POSTERS *IN ACTION!*

lesson plans for students based on NAPE's posters

POSTER — **Brain Workout Plan**

OVERVIEW

Learning about how the brain develops and grows helps students to adapt a growth mindset.[1] The brain is like a muscle: The more we use it, the stronger it gets. Students who understand this concept can fight the belief that intelligence is static. This lesson explicitly teaches about the brain's plasticity.

OBJECTIVES

- Describe how the brain grows as a person learns.
- Use knowledge of brain plasticity to support a growth mindset and challenge a fixed mindset.

GUIDING QUESTIONS

- What evidence supports the idea that intelligence can change over time?
- How does this evidence support a growth-mindset belief?

AUDIENCE

Secondary-Level Students *(Educators, Counselors, Administrators, Parents, too!)*

TIME

50 to 70 minutes *(Activity 1: 10 minutes, Activity 2: 20-30 minutes, Reflection: 20-30 minutes)*

MATERIALS

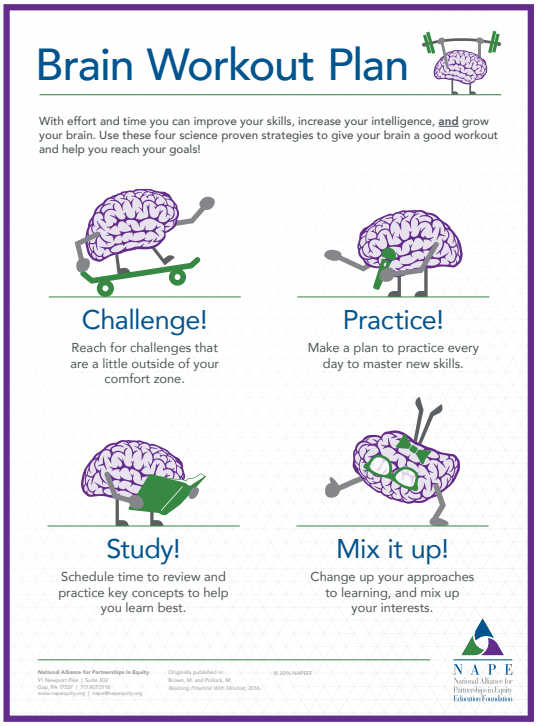
Handouts

Recommended: Realizing Potential with Mindset Toolkit, *by Brown and Pollock*

Order copies of the

Brain Workout Plan poster:

napequity.org/product/brain-workout-poster



NAPE
National Alliance for Partnerships in Equity

napequity.org
nape@napequity.org
(717) 407-5118

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Lesson Plans

** Ensure you operate from an asset (or strengths-based) mindset and create an equitable learning environment where every student thrives.*

REFLECTION ON INTELLIGENCE

Preparation: Provide students with the four reflection questions on intelligence, use the provided slide, or post the questions on the board.

Instructions:

1. Ask students to independently reflect on the four questions and write responses.
2. Ask students to share their responses in small groups or through a whole class discussion.
3. Emphasize that students should focus on their own beliefs and understandings on the topic rather than worrying about being "right." Once the discussion ends, explain that the following activity will help students better understand how intelligence (or learning) develops.

ALL ABOUT BRAIN PLASTICITY

Preparation: Prepare copies or project the four brain studies. Use the provided reflection questions for discussion.

Instructions:

1. Students should read the four brain studies and answer the reflection questions throughout the reading. This can be done as a whole class, in groups, as partners, or independently.
2. After students read the text, discuss the reflection questions and review key aspects of brain plasticity and how it connects to growth mindset.
   (This is if you've already taught them what growth mindset is and why it matters!)

USING THE SCIENCE OF BRAIN POWER

Preparation: Prepare copies of the Using the Science of Brain Power writing activity for each student.

Instructions:

1. Distribute the Using the Science of Brain Power writing activity to students.
2. Allow them time to apply what they learned from the four brain studies and set a goal!

References

1| Blackwell, L.S., K.H. Trzesniewski, and C.S. Dweck, Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. Child Development, 2007. 78(1): p. 246-263.
2| Kozorovitskiy, Y., et al., Experience induces structural and biochemical changes in the adult primate brain. Proceedings of the National Academy of Sciences of the United States of America, 2005. 102(48): p. 17478-17482.
3| Gaser, C. and G. Schlaug, Brain structures differ between musicians and non-musicians. The Journal of Neuroscience, 2003. 23(27): p. 9240-9245.
4| Draganski, B., et al., Temporal and spatial dynamics of brain structure changes during extensive learning. The Journal of Neuroscience, 2006. 26(23): p. 6314-6317.
5| Maguire, E.A., K. Woollett, and H.J. Spiers, London taxi drivers and bus drivers: a structural MRI and neuropsychological analysis. Hippocampus, 2006. 16(12): p. 1091-1101.
6| Kozorovitskiy, Y., et al., Experience induces structural and biochemical changes in the adult primate brain. Proceedings of the National Academy of Sciences of the United States of America, 2005. 102(48): p. 17478-17482.
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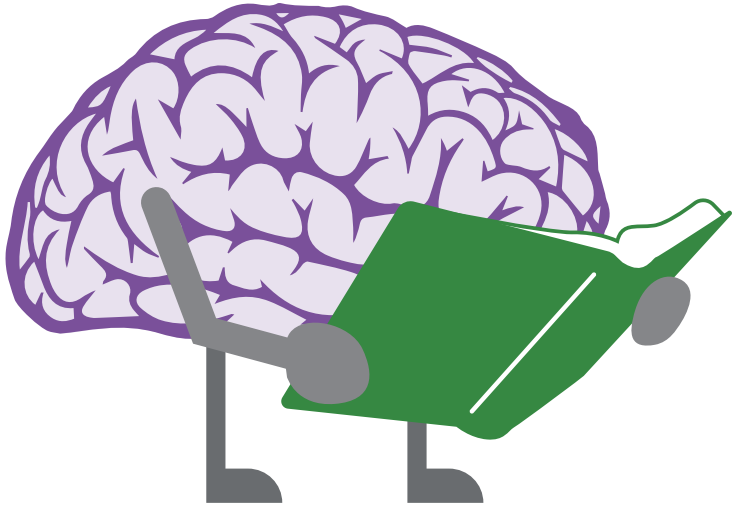


2. How do you know if someone is intelligent?

3. Can you grow your intelligence? If so, how? If not, why not?

4. A person claims that intelligence can be developed over time. What evidence can best support this claim?

REFLECTION ON INTELLIGENCE *Student Worksheet*

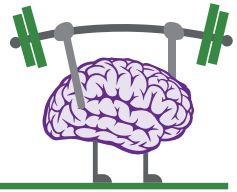
1. What is intelligence?

2. How do you know if someone is intelligent?

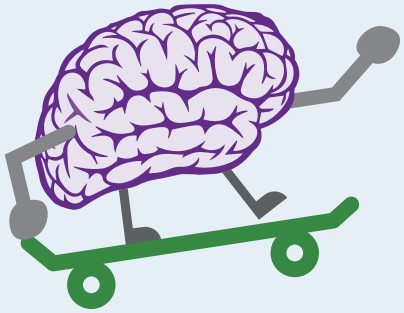
3. Can you grow your intelligence? If so, how? If not, why not?

4. A person claims that intelligence can be developed over time. What evidence can best support this claim?

Brain Workout Plan

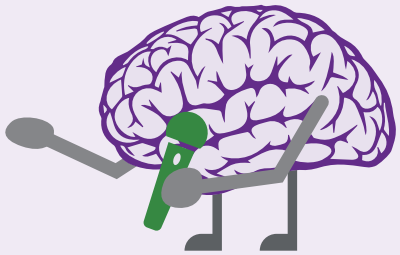


With effort and time you can improve your skills, increase your intelligence, **and** grow your brain. Use these four science proven strategies to give your brain a good workout and help you reach your goals!



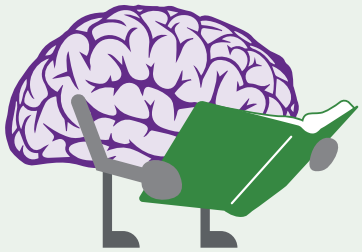
Challenge!

Reach for challenges that are a little outside of your comfort zone.



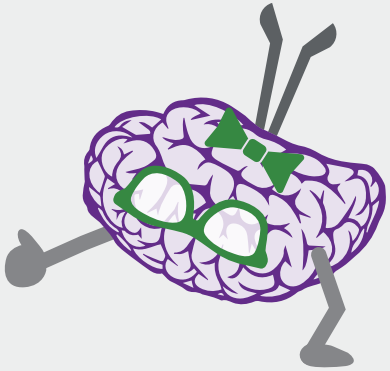
Practice!

Make a plan to practice every day to master new skills.



Study!

Schedule time to review and practice key concepts to help you learn best.



Mix it up!

Change up your approaches to learning, and mix up your interests.

National Alliance for Partnerships In Equity
www.napequity.org | nape@napequity.org

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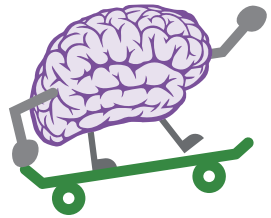
STUDY 1: Challenge! Monkeys in Different Cages



Researcher: Dr. Elizabeth Gould from Princeton University

Summary: Dr. Gould and her research team studied how a monkey's environment affects how much the dendrites in its brains grow. The research team put monkeys into three different types of cages.

- Cage A included many monkeys that had to forage for food and had many toys.
- Cage B had fewer monkeys and toys, but was still an interactive environment and monkeys still foraged for food.
- Cage C had each monkey alone in a bare wire cage with no toys or foraging.

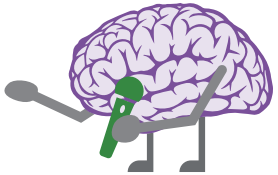
After the monkeys were in their cages for 1 month, the scientists looked at their brains to determine the number of dendritic connections.

Results: The research team found that the neurons in the monkeys in Cages A and B had far more connections (20-40 percent more) than those in Cage C.[2]

Takeaway: A challenging environment creates more dendritic connections in neurons than an unstimulating environment.

Strategy: Challenge! Reach for challenges that are a little outside of your comfort zone. Consider trying to read a book that is one grade-level higher than what you are comfortable reading now, or try one of the challenging math problems in a textbook. It's important to push far enough that you are sufficiently challenged. If you get stuck, ask a teacher or mentor for helpful strategies or to model best practices.

STUDY 2: Practice! From Amateur to Pro



Researcher: Dr. Christian Gaser from Harvard Medical School and Dr. Gottfried Schlaug from the University of Jena

Summary: Drs. Gaser and Schlaug compared the brain scans of professional musicians (full-time musicians), amateur musicians (those who played an instrument regularly but worked outside the field of music), and non-musicians.[3]

Results: The brain scans showed a strong relationship between the amount of gray matter in the brain (tissue made up of nerve cell bodies and dendrites) and musician status. Professional musicians had significantly more gray matter in areas of the brain connected to visual-spatial processing, sensory information, and motor operations, which are all needed to play an instrument. Amateur musicians had less gray matter in these regions, and non-musicians had even less gray matter in these regions.

Takeaway: These results show that all of a professional musician's practicing pays off! Long-term music training and practice lead to more brain tissue in areas of the brain connected to music.

Strategy: Practice! To master a skill, make a plan to practice every day and build up to harder skills. For example, if you want to learn how to write code for a complex video game, start with basic coding programs. Work on coding programs every day, slowly pushing into more difficult programming languages. Seek the help of a master programmer to help you navigate where to start and when to move on.

STUDY 3: Study! Your Brain on an Exam

Researcher: Dr. Bogdan Draganski from the University of Regensburg and colleagues from Germany and Sweden

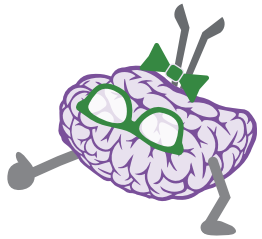
Summary: Dr. Draganski and his colleagues explored whether studying abstract information (in this case, studying for a medical exam) can change and grow the brain, and whether any changes can last 3 months after the exam. To do this, they looked at brain scans over time of two groups of medical students: those who had an upcoming exam and those who didn't.[4]

Results: The brains of students who studied for the exam showed changes in parts of the brain connected to memory and learning, while the brains of students who did not take the exam showed no changes. The students who studied grew more gray matter (tissue composed of nerve cell bodies and dendrites) in the parts of the brain associated with information transfer and long-term memory. The gray matter decreased by only a small amount 3 months later. What is more surprising is that gray matter also increased in the hippocampus, an area of the brain that is a gate to long-term memory and is known for its ability to create neurons. This gray matter actually increased 3 months after the exam, perhaps because there was less stress (which can inhibit growth) and because neurons take weeks to months
to grow.

Takeaway: This study shows that the brain grows as we study for an exam and even after the exam.

Strategy: Study! Studying material before an exam pays off—especially if you give yourself time to review and practice key concepts and develop studying strategies that help you remember and learn material. If you know you have a test or quiz coming up, spend time each day to study rather than cramming at the last minute. Remember, it takes time to grow those neurons! Also, make sure your studying techniques work for you.

STUDY 4: Mix it Up! Taxi Drivers vs. Bus Drivers



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Takeaway: This study shows that if you need to know more information, your brain will create more neural connections. The taxi drivers needed to navigate more roads than the bus drivers who drove set routes, and thus the taxi drivers had more gray matter in the area of their brain associated with spatial reasoning.

Strategy: Mix it up! Rather than practicing something the same way over and over again, consider changing up the route or routine to learn in different ways. In addition, learning a lot of different things grows your brain in a lot of different ways, so mix up your interests and your approaches to learning. Although learning new tasks and new ways of doing things may take some effort and persistence, your brain will grow in the process!

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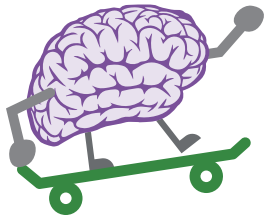

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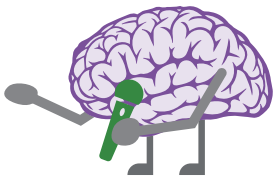

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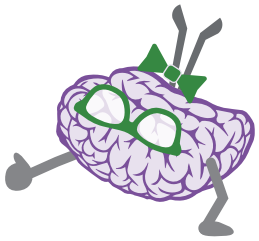

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REFLECTION ON BRAIN PLASTICITY

Student Worksheet

1. A student wants to remember new vocabulary for a test. She looks over the words once before the test. Is this enough? Why not? What does she have to do to remember the vocabulary?

2. Monkeys that can interact and play with toys and must find their food have more brain connections than those that sit alone without any interaction. How does this apply to you? What changes could you make to your life to grow your brain more?

3. What do the London taxi driver, the musicians, and the medical students who studied have in common? What could you do to build more connections in your brain?

BRAIN WORKOUT PLAN *Student Worksheet*

With effort and time you can improve your skills, increase your intelligence, and grow your brain. Brainstorm how you can use these four science proven strategies to give your brain a good workout and help you reach your goals!

Challenge!

Reach for challenges that are a little outside of your comfort zone.

Practice!

Make a plan to practice every day to master new skills.

Study!

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Change up your approaches to learning, and mix up your interests.

MAKE A PLAN
USE THE SCIENCE OF BRAIN POWER *Student Worksheet*

Now that you know the brain can grow, it's time to put the strategies to work! Get ready to take on a new challenge, practice and study and grow your brain. Once you've pushed yourself in one area, mix it up and make a goal to learn something new.

1. **Choose a Goal:** What do you want to work on? Do you want to improve at a skill, like using a tool, or playing a sport or instrument? Or do you want to improve at studying for exams or succeeding in a class? Choose the topic and/or skill that you want to work on and be specific about how you want to improve.

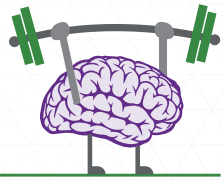
2. **Plan the Specifics:** Now that you have a goal, when will you work on it? Where? Will anyone help you? How long will you practice? Describe specifically when, where and how you will practice to work on your goal. Consider writing this down in a daily planner or calendar.

3. **Reflect and Revisit:** Mastering a skill takes repeated practice and reflection. After trying out your plan for a few weeks, pause and reflect. Are you making progress? What obstacles are limiting you? Reflect here and be prepared to make a new plan.

4. **My Successes So Far:**

5. **My Obstacles and New Plans:**

Brain Workout Plan



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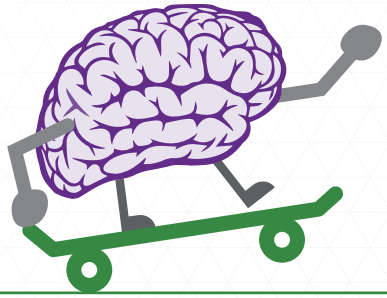

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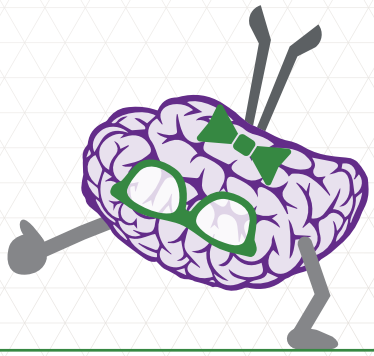

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