welker, J. I. Johnson and A. Noe. University of Washington, Michigan State University and the National Museum of Health and Medicine, USA. http://brainmuseum.org
Good for images of preserved brains from a wide range of species. Also has a brain development sequence. No animations or interactive.

Howard Hughes Medical Research Institute, Maryland, USA. http://www.hhmi.org/sensesl Seeing, hearing and smelling the world. Material may be too complex for junior secondary students, but very good for teachers and psychology students. Look for other science education materials at HHMI.

About the author

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Fran has a background in biomedical research laboratories working in cell biology, biochemistry and neuroscience. She has taught secondary science and VCE Biology at Northcote High School, VCE Biology at the Council of Adult Education and Laboratory Technology courses at Swinburne TAFE. She regularly presents sessions for teachers at STAV conferences.