The Female Brain Through Puberty, Pregnancy, Menopause

Name Date Class

Reading

1 Tell people that a woman's brain has lost gray matter, and most will imagine damage or decline. The evidence points to something more **counterintuitive**. Gray matter, the tissue packed with nerve cell bodies that forms most of the brain's wrinkled outer layer, shrinks noticeably during at least two healthy stages of female life: puberty and pregnancy. Both stages bring large shifts in the sex hormones estrogen and progesterone, which act on **receptors** found throughout the brain. Menopause seems to follow a different rule. Together, these findings raise a question with no simple answer: when does a smaller brain mean a worse one?

2 The clearest case is adolescence, when both girls and boys lose gray matter, a change widely thought to reflect **pruning**: the brain removes connections it rarely uses so that the ones it uses often can work more efficiently. This explanation rests mainly on imaging and animal research, not on direct counts of connections in living teenagers. In girls, the loss overlaps with the hormonal **surge** around the first menstrual period.

3 Pregnancy produces a similar pattern. In a **longitudinal** study published in Nature Neuroscience in 2017, a team from Barcelona and Leiden led by Elseline Hoekzema scanned 25 women before and after their first pregnancy. The mothers lost gray matter in regions linked to social cognition, the ability to understand what other people think and feel, and the losses were still visible two years after birth. The changes were consistent enough for a computer program to identify, from the scans alone, which women had been pregnant. In 2024, a US team led by Laura Pritschet scanned one first-time mother 26 times before, during, and after her pregnancy. Gray matter fell by an average of about 4 percent in roughly 80 percent of the regions measured, while white matter, the brain's connecting fibers, briefly became more robust before returning to its **baseline** after birth. With only one person scanned, the result shows what can happen, not what usually happens.

4 A 2026 study in Nature Communications, led by Sophie van 't Hof at Amsterdam University Medical Center, compared all three transitions with a single method, following each woman over time. It used one **cohort** for each transition, 1,095 women in total. Girls going through their first period lost cortical gray matter at an **accelerated** rate, about 0.16 percent a month, and women in a first or second pregnancy lost about 0.12 percent a month; comparison groups not in transition showed no such speed-up. Van 't Hof calls her team's interpretation a hypothesis: they see the loss as **adaptive** fine-tuning, not harm. She has also stressed that less gray matter is not a memory complaint, and that, as of 2026, research had not linked the pregnancy changes to so-called “mommy brain.”

5 Menopause did not fit this pattern. Using UK Biobank data, the team compared 120 women who passed through the transition during the study with women before or after it. The stable groups lost gray matter at the slow rate expected with age, about 0.03 percent a month. The women in transition showed no detectable loss, as if ordinary aging had paused. This does not match all earlier work. In 2021, Lisa Mosconi's team in New York reported a **transient** dip in gray matter in at least one region, the precuneus, which recovered after menopause, along with increases in blood flow and cellular energy production that looked **compensatory**. One possible reason for the **discrepancy** is design: Mosconi's team examined specific regions and compared women at different stages, while the Amsterdam team tracked total gray matter within the same women.

6 The Amsterdam team lacked directly measured hormone data for every group, so the role of estrogen and progesterone is inferred rather than shown to be **causal**. Menopause status was self-reported, the groups were scanned on different machines, and every study described here is observational: researchers recorded changes rather than controlling them. Commenting for Spain's Science Media Centre, the biomedical researcher Nuria Marín Jiménez noted that structural changes do not, on their own, show that a brain works better or worse.

7 These questions are still open partly because female biology has long been **overlooked** in brain research. A survey by Liisa Galea's group at the University of British Columbia, published in 2022, examined more than 3,000 neuroscience and psychiatry papers and found that in 2019 only 5 percent analyzed sex as a factor that might explain their results. With so little earlier work to compare against, the menopause finding is **preliminary**, and its authors have said they cannot explain the pause. The next test is scale: the Maternal Brain Project, described in 2024 by the team behind the single-case study, aims to scan hundreds of women and could show whether these changes predict memory or mood after birth.

Vocabulary Matching

Match each word from the reading with its meaning. Write the letter on the line.

1	**counterintuitive**	_____	**A**	cell structures that bind to specific chemical signals
2	**receptors**	_____	**B**	relating to the cause of something, not just an association
3	**pruning**	_____	**C**	not noticed or not given enough attention
4	**surge**	_____	**D**	helping something adjust successfully to new demands
5	**longitudinal**	_____	**E**	happening faster than would normally be expected
6	**baseline**	_____	**F**	coming before a fuller, more certain analysis
7	**cohort**	_____	**G**	following the same subjects repeatedly over time
8	**accelerated**	_____	**H**	the selective removal of unnecessary parts of a structure
9	**adaptive**	_____	**I**	a group of people studied together over time
10	**transient**	_____	**J**	making up for a loss or weakness elsewhere
11	**compensatory**	_____	**K**	a difference between things that should match
12	**discrepancy**	_____	**L**	a sudden, large increase in something
13	**causal**	_____	**M**	the starting level used for later comparison
14	**overlooked**	_____	**N**	the opposite of what common sense would suggest
15	**preliminary**	_____	**O**	lasting only a short time before things return to normal

Fill in the Blank

Choose a word from the box to complete each sentence. Use each word once. The words are already in the correct form.

accelerated	**adaptive**	**baseline**	**causal**	**cohort**	**compensatory**	**discrepancy**	**longitudinal**
overlooked	**preliminary**	**pruning**	**receptors**	**surge**	**transient**		

1 Some painkillers work by blocking _____ in nerve cells.

2 Careful _____ in early spring helps the roses flower later.

3 The final match caused a huge _____ in ticket sales.

4 A _____ study tracked the same patients for thirty years.

5 Record your sleep for a week first to set a _____ .

6 The 2020 _____ of nursing students finished their training online.

7 Students in the _____ program finish the degree in three years instead of four.

8 Camouflage is an _____ feature that helps animals hide from predators.

9 The fog was _____ and cleared before noon.

10 The company paid _____ damages to customers affected by the delay.

11 There is a _____ between what the ad promised and what arrived.

12 The survey shows a connection, but not a _____ relationship.

13 Her work on the project was _____ in the final report.

14 The _____ design will change after the client gives feedback.

Comprehension Questions

Answer in your notebook or discuss with a partner. Questions 10 to 12 are IELTS-style.

1 What common assumption does the writer question in the first paragraph?

2 What is pruning, and why is it thought to be useful?

3 What did Hoekzema's team find in first-time mothers, and how long did the changes last?

4 How did white matter change in the 2024 single-case study?

5 What was new about the design of the 2026 Amsterdam study?

6 How did menopause differ from puberty and pregnancy in the 2026 study?

7 What reason does the writer give for the discrepancy between the Amsterdam and Mosconi findings, and how certain is it?

8 Why is the role of hormones described as inferred rather than causal, and what other limits does the writer mention?

9 Why do you think the writer ends with the Maternal Brain Project instead of a conclusion?

IELTS-Style Questions

10 **True, False, or Not Given:** "*The Amsterdam team measured hormone levels directly in all three groups.*" Explain your answer using evidence from the reading.

11 **Yes, No, or Not Given:** "*The writer believes that a smaller brain is always a worse brain.*" Explain your answer using evidence from the reading.

12 **Author's purpose:** Why does the writer include the finding from Galea's survey in the last paragraph?

True or False

Circle T (true) or F (false) according to the reading. Write a correction for each false statement on the dotted line.

1 **T / F** Estrogen and progesterone act on receptors found throughout the brain.

2 **T / F** Only girls lose gray matter during the teenage years.

3 **T / F** The gray matter changes in the 2017 study were still visible two years after birth.

4 **T / F** In the 2024 study, white matter stayed more robust for years after the birth.

5 **T / F** The 2026 study included 1,095 women across three groups.

6 **T / F** Van 't Hof presents the fine-tuning explanation as a proven fact.

7 **T / F** In the menopause cohort, stable groups lost gray matter at about 0.03 percent a month.

8 **T / F** Mosconi's team found that gray matter kept falling in every region after menopause.

9 **T / F** The studies described in the reading were controlled experiments.

10 **T / F** Galea's survey examined more than 3,000 papers.

Discussion Questions

Talk with a partner or in a small group. The questions move from personal to more abstract.

1 Before reading this, what did you think happened to the brain as people grow older?

2 Which finding in the reading did you find most unexpected?

3 When you hear the word "loss," do you usually think of something negative? Can you think of a loss that is useful?

4 In your culture, how openly do people talk about puberty, pregnancy, or menopause?

5 Many people joke about "mommy brain." Why might ideas like this spread even when the evidence is limited?

6 How much weight should a study of one person carry? What would convince you that a finding applies to most people?

7 Why do you think female biology has been studied less than male biology in brain research?

8 Should research funders require studies to analyze sex as a factor? What might the costs be?

9 How should journalists report early findings like these so that readers are informed but not misled?

10 If your own brain were changing in a major way, would you want to know the details? Why or why not?

11 Should schools teach teenagers that their brains are still changing? How might that knowledge affect them?

12 Should workplaces offer support to employees going through menopause? What might that support look like?

13 The reading calls some brain changes possibly "adaptive." Who decides what counts as normal or healthy when bodies change?

14 Can science describe differences between groups of people without those findings being used to limit them? How?

Language Focus: Reduced relative clauses (participle phrases after nouns)

A reduced relative clause is a relative clause shortened to a participle phrase. "Regions that are linked to" becomes "regions linked to" (past participle, passive meaning). "Girls who are going through" becomes "girls going through" (-ing participle, active meaning).

In the reading:

- "Gray matter, the tissue **packed with nerve cell bodies** that forms most of the brain's wrinkled outer layer, shrinks noticeably…"
- "…which act on receptors **found throughout the brain**."
- "The mothers lost gray matter in regions **linked to social cognition**…"

Practice: Reduce the relative clauses: *"The hormones that are produced during pregnancy affect many organs. Researchers who are studying menopause want larger samples."*

Activities and speed challenge
englishbridges.com/lessons/female-brain-transitions

Notes