Inside the Brain

Compare what brain research methods reveal and what they cannot.

P.2.4 "Compare and contrast the methods for studying the brain (e.g., MRI, EEG, CT, FMRI, PET scan, lesion studies) and explain their strengths and limitations."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline one strength and circle one limitation of each method named in the passage. Number two places where the passage compares methods so you can use those comparisons in your answers.

When Music Becomes Hard to Read

1. When a violinist can no longer read music after a head injury, researchers might begin with images of the brain's structure. A CT scan uses X-rays to produce cross-sectional images quickly, making it useful for checking urgent bleeding. However, it exposes the person to ionizing radiation and shows less soft-tissue detail than MRI. MRI uses strong magnets and radio waves to show fine structural detail without ionizing radiation, although scanning takes longer and some metal implants can prevent its use. Neither scan alone shows exactly when nerve cells send signals during reading.

2. To study activity while the violinist reads a score, researchers could record an EEG. Electrodes on the scalp detect changing electrical activity with millisecond precision, so EEG can show when a response occurs. Yet signals from several brain regions mix at the scalp, making their exact sources hard to locate. Functional MRI, or fMRI, maps changes in blood oxygen linked to activity and pinpoints active regions more precisely than EEG. Its signal lags behind neural activity by seconds, though it avoids ionizing radiation. Both methods can show patterns associated with a task, but activity alone does not prove a region is required for it.

3. Another option, a PET scan, uses an injected radioactive tracer to map processes such as glucose use. It can reveal metabolic patterns that structural images miss, but it involves radiation and cannot capture millisecond changes. Researchers can also study people who already have injuries to particular brain areas, called lesion studies. If damage to one area repeatedly goes with difficulty reading music, that is stronger evidence the area matters for the skill than activity alone. Still, injuries often affect several areas or connections, so a lesion cannot neatly isolate one brain region. No single method answers every question about the brain.

2 ANSWER WITH EVIDENCE

Use the passage

1. A runner may have bleeding in the brain after a fall. Why might a doctor choose CT first instead of MRI, and what advantage would MRI have for a later scan?

2. A researcher wants to know both when a response to a sound occurs and where activity occurs. Compare what EEG and fMRI could contribute, including one limit of each.

3. A team wants to examine brain metabolism rather than brain structure. Why would PET be more useful than MRI for that goal, and what drawback would PET add?

4. Why could a lesion study provide stronger evidence than fMRI that an area matters for a skill? What limits that conclusion?

3 YOUR TURN

Your own words

A research team wants to learn both when people recognize a familiar face and whether a brain area is needed for that skill. Propose a two-method plan using methods from the passage, explaining what each method adds and one limitation of each in four sentences.

Inside the Brain

PART 1 · READ AND MARK

Underline one strength and circle one limitation of each method named in the passage. Number two places where the passage compares methods so you can use those comparisons in your answers. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A runner may have bleeding in the brain after a fall. Why might a doctor choose CT first instead of MRI, and what advantage would MRI have for a later scan?	**CT is quicker and useful for checking urgent bleeding. MRI shows finer soft-tissue detail without ionizing radiation.**
2	A researcher wants to know both when a response to a sound occurs and where activity occurs. Compare what EEG and fMRI could contribute, including one limit of each.	**EEG tracks the response with millisecond precision but cannot locate its source precisely. fMRI locates active regions more precisely, but its signal lags behind neural activity by seconds.**
3	A team wants to examine brain metabolism rather than brain structure. Why would PET be more useful than MRI for that goal, and what drawback would PET add?	**PET can map processes such as glucose use that structural MRI does not show. PET requires a radioactive tracer, while MRI does not expose the person to ionizing radiation.**
4	Why could a lesion study provide stronger evidence than fMRI that an area matters for a skill? What limits that conclusion?	**Difficulty after damage is stronger evidence that an area matters than activity during a task alone. Injuries may affect several areas or connections, so the effect cannot always be tied to one area.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The team could compare face recognition in people with existing brain injuries and people without those injuries. If damage to an area repeatedly disrupts recognition, the lesion evidence suggests that area matters, although injuries may also affect other areas or connections. The team could record EEG during the task to find when recognition-related signals occur with millisecond precision. EEG cannot locate their source precisely, so the two methods provide different kinds of evidence.

For Part 3, accept a plan that uses lesion studies to investigate whether an area matters and EEG to measure timing, with an accurate limitation for each. Do not accept a claim that either method alone proves exactly where and when recognition occurs.