



NAPE

Neuroscience: The Biological Link to Learning

**MICROMESSAGING TO REACH AND TEACH
EVERY STUDENT™ WORKSHOP**



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Agenda

Topic	Approximate Time
Introduction	10 minutes
Physical Process of Learning	30 minutes
Applying the Natural Learning Process	20 minutes
Research on Gender Differences	30 minutes
Gender Differences in Visualization	15 minutes
Wrap-up	10 Minutes



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Goal

Apply awareness of the natural learning process and use teaching methods that help students strengthen their abilities in both gender typical and atypical fields.





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Activity: Warm Up

1. Think of something you learned to do as an adult.
2. Write it down.
3. What motivated you to learn it?
4. Think about how you learned it and write it down.



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Physical Process of Learning



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Activity: About the Brain

Think, pair, share, and discuss everything and anything you know about the brain.





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Information About the Brain

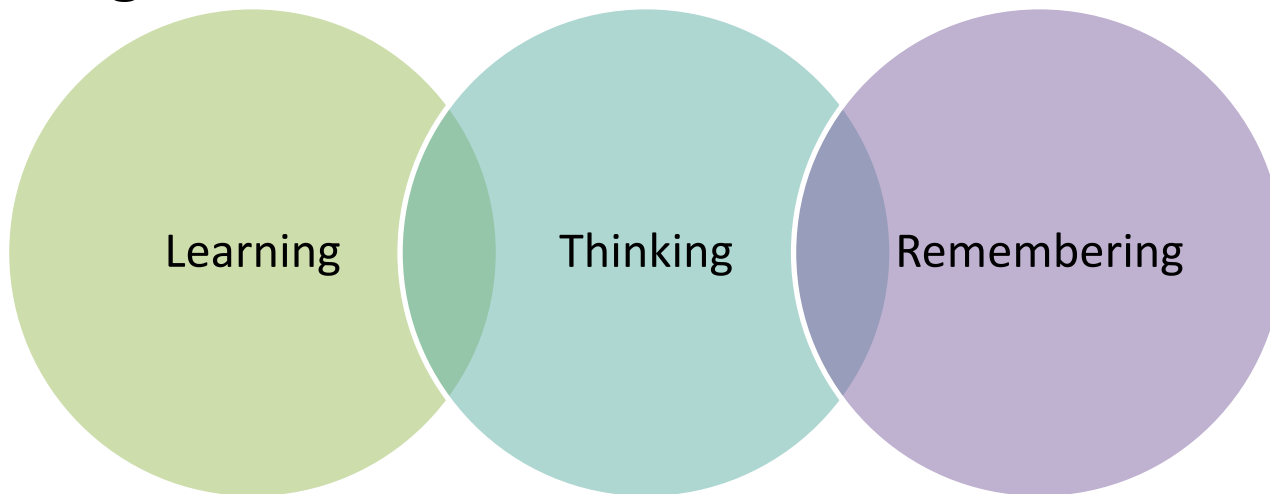
1. The brain weighs about lbs.
2. The brain consumes about of the body's energy.
3. A tool that has helped us learn more about the brain in recent times is the



The Brain's Natural Processes

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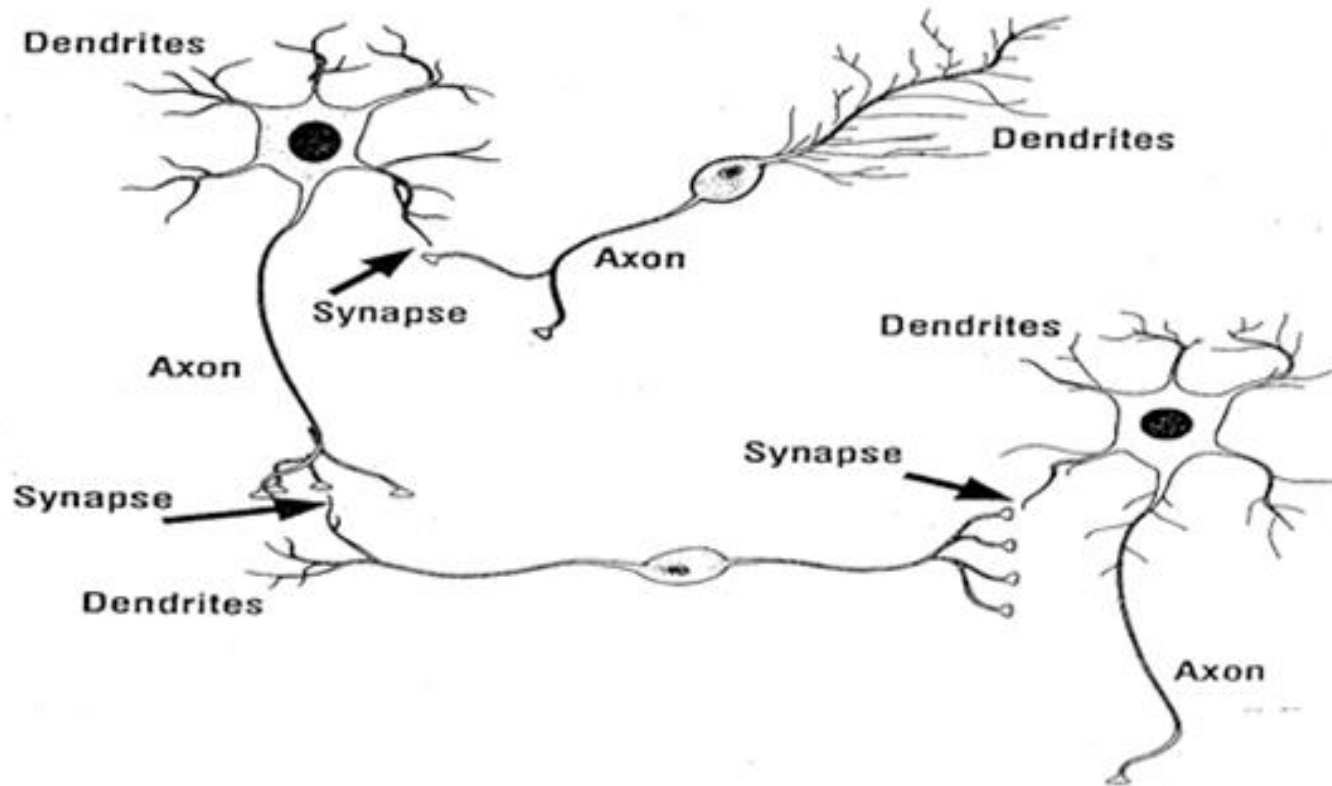
We construct physical structures in the brain every time we connect new information to previous knowledge.





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How Neurons Make Connections: Axon-Synapse-Dendrite Pathways Are Electrical to Chemical to Electrical



[Watch two neurons make connections in this video](#)



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Physical Process of Learning

When we are learning a particular skill or concept:

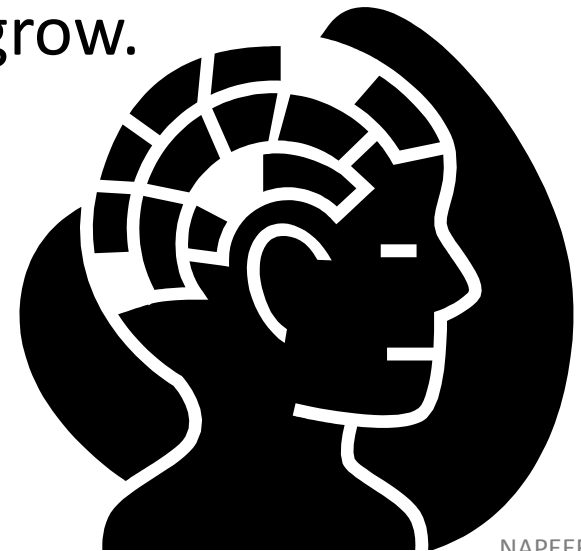
- Brain nerve cells or *neurons*, grow branching tree-like fibers called dendrites.
- Dendrite fibers are connected at electrical connections points called *synapses*.
- As we learn about a concept or skill, we develop more connections between these neurons (neural network).



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Physical Process of Learning

- The larger our neural network the larger our knowledge of the concept or skill.
- Neural networks need time to grow.



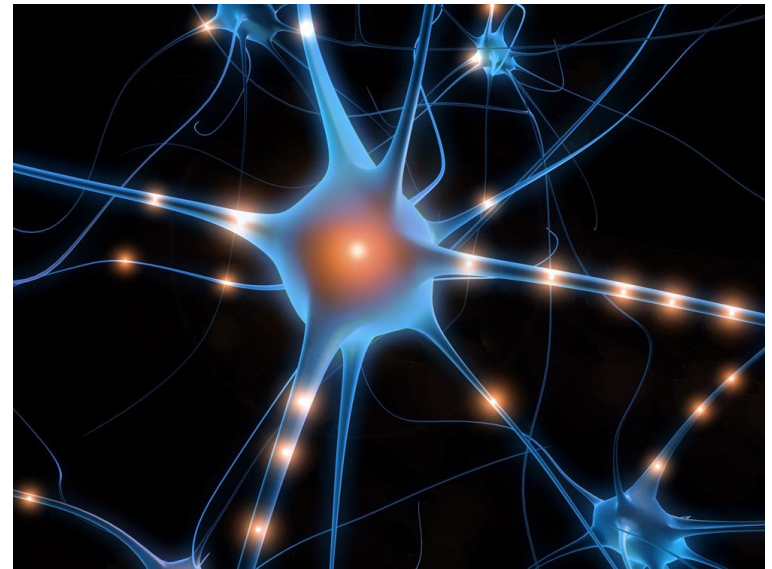
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Neurotransmitters

- The chemicals that connect our neurons together
- Many important ones
- Some examples include:
 - Glutamate (stimulates)
 - Dopamine (reward and pleasure)
 - Adrenaline (attention and mental focus)





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Hormones

- Receptors found all over brain
- Affect neurotransmitters
- Some produced in brain
- For example, melatonin by pineal gland that helps signal our bodies that it is time for sleep





“All human beings are born
as natural learners.”

Our brain has a natural, innate thinking and learning process.

It knows how to learn and remember and is thinking soon after birth.

Learning by the brain’s natural learning process helps students become the motivated, eager, successful learners they are born to be.

Dr. Rita Smilkstein

“We’re Born to Learn”



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Activity: Learning Assumptions

What Is Natural?

What Is Non-Natural?



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Activity: Learning Assumptions- Answers

Natural

- Brain actively constructs its own knowledge.
- Process enhanced when students have the opportunity to be active learners.
- Process takes time.
- Networks can't grow from nothing. They have to be connected. Therefore creating new networks starts with something the students already know.
- The sequence of learning is active learning followed by teacher input.
- Learning is pleasant when students are given the opportunity to be active learners.

Non-Natural

- The brain is a container into which knowledge is to be put.
- Real teaching is done when teachers impart knowledge to students.
- If students do not understand the material, then they do not have the ability.
- Sequence of teaching has the instructor lecturing to the students, which is followed by a test of the information imparted.
- Learning is pleasant for students only when the teacher, materials, or assignments are entertaining.



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Learning

We grow specific neural networks for each particular new object of learning.

You say:

Aha! I feel I'm getting it!

You could say:

I feel my neural networks growing.



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5 Rules of How the Brain Learns

1. Neural networks grow off what is already there.
2. Networks grow from what is actively, personally, and specifically experienced and practiced.
3. Neural networks grow from stimulating experiences.
4. Use it or lose it.
5. Emotions affect learning.



Super Strategies



- Teach students that ability can be enlarged and expanded throughout life.
- Teach students that intelligence is malleable, not fixed, so hard work makes them smarter and more capable.
- Teach that brainpower is incremental.



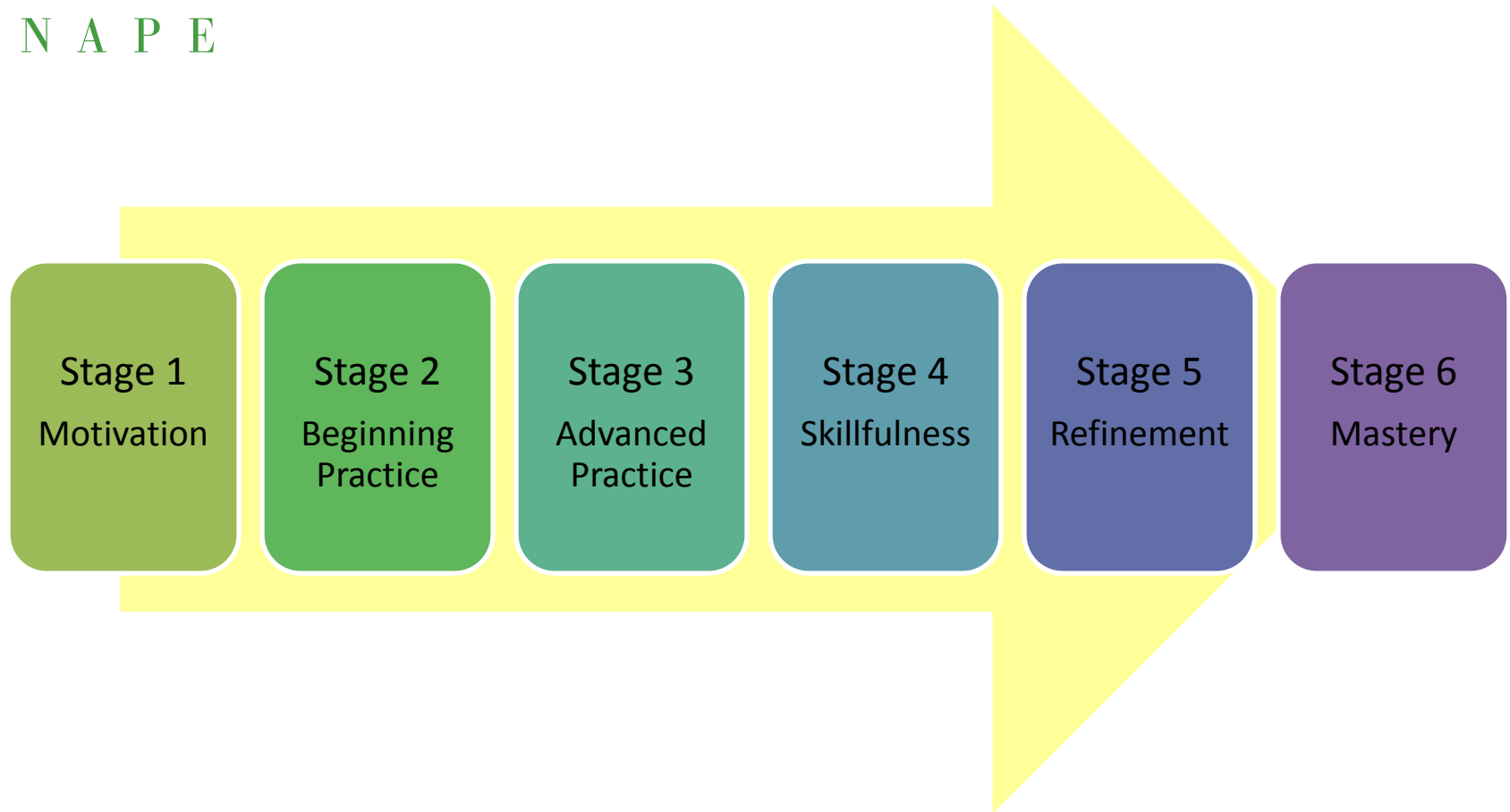
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Applying the Natural Learning Process



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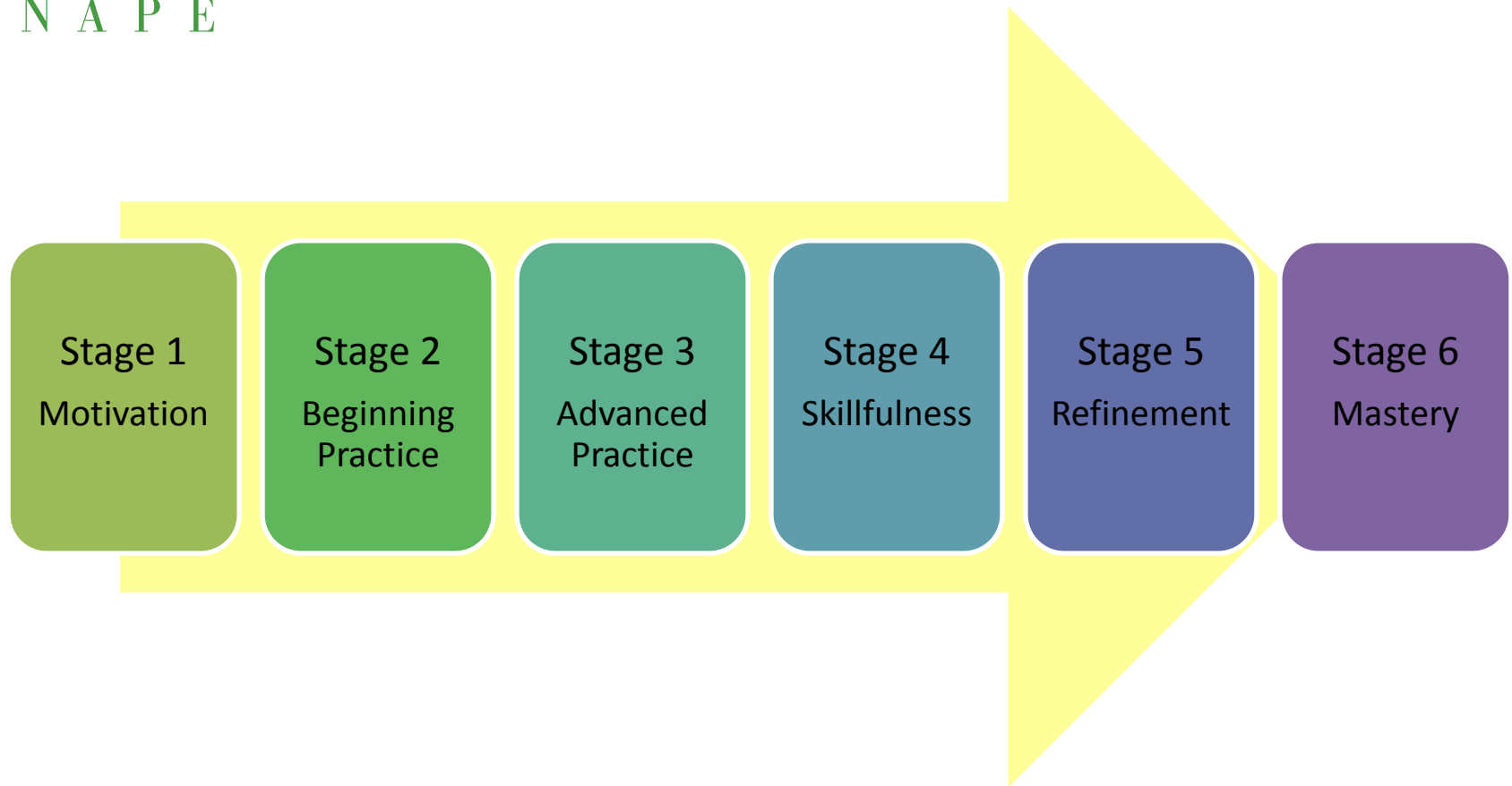
Natural Learning Process Stages





Natural Learning Process Stages

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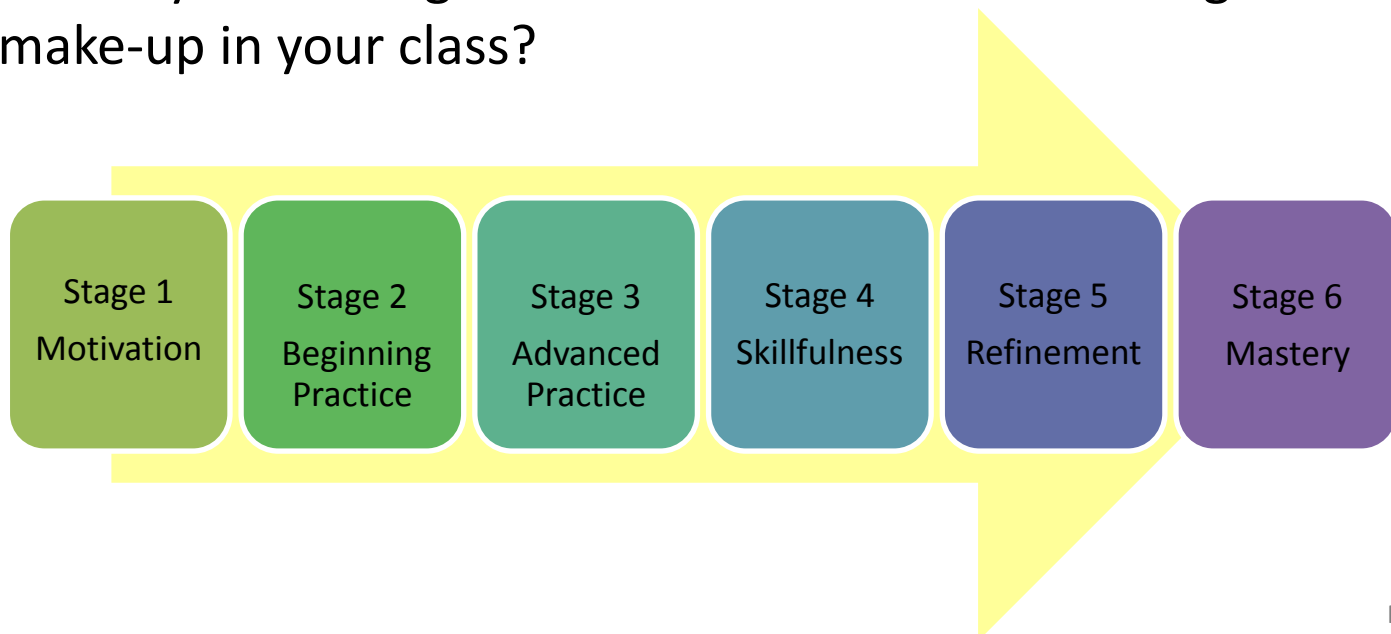




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Activity: How to Teach with the Natural Learning Process

1. Identify one objective that you hope to teach your students.
2. Try to determine activities that will enable your students to move through all six stages.
3. Would your strategies be different with a different gender make-up in your class?





Super Strategies



- Develop your ability to apply the six stages of the learning process in your curriculum delivery.
- Use what students already know and can do as a basis for developing new skills.
- Provide opportunities to practice new skills and knowledge.
- Use micro-affirmations to support students' movement toward mastery.



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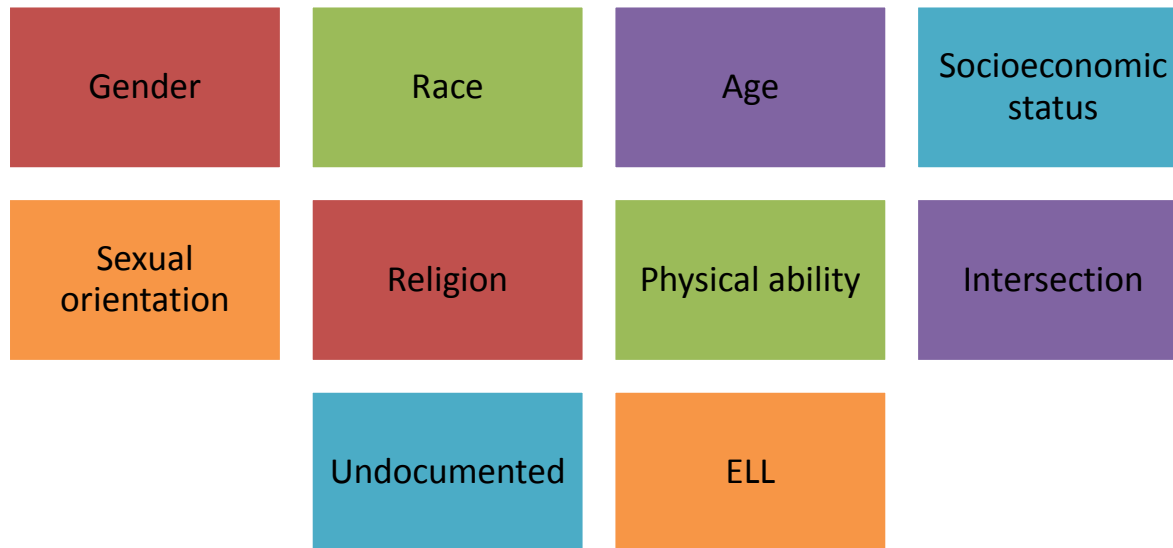
Research on Gender Differences



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The Brain and Gender

Everything we have studied so far about the brain and learning holds regardless of:



So how do **gender differences** grow, and what can teachers do to help minimize them?



The “Nurture” Side: Neural Plasticity

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- Neural circuits are **not** fixed at birth.
- The selection and pruning of synaptic connections (“circuit wiring”) is critically dependent on a child’s experience.
- Practice and social learning have been shown to contribute to every behavioral sex difference.



Activity: Gender Learning Differences True or False

Read each statement and think about whether it is true or false.

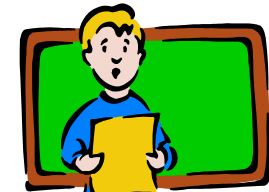




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Activity: Discussion

1. Do you think males and females are more similar or more different from each other? Why?



2. What shapes gender differences?



3. How can we use our knowledge of these influences to help both females and males achieve their full potential?



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Summary of Current Research

- Physiological differences tell us there must be differences in brain structure or function.
- Brain differences, like cognitive and behavioral differences, are small, but not categorical. Sex differences are real, but generally smaller than current beliefs.
- Boys and girls may have different interests and abilities, but the learning process is the same.



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Summary of Current Research

- Girls' steady advances in math, science, and athletics prove abilities are malleable.
- Earlier spatial skill training may help girls transition from high school to college math and science.
- The biggest hurdle for getting more women into STEM careers remains cultural.



Super Strategies



- Ensure that you call on males and females equally in your classroom.
- Use examples in class that reflect both male and female interests and experiences, as well as the many intersections.



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Gender Differences in Visualization



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Spatial Skills

- Studies show a strong correlation between spatial skills and aptitude in math, science, and engineering.
- Innate aptitude plus experience and practice impact spatial skills.
- For more information: Sorby, Wysocki, and Baartmans. *Introduction to 3D Spatial Visualization: An Active Approach* (Book & CD).



Activity: Dr. Marshall's Patented (not really) Test of Spatial Visualization

Draw the 2-D pattern piece(s) from which the sleeve of a man's suit coat is made.

Did yours look like this?

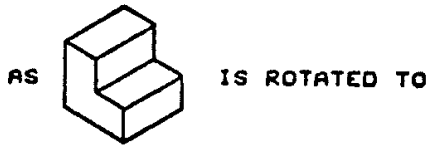




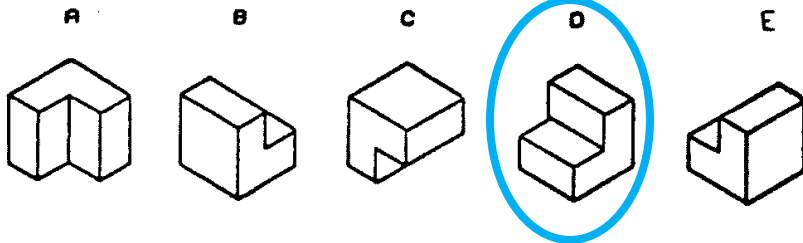
Spatial Skills Are Not Innate and Can Be Improved with Training!



IS ROTATED TO



IS ROTATED TO



This is a sample question on mental rotation.

Do you know the right answer?

Playing with building toys as well as drawing can help children develop spatial skills.

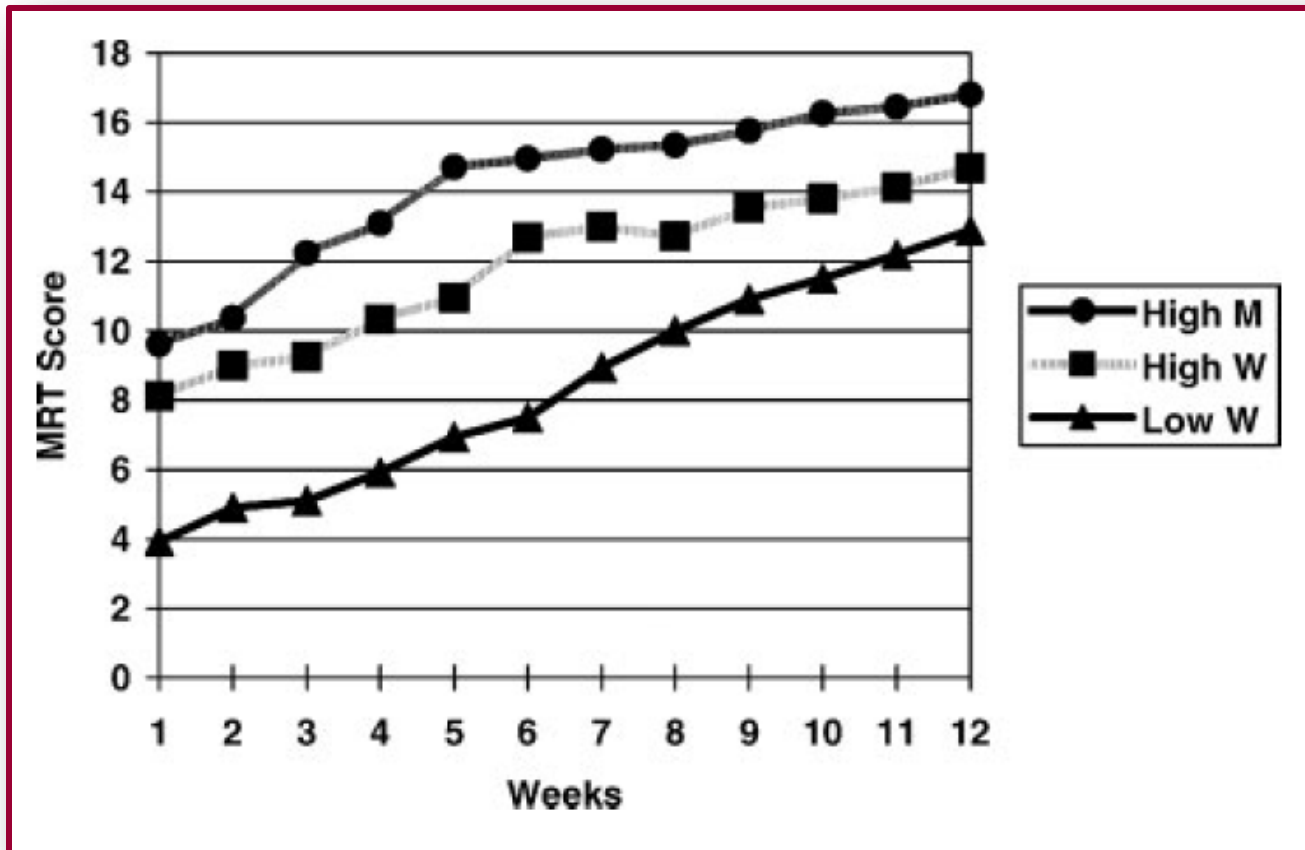




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Effect of Spatial Experience

Terlecki, Newcombe & Little. (2007) *Applied Cognitive Psychology*, 22:996



Study shows improvement in mental rotation performance with practice. All subjects improve, but women who were least able (“Low W”) showed the greatest improvement.



Super Strategies



- Teach visual-spatial skills by integrating activities in your classroom that build student skills such as:
 - Lego sets
 - Suitcase packing or kitchen cabinet organizing
 - Block building exercises
 - 3D puzzles
 - Sims computer programs and games
- Teach visual-spatial skills to girls so that they understand that with proper training, they can do it too.



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Wrap-up



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Goal

Apply awareness of the natural learning process and use teaching methods that help students strengthen their abilities in both gender typical and atypical fields.





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Objectives

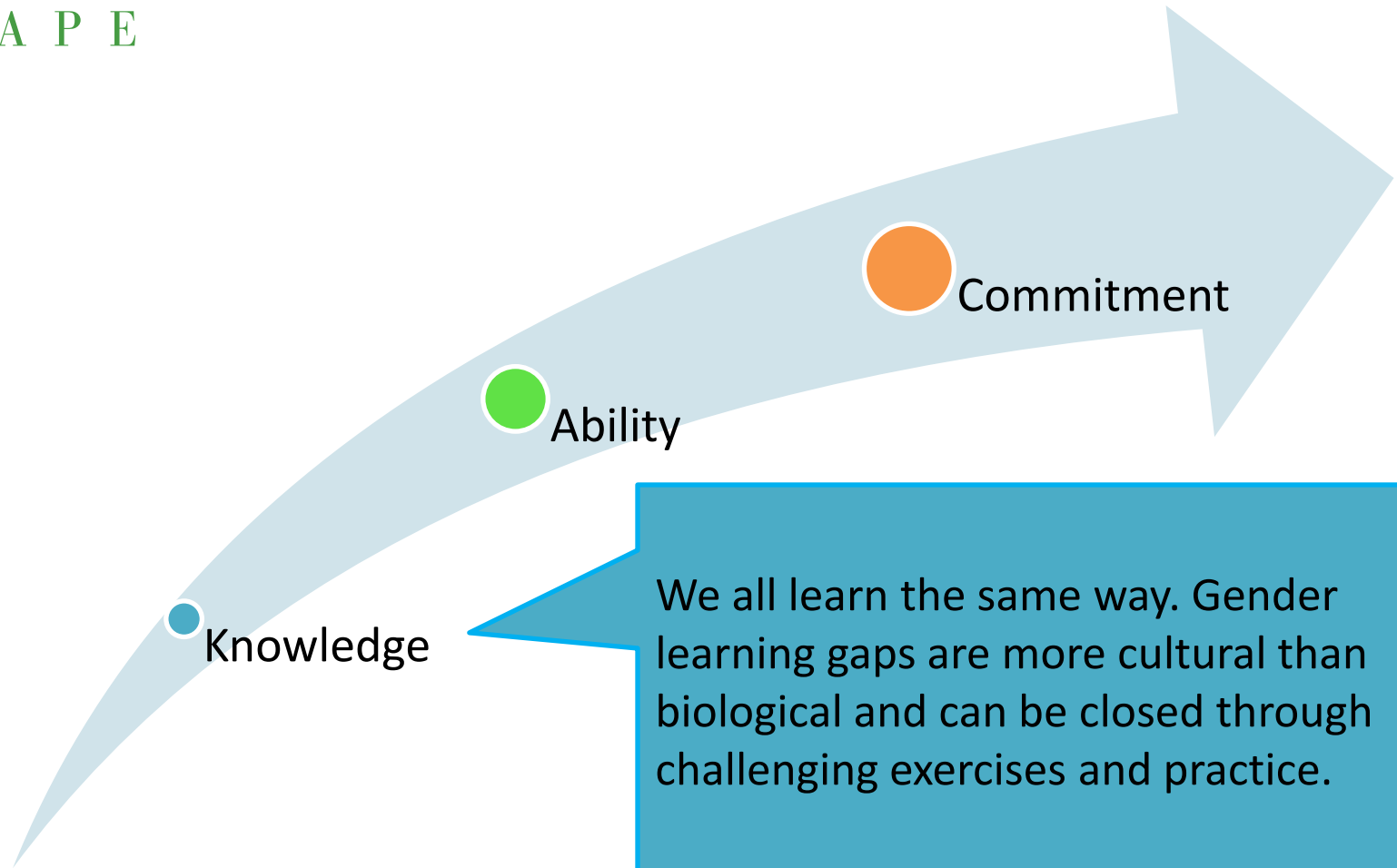
You should now be able to:

- ✓ recall the processes in the brain that contribute to learning
- ✓ develop teaching techniques designed to maximize the brain's natural learning process
- ✓ describe how nature and nurture interact in shaping the development of gender differences
- ✓ identify the kinds of activities and attitudes that promote spatial skills.



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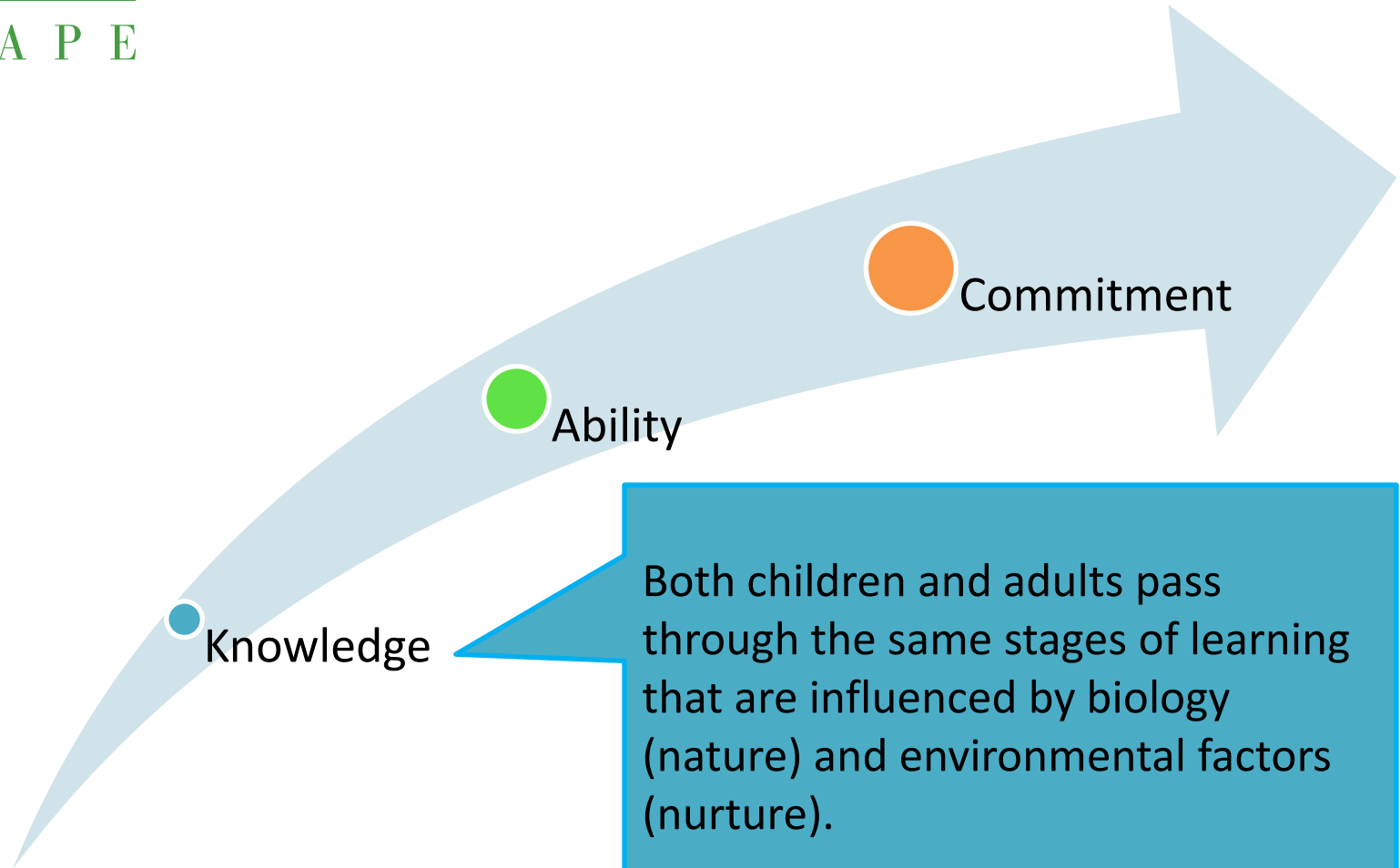
Key Takeaway Points





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Key Takeaway Points

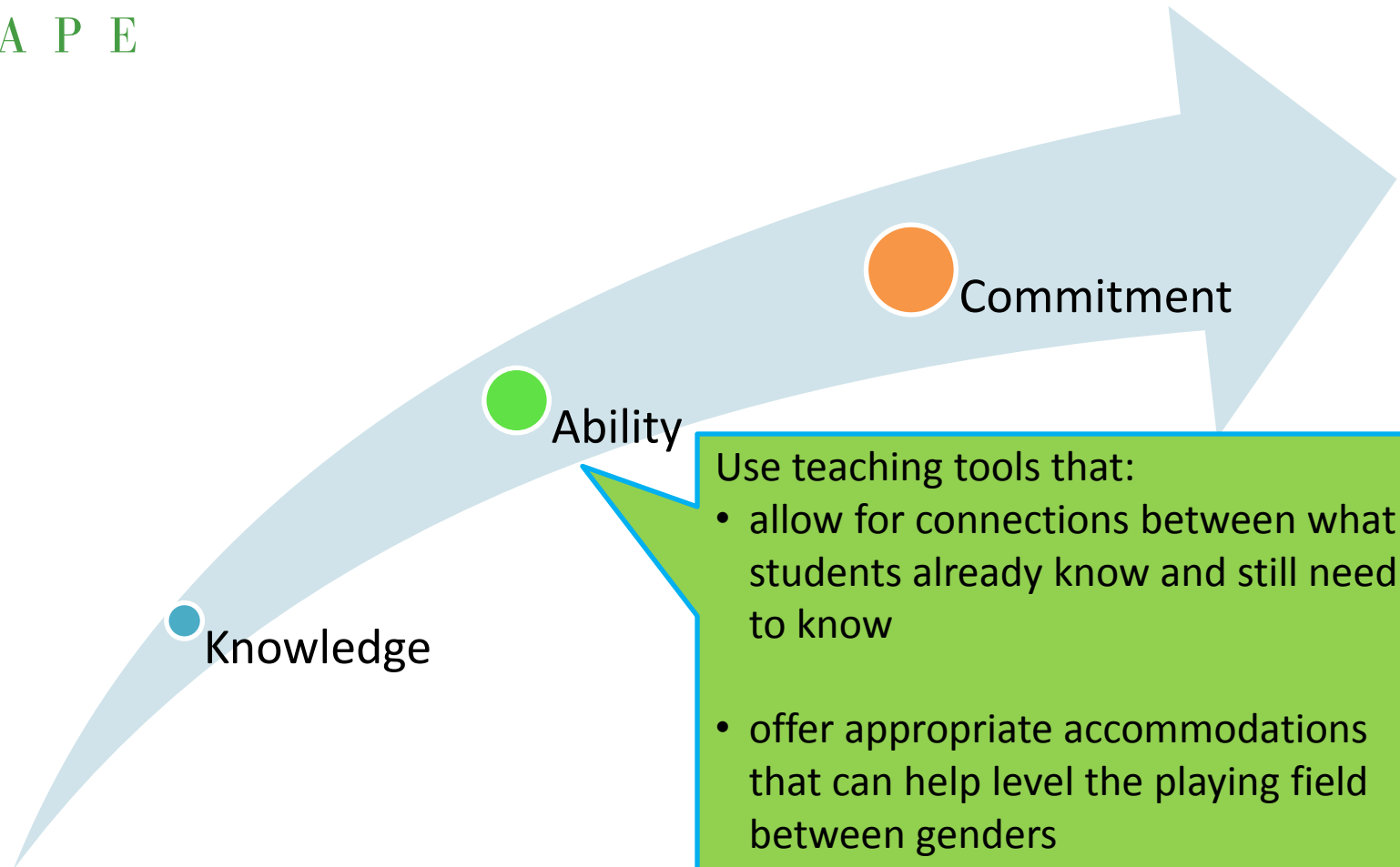


Both children and adults pass through the same stages of learning that are influenced by biology (nature) and environmental factors (nurture).



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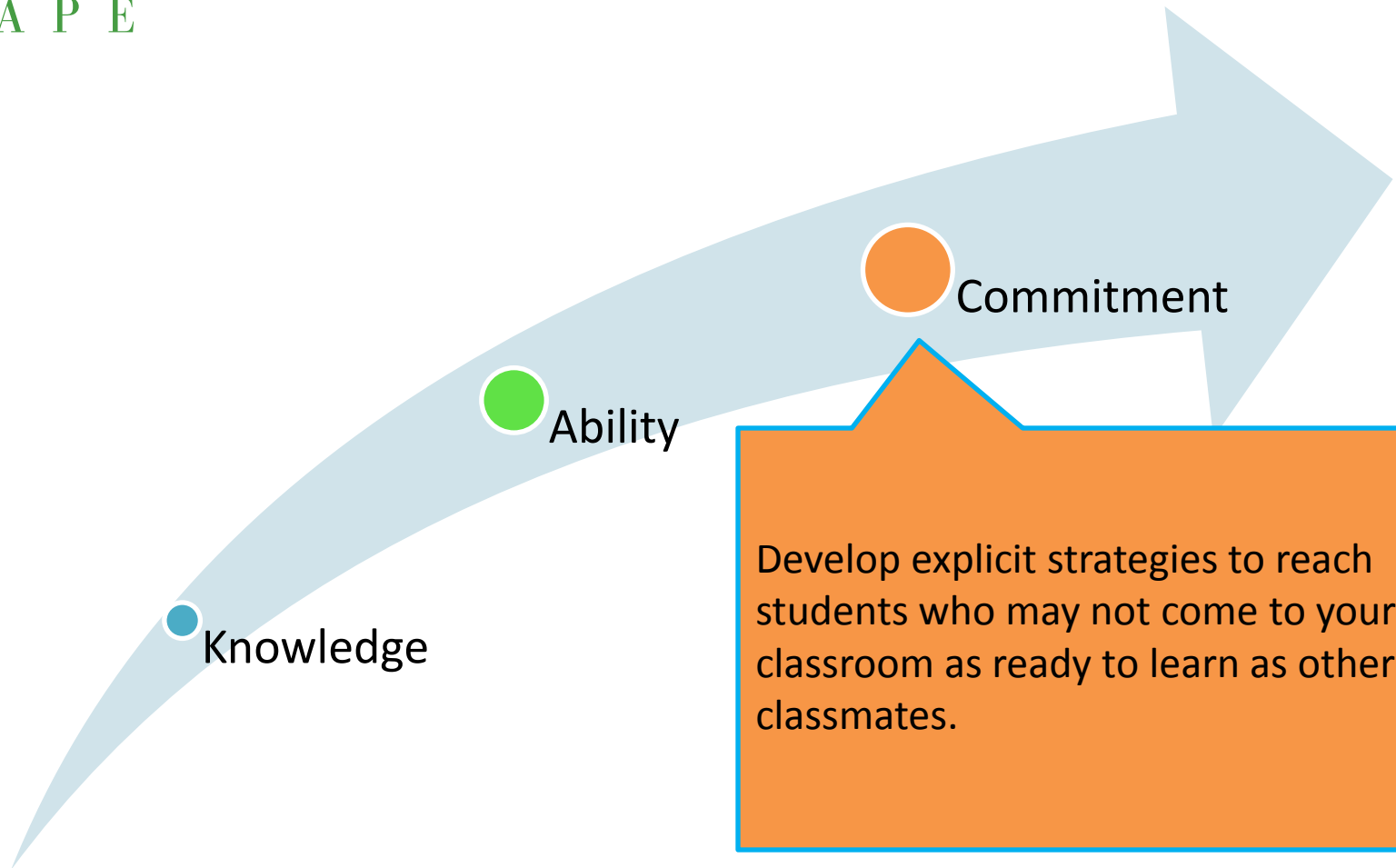
Key Takeaway Points





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Key Takeaway Points





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Moving Forward

- Continue to use your Reflection Journals to critically examine how you can best help females in your classes close the gender gap.
- Consider experimenting with exercises to enhance spatial skills for female students and verbal skills for male students.
- Read:
 - *Pink Brain, Blue Brain* pp. 216-235
 - *Why So Few?* Pp. 52-56
- Watch the NAPE webinar, “Pink Brain, Blue Brain: Females and Males in Math and Science” accessed at:
 - <https://www106.livemeeting.com/lrs/8001043798/Registration.aspx?pageName=lw8612gkl66xg43w>



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“The brain is wider than the sky
For put them side by side
The one with the other will contain
With ease and you beside.”

– Emily Dickinson

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