EDGROUND
TEACH SMARTER

Growth Mindset Through Neuroplasticity

Part 1: Teacher Guide

An interactive classroom resource exploring how the brain changes through learning, practice and experience.

Ages
Upper Primary & Secondary

Duration
60 minutes

Includes
Simulator Guide
Teaching Strategies
Vocabulary & References

The brain is not fixed.
With experience and practice,
we can build stronger connections,
deepen understanding and grow.

Growth Mindset Through Neuroplasticity

Part 1: Teacher Guide

Info

Suggested age range: Upper primary to secondary
Duration of lesson: 60 minutes
Main teaching tool: Interactive 3D Neural Plasticity Simulator
Core message: The brain is not fixed. Learning and practice change the brain by strengthening useful connections and weakening unused ones.

1. Purpose of This Resource

This resource supports a classroom lesson on growth mindset using an interactive 3D neural plasticity simulator. The aim is not to teach a full biology lesson. Neuroscience is used as evidence base for a learning message: **ability is not fixed, and effective practice can change what the brain is able to do.**

Many students use fixed-mindset language without realising it. They may say, “I am not good at maths,” “I am not a science person,” or “I will never understand this.” These statements can feel true because difficulty often feels like evidence of inability. This lesson challenges that interpretation. Difficulty is not proof that the brain cannot learn. Difficulty often means the brain is in the process of forming, strengthening, and reorganising connections.

The simulator gives students a visual model of this process. As the teacher clicks buttons such as Learn, Practice, Fire, and Neglect, students can see neurons, synapses, dendritic spines, signal cascades, and pruning represented on screen. **The visual model helps students connect abstract language,** such as “practice makes you better”, **to a more concrete idea:** practice changes the structure and efficiency of neural networks.

Important clarification

A key point for teachers is that **the simulator is a representational model, not a literal microscopic recording of a student’s brain**. In real brains, learning usually involves changes in existing neural networks: synapses strengthen or weaken, dendritic spines change, and unused connections may be pruned over time. The simulator simplifies this by showing neurons and their connections appear, light up, strengthen, and

disappear. This is useful for teaching, but students should understand, at an age-appropriate level, that models show selected features of reality; they are not exact copies of reality.

For **younger primary students**, the teacher does not need to emphasise biological detail. The message can be expressed very simply:

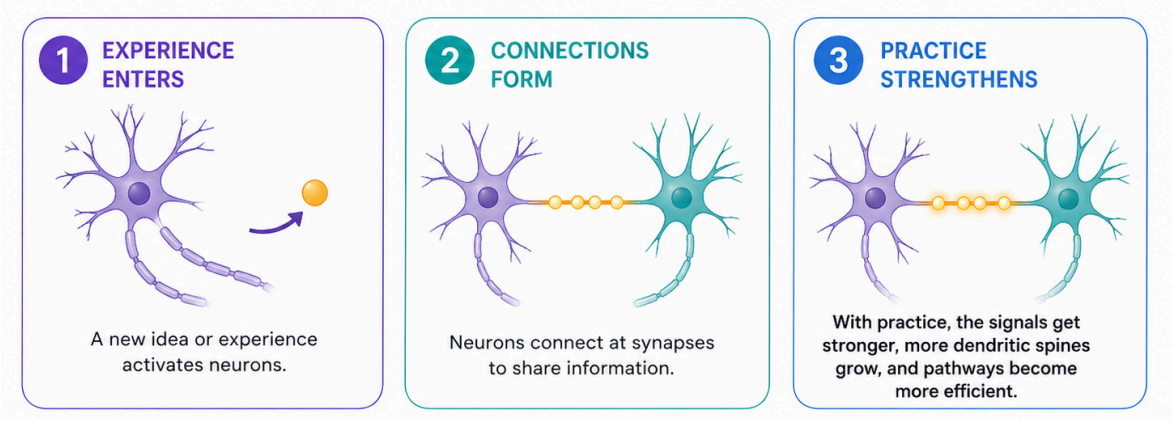
> **When you practise, your brain gets better at that thing.**

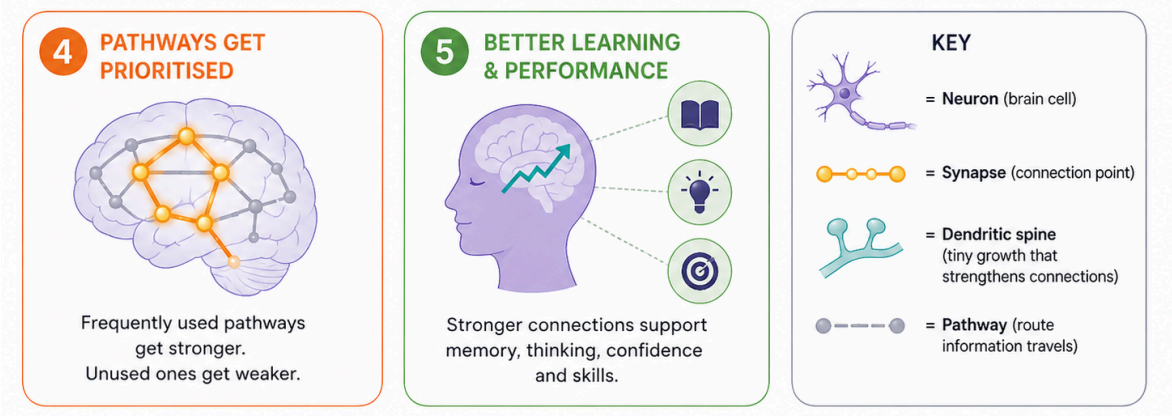
For **older secondary students**, the teacher can be more precise:

> **Learning changes neural networks by strengthening useful pathways, weakening unused ones, and improving retrieval efficiency over time.**

2. Teacher Background: Neuroplasticity

Neuroplasticity is the brain's ability to change in response to experience, learning, practice, and environment. The brain is made of networks of neurons. These neurons communicate at specialised connection points called synapses. When a person practises a skill or thinks through an idea repeatedly, some neural pathways become more efficient. This may involve stronger synaptic signalling, changes in the shape and number of dendritic spines, and changes in which pathways are most frequently used.





This is why learning is not simply “putting information into the brain” like saving a file on a computer. Learning is a biological process. The learner’s brain is physically and chemically active. When students practise retrieving information, solving problems, explaining ideas, correcting mistakes, or applying knowledge in a new situation, the brain is not passive. It is changing through use.

The phrase “use it or lose it” is a useful classroom simplification. Connections that are used repeatedly are more likely to become stronger and easier to activate. Connections that are not used may weaken or be pruned. This does not mean students instantly lose knowledge after one missed homework task. It means that long-term learning depends on repeated activation over time.

For this lesson, avoid overwhelming students with too much technical biology. The most important idea is:

Learning changes the brain. Practice strengthens useful pathways. Neglect weakens unused pathways.

A helpful analogy is a path through grass. The first time someone walks across a field, the path is difficult to see. If people walk the same route many times, the path becomes clearer and easier to follow. If nobody uses the path for a long time, the grass grows back. Neural pathways are more complex than grass paths, but the analogy helps students understand why practice matters.

Age-appropriate framing

For younger primary students:

Use concrete language. Avoid overloading students with terms such as synapse, dendrite, and long-term potentiation unless the lesson is being used as science enrichment. The main message is enough:

“Your brain can grow stronger at things you practise.”
“Hard does not mean impossible.”
“Mistakes help your brain learn what to try next.”

For older secondary students:

Use the biological vocabulary more deliberately. Students can understand that "brain growth" in this lesson mostly means changes in connections and pathway strength, not simply the brain becoming physically larger or producing a new neuron for every new idea.

"Learning is linked to changes in neural networks, especially changes in synaptic strength and pathway efficiency."

3. Teacher Background: Growth Mindset

A growth mindset is the belief that abilities can develop through effort, effective strategies, feedback, and time. A fixed mindset is the belief that abilities are mostly fixed and that difficulty means a person lacks talent or intelligence.

In the classroom, a growth mindset should not be reduced to slogans such as "just try harder" or "believe in yourself." That version can be unhelpful because it ignores the quality of teaching, the usefulness of strategies, and the need for feedback. A stronger version is:

I can improve when I practise deliberately, use better strategies, seek feedback, and keep working over time.

This lesson, therefore connects growth mindset to specific behaviours:

- practising more than once;
- correcting mistakes;
- asking for feedback;
- using retrieval practice;
- explaining ideas to someone else;
- returning to difficult ideas after a gap;
- choosing strategies rather than simply repeating the same ineffective method.

A growth mindset supports learning by changing how students interpret difficulty. A fixed-mindset student may see a challenge as a sign to stop: "I can't do this." A growth-mindset student is more likely to see challenge as information: "This pathway is still weak. I need a strategy and more practice."

The aim of the lesson is not for students to chant positive phrases. The aim is for students to understand that learning is a process of change. They should leave with a more accurate sentence to use when learning feels difficult:

I cannot do this yet, but my brain can change if I practise in the right way.

Age-appropriate framing

For younger primary students:

A growth mindset should sound practical and emotionally safe. Use simple classroom phrases:

"I cannot do it yet."
"I can try again."
"Mistakes help me learn."
"My brain is practising."
"I can use a new strategy."

Avoid telling younger children that they must always feel positive. It is acceptable for them to say, "This feels hard," or "I feel frustrated." The growth mindset response is not to deny the feeling. It is to add a next step:

"This feels hard so that I will try one small step."

For older secondary students:

A growth mindset can be framed as a more accurate model of skill development. Older students can be challenged to avoid shallow motivational language. They should understand that improvement depends on strategy, feedback, deliberate practice, and time, not simply confidence.

"A growth mindset is not positive thinking. It is a realistic belief that ability can change through effective practice and feedback."

4. Using the Neural Plasticity Simulator

The simulator should be projected at the front of the classroom. It is not intended to be a student-controlled activity during the main lesson. The teacher controls the simulation while students observe and interpret what changes on screen.

Suggested setup

Before the lesson:

1. Open the simulator in full-screen mode or in a large browser window.
2. Check that the projector shows the cyan, orange, gold, and pink elements clearly.
3. Use the reset button so the simulation begins from a baseline state.
4. Keep region labels visible at first, then hide them later if they distract students.

5. Have blank paper ready for the crumpled paper activity.
6. Print the student worksheet or display it digitally.

Age-appropriate setup notes

For younger primary students:
Keep the screen visually calm. Hide region labels if they distract from the main message. You may describe the simulation as “a brain model” rather than naming every part. Focus attention on three visible changes: new learning, stronger connections, and unused connections fading.

For older secondary students:
Keep the region labels visible at the beginning and briefly explain that different brain areas support different functions. Do not turn the lesson into a brain anatomy lesson, but allow the labels to give older students a sense that the model is grounded in real brain structure.

5. Simulator Controls and Classroom Meaning

Simulator control	What students see	Classroom meaning	Teacher caution
Learn new concept	A new orange neuron appears and connects to the network.	A new idea becomes connected to what the learner already knows.	In real brains, learning does not always mean a brand-new neuron is created. Treat this as a model for adding a new idea to a network.
Practice (varied)	Dendritic spines grow; synapses brighten and strengthen.	Practice strengthens connections and makes pathways easier to use.	Emphasise quality practice, not just repetition.
Fire signal cascade	Neurons and connections light up in a sequence.	Thinking involves signals moving through networks. Stronger networks can activate more efficiently.	Avoid saying one thought equals one simple pathway. Real cognition is distributed and complex.
Neglect / pruning	Weak synapses fade and disappear.	Unused connections can weaken over time.	Avoid making students anxious. This is a reason to revisit learning, not a threat.

Toggle region labels	Brain region names appear or disappear.	Shows that different areas can be involved in different functions.	This lesson is not about memorising brain regions. Keep focus on learning and practice.
Reset brain	The model returns to baseline.	Useful if the screen becomes too crowded or if you want to repeat the demonstration.	Remind students that real brains do not reset like a computer simulation.

6. Primary and Secondary Teacher Language for Simulator Controls

Simulator control	Primary-friendly teacher language	Secondary teacher language
Learn new concept	“The brain is meeting a new idea. It is starting to connect it to other things.”	“The model represents a new idea entering an existing network of knowledge. Real learning usually changes networks rather than creating one new neuron for every idea.”
Practice (varied)	“When we practise, the brain pathway gets stronger.”	“Repeated and varied practice strengthens useful neural pathways and can be linked to changes in synaptic strength and dendritic spines.”
Fire signal cascade	“The brain is sending messages. The ideas are working together.”	“The model shows signal activity through a network. Stronger pathways are easier to activate and retrieve.”
Neglect / pruning	“If we never use something, the brain may make that pathway weaker.”	“Unused or weakly activated pathways can weaken over time. Pruning is part of how the brain becomes more efficient.”
Toggle region labels	“These names show different parts of the brain, but today we only need the big idea: the brain can change.”	“These labels identify simplified brain regions. They are useful context, but the lesson focus remains plasticity and learning behaviour.”
Reset brain	“This restarts our model. Real brains do not restart like this.”	“Resetting is only a simulation function. Real brains are continuously changing and do not return to a clean baseline.”

7. Visual Elements in the Simulator

Visual element	What it represents
Blue / cyan neurons	Existing neurons or active neurons in the model.
Orange neuron	A newly introduced learning element or concept in the model.
Cyan connections	Synapses or pathways between neurons.
Bright cyan connections	Strengthened or active connections.
Gold / pink spines	Dendritic spines: small structures linked to synaptic connection and learning.
Fading red/orange connections	Pruning: weakening/removal of unused or weaker connections.
Brain region labels	Simplified labels for areas such as frontal, parietal, temporal, occipital, and hippocampus.

8. Recommended Teacher Framing

Use phrases such as:

- “This model shows the idea of brain change.”
- “The real brain is more complex, but the pattern is useful.”
- “Practice makes pathways stronger.”
- “Mistakes are not proof of failure; they are information for the brain.”
- “The word ‘yet’ matters because learning is a process.”

Avoid phrases such as:

- “Every time you learn, you grow a new neuron.”
- “If you do not practise once, your brain deletes the idea.”
- “Growth mindset means you can do anything if you try.”
- “Smart students have better brains.”

9. Vocabulary for Different Teaching Purposes

The vocabulary in this lesson has two different purposes. Teachers should not feel that all students must memorise all biological terms to understand the growth mindset. Neuroscience vocabulary is useful for building teacher confidence and for older students who are ready for a more precise explanation. Younger primary students need simpler language to express their learning, effort, mistakes, and improvement.

A. teacher and older secondary vocabulary

Use this list for teacher background, secondary students, or science enrichment. These terms are useful for explaining how the simulator connects to real neuroscience.

Term	Student-friendly definition	Classroom example sentence
Neuron	A brain cell that sends and receives information.	“Neurons work together in networks.”
Synapse	A connection point where neurons pass signals.	“Practice can strengthen synapses.”
Dendrite	A branch of a neuron that receives signals.	“Dendrites help neurons receive information.”
Dendritic spine	A tiny bump on a dendrite that helps make connections.	“Dendritic spines can change with learning.”
Neuroplasticity	The brain’s ability to change with experience and practice.	“Neuroplasticity means my brain can learn.”
LTP / Long-Term Potentiation	A process where repeated activation makes a synapse stronger.	“LTP is one way practice can strengthen learning.”
Pruning	The weakening or removal of unused connections.	“Pruning helps the brain become more efficient.”
Growth mindset	The belief that ability can improve with effort, strategies, feedback, and time.	“I am not good at this yet.”
Fixed mindset	The belief that ability is fixed and cannot change much.	“I am just bad at science.”

B. Primary-friendly vocabulary

Use this list for younger students, EAL students, or any class where the main goal is a growth mindset rather than neuroscience. These words help students understand and express the learning message without needing too much

biological detail.

Word or phrase	Simple meaning	Example sentence
Grow	To get stronger or better over time.	“My brain can grow stronger.”
Yet	Not now, but maybe later with practice.	“I cannot do this yet.”
Practise	To do something again to improve.	“I practise reading every day.”
Mistake	Something that shows what I need to learn next.	“My mistake helps me learn.”
Try again	To have another go.	“I can try again.”
Strategy	A way to help me learn.	“Drawing a picture is my strategy.”
Feedback	Help that shows me how to improve.	“My teacher’s feedback helps me.”
Hard	Not easy yet.	“This is hard, but I can take one step.”
Fixed	Stuck; not changing.	“A fixed mindset says I cannot change.”
Growth	Changing and improving.	“A growth mindset says I can improve.”
Pathway	A brain road for learning.	“Practice makes the pathway stronger.”

C. Minimum vocabulary for a short primary lesson

If time is limited, use only these five words:

- brain
- practise
- mistake
- yet
- grow

Suggested primary sentence:

“My brain can grow when I practise. I cannot do it yet, but I can try again.”

10. Teacher Reference Links

These links are useful for teacher background reading and for improving the lesson’s scientific framing.

Neuroplasticity and brain learning

BrainFacts — Making and Breaking Connections in the Brain
https://www.brainfacts.org/brain-anatomy-and-function/cells-and-circuits/2020/making-and-breaking-connections-in-the-brain-111820

BrainFacts — Eliminating Neural Connections
https://www.brainfacts.org/thinking-sensing-and-behaving/brain-development/2023/neural-pruning-and-apoptosis-011623

NCBI Bookshelf — Synaptic Plasticity as a Model for Learning and Memory
https://www.ncbi.nlm.nih.gov/books/NBK27983/

Review article — Dendritic Spine Plasticity: Function and Mechanisms
https://pmc.ncbi.nlm.nih.gov/articles/PMC7484486/

Growth mindset

PERTS Mindset Kit — Teaching a Growth Mindset
https://www.mindsetkit.org/topics/teaching-growth-mindset

PERTS Mindset Kit — Introducing Students to the Malleable Brain
https://www.mindsetkit.org/topics/teaching-growth-mindset/introducing-students-to-malleable-brain

Yeager et al. (2019) — A national experiment reveals where a growth mindset improves achievement
https://www.nature.com/articles/s41586-019-1466-y

APA Monitor — Making mindset science work in the real world
https://www.apa.org/monitor/2021/04/career-lab-mindset

Suggested academic references

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Tipton, E., Schneider, B., Hulleman, C. S., Hinojosa, C. P., Paunesku, D., Romero, C., Flint, K., Roberts, A., Trott, J., Iachan, R., Buontempo, J., Yang, S. M., Carvalho, C. M., … Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature, 573*, 364–369.

Macnamara, B. N., & Burgoyne, A. P. (2023). Do growth mindset interventions impact students' academic achievement? A systematic review and meta-analysis with recommendations for best practices. *Psychological Bulletin, 149*(3–4), 133–173.

11. Teacher Notes for Responsible Framing

A growth mindset is useful when taught carefully, but it should not be used to blame students for struggling. Students do not learn simply because someone tells them to believe in themselves. They learn when they receive clear instruction, practise effectively, receive useful feedback, and have enough time to improve.

The most responsible classroom message is:

> **Your ability is not fixed, but improvement requires the right kind of effort.**

For younger students, this can become:

> **You can improve when you practise and try again.**

This lesson should therefore lead naturally to better study habits. After the lesson, teachers can reinforce the message by praising the process and strategy rather than innate ability. For example:

Instead of: "You are so smart."
Use: "Your diagram helped you organise the forces clearly."

Instead of: "Good job for trying."
Use: "You tried a new strategy, checked your mistake, and improved your answer."

The simulator is most powerful when it is integrated into repeated classroom routines. Students should hear growth-mindset language not only in this lesson but also when they revise, correct their work, respond to feedback, and prepare for assessments.ments.