Scanning the Brain
Answer Key

Explore the different technologies used to explore the brain and record the information in the chart below.

Technology	How it Works	Information it Provides	Advantages/Drawbacks
CAT (or CT) Scanning (Computerized Axial Tomography) Developed in the 1970s.	The subject is placed in a special, donut-shaped x-ray machine that moves around the person and takes x-rays. A computer combines the 2-dimensional x-ray images to make the cross-sections or 3-dimensional images.	It combines many 2-dimensional x-ray images to generate cross-sections or 3-dimensional images of internal organs and body structures (including the brain).	**Advantages:** ▪ Can detect brain damage and highlight changes in cerebral blood flow (a measure of brain activity) as a subject performs a task. ▪ Noninvasive and painless. **Drawbacks:** ▪ Delivers a high dose of radiation to the patient.
EEG (electro-encephalograph) Fun fact: Austrian psychiatrist Hans Berger was the first to record this activity in humans, in the late 1920s.	An EEG is a recording of electrical signals from the brain. Electrodes, hooked up to the subject's scalp, pick up electric signals naturally produced by the brain and send them to galvanometers (instruments that detect and measure small electric currents). The galvanometers are hooked up to pens, which trace the signals onto the graph paper.	EEGs allow researchers to follow electrical impulses across the surface of the brain and observe changes over split seconds of time. An EEG can show what state a person is in -- asleep, awake, anaesthetized -- because the characteristic patterns of current differ for each of these states. One important use of EEGs has been to show how long it takes the brain to process various stimuli.	**Advantages:** ▪ The EEG is one of the first -- and still very useful -- ways of non-invasively observing human brain activity. **Drawbacks:** ▪ A major drawback of EEGs is that they cannot show the structures and anatomy of the brain or provide information about the functions of specific regions.
MEG (magneto-encephalography)	Magnetic detection coils bathed in liquid helium are poised over the subject's head. The brain's magnetic field induces a current in the coils, which in turn induces a magnetic field in a special, incredibly sensitive instrument called a superconducting quantum interference device, or SQUID. (The liquid helium chills the coils to super-conducting temperatures, of -269 degrees Celsius.)	MEG is a new technology that measures the very faint magnetic fields that emanate from the head as a result of brain activity.	**Advantages:** MEG provides the most accurate resolution of the timing of nerve cell activity -- down to the millisecond (most accurate of all brain scanning methods.) **Drawbacks:** Expensive. One MEG device costs millions of dollars and weighs about eight tons, so there are only a few worldwide.

Information in this answer key has been taken from the following sources:
http://www.pbs.org/wnet/brain/scanning/index.html
http://faculty.washington.edu/chudler/image.html

Technology	How it Works	Information it Provides	Advantages/Drawbacks
MRI and fMRI (Magnetic Resonance Imaging and Functional Magnetic Resonance Imaging) Fun fact: The invention of MRI in 1977 was a major breakthrough in imaging technology.	The subject is placed on a moveable bed that is inserted into a giant circular magnet. Images of sections of the brain are obtained through the use of "gradient magnets" which alter the main magnetic field in a very specific area while the magnetic force is being applied. The MRI technician can pick exactly what area of the person's brain he or she wants an image of.	MRI produces clear and detailed pictures of brain structures. The images often take the form of cross-sectional "slices." fMRI compares successive MRI scans to detect changes in blood flow to different areas of the brain and provide information about brain activity.	**Advantages:** ▪ MRI does not require the subject to be injected with a tracer substance. ▪ Safe, painless, non-invasive. ▪ No special preparation is needed by the subject. ▪ MRI scans show brain anatomy. ▪ fMRI scans show brain anatomy and brain function. **Drawbacks:** ▪ Expensive. ▪ Cannot be used in patients with pacemakers or other metallic devices. ▪ Patients must lie still.
PET (Positron Emission Tomography)	The subject is injected with a very small quantity of radioactive glucose. The PET then scans the absorption of the radioactivity from outside the scalp. PET is one of the most popular scanning techniques in current neuroscience research.	PET scans allow one to observe blood flow or metabolism in any part of the brain. Brain cells use glucose as fuel, and PET works on the theory that if brain cells are more active, they will consume more of the radioactive glucose, and if less active, they will consume less of it. A computer uses the absorption data to show the levels of activity as a color-coded brain map, with one color (usually red) indicating more active brain areas, and another color (usually blue) indicating the less active areas.	**Advantages:** ▪ Provides an image of brain activity. ▪ Allows researchers to look at cross-sectional "slices" of the brain, and observe deep brain structures, which earlier techniques like EEGs could not. **Drawbacks:** ▪ PET scans require the subject to be injected with a tracer substance. ▪ Expensive.