The BIG Idea

- What evidence do we have that our brains change when we learn new things?

AGENDA

Approx. 45 minutes

I. Warm Up: How I Became an Expert (5 minutes)

II. Practice Makes Perfect (10 minutes)

III. You Can Grow Your Intelligence (10 minutes)

IV. Juggling Experiment (15 minutes)

V. Wrap Up (5 minutes)

MATERIALS

- ❑ **STUDENT HANDBOOK PAGES:**
  - Student Handbook page 10, How I Became an Expert
  - Student Handbook page 11, The Myth of Michael Jordan
  - Student Handbook pages 12-13, You Can Grow Your Intelligence
  - Student Handbook pages 16 and 17, Juggling Experiment
- ❑ Overhead projector
- ❑ Chart paper and markers
- ❑ Colored pencils

OBJECTIVES

During this lesson, the student(s) will:

- Create a list of evidence that brains change with learning

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OVERVIEW

In this lesson, students examine evidence that practice makes perfect. Evidence includes:

- Skills they've mastered
- Michael Jordan's rise to basketball superstardom
- Juggling experiment

PREPARATION

- ❑ List the day's **BIG IDEA** and activities on the board.
- ❑ Write the day's vocabulary and definitions on the board.
- ❑ The following handouts need to be made into overhead transparencies or copied onto chart paper:
  - **Student Handbook page 11, The Myth of Michael Jordan**
  - **Student Handbook page 12-13, You Can Grow Your Intelligence** (NOTE: You will use the first page this week and the second page in next week's lesson)
  - **Student Handbook page 16 and 17, Juggling Experiment**
- ❑ If possible, print out some color copies of **Student Handbook pages 16-17, Juggling Experiment**, so that the yellow areas in the photo of the brain are evident.

VOCABULARY

Control Group: in an experiment, the group that receives no treatment.

Experiment: a procedure designed to examine the effects of a treatment. Often two groups are compared. The first group is exposed to one kind of treatment, while the other gets another kind of treatment, or often no treatment at all. Both groups are observed to see if any changes took place as a result of the treatment.

Experimental Group: in an experiment, the group that receives the treatment, and is compared to a control group that does not.

Magnetic Resonance Imaging (MRI): type of body scan used to see the structure of the part

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examined, for example, the brain.

IMPLEMENTATION OPTIONS

In **Activity III, You Can Grow Your Intelligence,** you may choose to read the story aloud as a class, to assist struggling readers. Underline the key points in the article on the overhead and have students highlight those points on their handbook pages.

For **Activity IV, Juggling Experiment,** you may choose to introduce this activity by splitting the class into experimental and control groups. Then explain the differences in the treatment for each of these groups.

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ACTIVITY STEPS

I. Warm Up: How I Became an Expert (5 minutes)

1. [Have students turn to **Student Handbook page 10, How I Became an Expert,** in which they describe a skill they've mastered and how they learned it.]

2. [Then have students pair up and describe this learning process to a partner, allowing a minute for each to speak.]

II. Practice Makes Perfect (10 minutes)

1. **SAY SOMETHING LIKE:** Last week, we finished up by discussing two different ideas about intelligence. Who can summarize what those ideas were? (One is that your intelligence remains the same throughout life; the other is that you can grow your intelligence.) Today we're going to look at some of the evidence that shows that you can change your brain through effort and hard work.

   You've heard the expression "practice makes perfect"? Let's hear some of your **How I Became An Expert** examples to see if it's true.

2. [Ask several students to describe their skill (and how they learned it) to the class. Include the following questions if students don't make these points themselves:
   - Were you good at this skill the first time you tried it?
   - Did you make any mistakes as you were learning?
   - How often do you practice this skill?
   - What will you do to continue to improve?]

3. [On chart paper, list students' examples of learning through practice. For example, "Luke: Typing, keyboarding class + 2 years practice."]

4. **SAY SOMETHING LIKE:** It's easy to look at someone who does something really well and not see the effort it took to get there. Our next example is a famous one – Michael Jordan. Who can tell me something about his career? [Students respond.]

   When people talk about Michael Jordan, they often describe him as a "natural athlete." But the truth may surprise you.

5. [Refer students to **Student Handbook page 11, The Myth of Michael Jordan,** and read the story aloud.]

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6. [Ask students for the evidence that Michael Jordan's attitude and training propelled him to the top of his game, and add his accomplishment to the chart.]

III. You Can Grow Your Intelligence (10 minutes)

1. **SAY SOMETHING LIKE:** We've created quite a list of personal accomplishments that required lots of effort. By a show of hands, how many are convinced that you can "grow your intelligence"? [Students respond.]

   The kind of evidence we have on this chart led scientists to the idea that being talented or smart might be something people could change. Please turn to **Student Handbook page 12-13, You Can Grow Your Intelligence,** to find out more.

2. [Read the first paragraph on aloud.]

   SAY SOMETHING LIKE: This says that scientists agree that "practice makes perfect." I wonder what evidence they have?

   [Ask students to read the remaining paragraphs on page 12. Under "Build a Better Brain." Have them underline the sentence that describes how the brain changes as a result of practice.]

3. [Ask for a volunteer to read his underlined sentence aloud.

   SAY SOMETHING LIKE: So scientists say your brain connections grow when you learn something new, that you get more of these tiny branches called dendrites, which help neurons connect with other neurons to send information through the brain. I'm really curious about how they know that.

IV. Juggling Experiment (15 minutes)

1. **SAY SOMETHING LIKE:** If you were going to design an **experiment** to test whether learning changes your brain, what would you do? [Explain what's meant by an experiment, and call students' attention to remaining vocabulary words as they're introduced. Distribute colored pencils to students.]

   A few years ago, brain researchers at the University of Regensburg in Germany wanted to know if they could see a change in people's brains when they learned something new. They decided to teach people to juggle, and observe the results. How do you think they might identify changes? [Allow students to guess.]

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[Have students turn to **Student Handbook pages 16-17, Juggling Experiment**, and put its transparency on the overhead, referring to it as you explain each step.]

2. The researchers worked with a group of 24 people. None of them knew how to juggle. The people were divided into two groups. Group A was the **control group**. They would not learn to juggle. At each step of the experiment, their brains would be compared with the brains of the people in Group B.

   Group B was the **experimental group**. They would learn and practice juggling. Before the experiment began, everybody in both groups received an **MRI** (brain scan). Who remembers what an MRI shows? (Allow students to respond). That's right, it shows the structure of the brain.

   [Instruct students to draw a picture or write words in each of the top two boxes as a reminder of how Group A and B were different. For example, they could draw a stick figure of someone juggling in the box labeled Group B, and write "No Juggling" in the box under Group A. **Note**: At each step of the experiment, students should write or draw something in the boxes that will help them remember the material.]

3. For three months, the people in Group B practiced juggling. The people in Group A did not. Then, all of the participants had another MRI to show what their brains looked like. What do you think the researchers discovered? [Allow students to respond.]

   [Show students the yellow areas in the diagram of the brain.] These areas show new structures in the brains of the jugglers, colored yellow to make them easier to see. No changes were found in Group A. The changes in Group B happened in parts of the brain that process information about moving objects. The jugglers' practice caused physical changes in the brain!

   In the last step of the experiment, the people in Group B discontinued their juggling – no more practice. Three months later, each person received one last MRI. Would you expect any brain changes in Group A, the people who had never juggled? (No.) What would you predict happened in the brains of Group B, the people who had once juggled and no longer practiced? (The brain structures they'd built during their three months of juggling got smaller once they stopped practicing.)

4. [Add research results to the chart begun in **Activity II, Practice Makes Perfect**.]

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V. Wrap Up (5 minutes)

1. [Discuss the following:
   - What happens to the nerve cells in the brain as learning takes place?
   - What everyday evidence do we have that it is possible to "grow your intelligence"?
   - What scientific evidence do we have from the researchers in Germany?]

2. **SAY SOMETHING LIKE:** Next week, we're going to follow up on the last piece of the Juggling Experiment. What happens to your brain when you stop practicing a skill? Hint: the title of the lesson is "Use It or Lose It."

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How I Became an Expert

Name one subject or activity that you do well (for example, math, basketball, playing the guitar, painting, cooking, or car repair). _____

_____

Describe how you learned it.

_____

_____

_____

_____

List two things you've done to get better at this activity.

1) _____

_____

2) _____

_____

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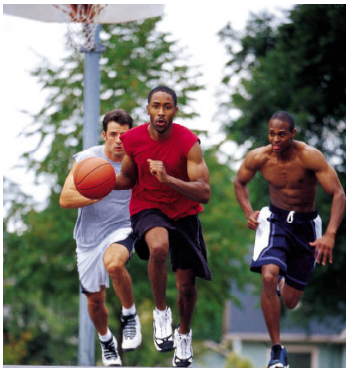
The Myth of Michael Jordan



Michael Jordan is one of the best basketball players of all time. His average points per game is the highest in NBA history – 31.5. He is one of two players to score more than 3000 points in a single season. And he has 11 MVP awards – five for the regular season and six for the finals.

It was dazzling to watch Jordan play. People often spoke of his grace on the court. They talked about his natural abilities.

But the true story is different. When he was a sophomore in high school, Michael Jordan didn't even make the team. "It was embarrassing not making the team," he says. "They posted the roster [list of players] and it was there for a long, long time without my name on it. I remember being really mad, too, because there was a guy who made it that wasn't as good as me."

Someone else might have sulked, or quit. But this setback only fueled Jordan's desire to improve. "Whenever I was working out and got tired and figured I ought to stop, I'd close my eyes and see that list in the locker room without my name on it," Jordan says, "and that usually got me going again."

The phys ed teacher at Jordan's high school, Ruby Sutton, describes Jordan's commitment to the game in those days. "I would normally get to school between 7 and 7:30. Michael would be at school before I would. Every time I'd come in and open these doors, I'd hear the basketball. Fall, wintertime, summertime. Most mornings I had to run Michael out of the gym."

Adapted from "Michael Jordan transcends hoops" by Larry Schwartz. ESPN.com, 2007.

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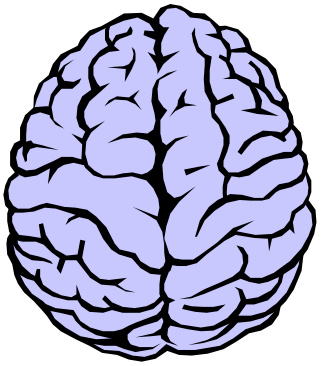
You Can Grow Your Intelligence

Mysteries of the Brain Revealed!

Practice Makes Perfect

"Practice makes perfect!" Coaches say it. Teachers say it. And now scientists are saying it, too. If you've always thought that you were smart or dumb, athletic or klutzy, artistic or not-so-artistic, think again. It turns out that old "practice makes perfect" saying is true.

The evidence is all around you. Basketball players spend time in the gym, practicing passing, shooting, and defensive skills. Their coaches watch their performances and suggest ways they can improve their technique. The more they practice, the better they get. This works for school subjects as well - from algebra to zoology.



Build a Better Brain

It might surprise you to know that practice causes changes in the brain. Your brain has billions of nerve cells called neurons. To think and solve problems, your brain sends messages from one neuron to the next. Learning builds connections between neurons. When you practice a skill, you're building these connections. The more you practice, the more connections you have, the better you get at the thing you're practicing.

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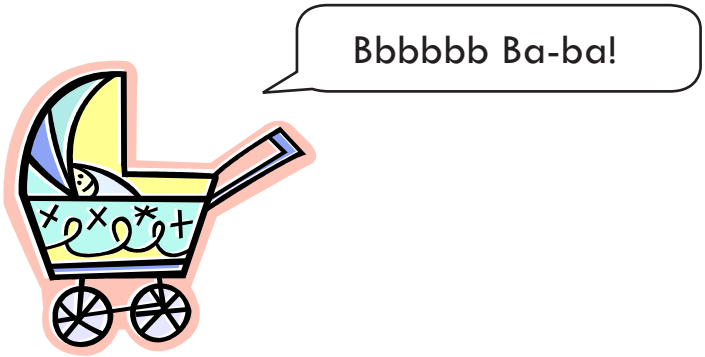
Out of the Mouths of Babies

Babies are a good example of "practice makes perfect." They can't understand language when they're born. They spend a lot of time listening and trying to figure out what's going on around them. They practice the sounds they hear, cooing and gurgling like they're having a conversation. Baby sounds lead to their first words, like "mama" and "bottle." People might not even recognize these words at first, but the babies keep right on practicing. They make a lot of mistakes, but no one thinks they're stupid. Everybody knows they're learning.

By age one, babies may say a word or two. By age two, they may say two or three hundred words. By age three, they can put words into sentences. The babies' brains have changed. They've built new connections. They've actually gotten smarter. Practice makes perfect!



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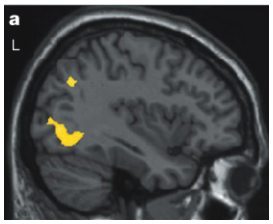
Juggling Experiment

The experiment began with two groups of people who didn't know how to juggle. There were 12 people in each group. Each person had a brain scan at the beginning of the experiment. For each of the boxes below, draw or write something that will help you remenber the differences between Group A and B.

Group A	**Group B**
The **control** group	The **experimental** group

Then, both people in both groups had MRIs (brain scans).

	
There were _____in the brains of the people in the control group.	The jugglers' brains showed _____ _____ _____.

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The jugglers stopped practicing. 3 months later, people in both groups had MRIs (brain scans).

Group A	Group B
What happened to the brains of the people in Group A?	What happened to the brains of the people in Group B?
_____	_____
_____	_____
_____	_____

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