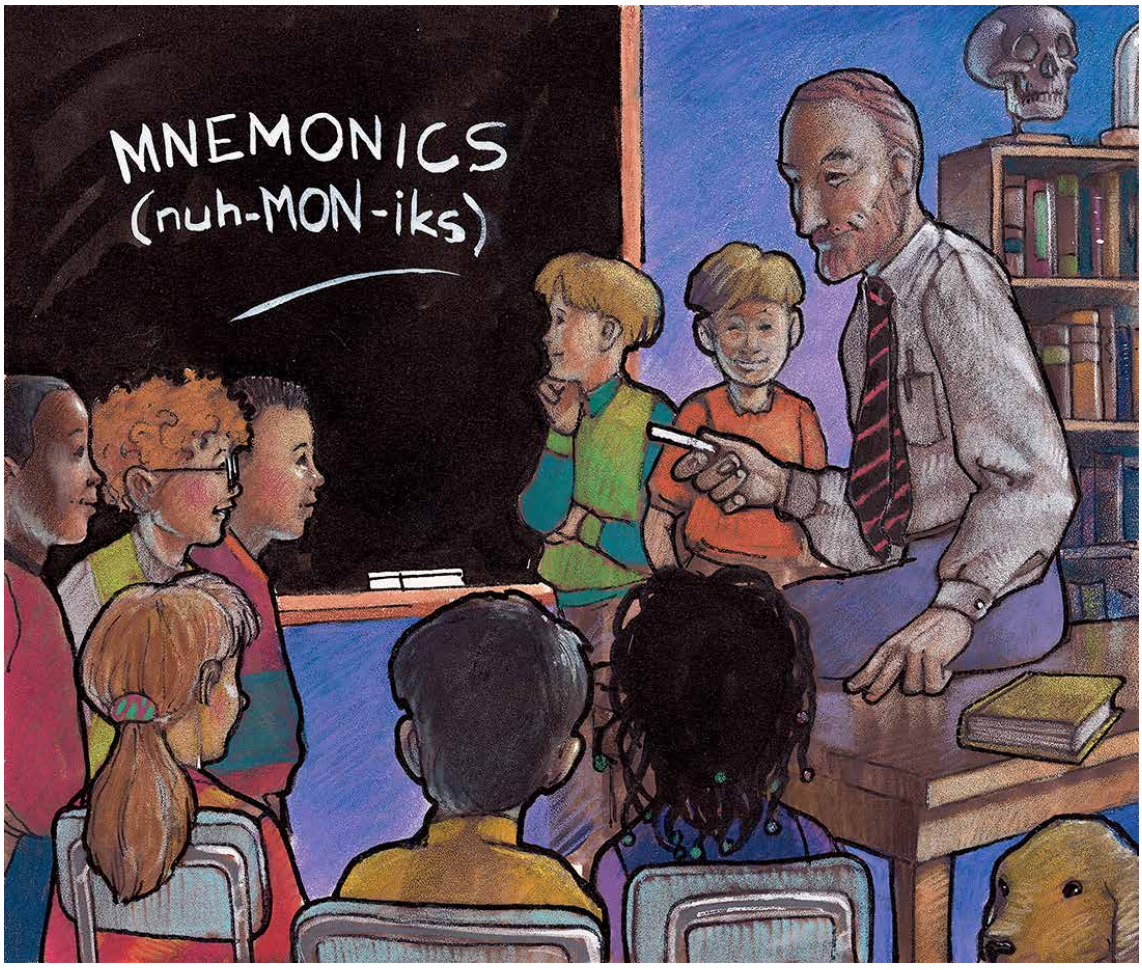
BrainLink

MEMORY AND LEARNING

EXPLORATIONS

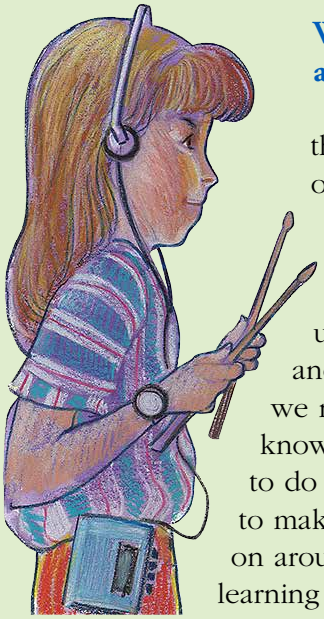
How's *Your* Memory?



The NeuroExplorers club spent the morning with Professor Ottzinger in his office, discussing the brain and how learning and memory work. They decided to challenge their memory powers by taking a simple test. Turn to the bottom of page 2 to test your own memory!

Baylor College of Medicine

Matter of Fact!



What are learning and memory?

Every day we learn new things and remember old ones. Learning is the process of gaining new information. Memory is the system our brain uses to save information and to get it back when we need it. All the facts we know, our knowledge of how to do things and our ability to make sense of what is going on around us depend on learning and memory.

Every time we learn something new, tiny changes take place in the connections inside our brains. The changes made and the things we learn depend on everything we see, hear, smell, taste and touch—our experiences.

How do we learn?

We learn from our experiences in many different ways. Our brains are programmed to help us learn some of the things we need to know. For example, infants are born with the ability to learn any human language. The language a baby learns depends upon the language spoken by the people around him.

BRAIN FLASH

Just after birth, some baby birds learn to identify and follow the most noticeable large moving object around them. This usually is their mother or father, but sometimes it can be another animal or even a person! This kind of learning is called imprinting.

One way of learning is by copying what we see or hear. This is called learning by imitation. Young children learn to open a door or brush their teeth by watching someone else do those things.

Learning also takes place as we make connections between daily experiences. For instance, your dog may notice that every time you take her leash out, she gets to take a walk. Her brain makes a connection between the leash and a walk. Soon, she gets excited and goes to the door whenever she hears the rattle of her leash. This is an example of learning by association.

Often, we must learn by repetition—doing or saying something over and over until it stays in our memory. This is the way you learn to tie your shoes, throw a baseball well or recite a poem.

Sometimes, we don't even know we're learning. You probably can sing a song or recite a commercial simply because you have heard it many times on TV, even though you never have tried to memorize it. Learning and memory are happening all the time!

How long do memories last?

Some of our memories last only a short time. Have you ever forgotten a telephone number right after making your call? This brief kind of memory, called short-term memory, includes information you remember only as long as you are paying attention.

Some of the things we remember are saved as long-term memory, which can last from a few hours to a lifetime. The most important things may be placed in "permanent storage." This sometimes involves repetition or rehearsal. We often have to

How's *Your* Memory?

Can you remember what is in the drawing of Professor Ottzinger's office (on the front cover)?

1. **Without looking at the cover**, write a list of all the details you remember.
2. Now, go back and study the drawing of the Professor's office for three minutes. Do not write down what you see.
3. Turn to page 8 and answer the questions under "How's *Your* Memory?"

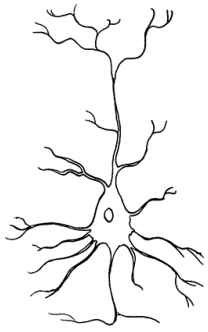
(Continued on page 8)

practice what we want to learn, from songs in music class, to the multiplication tables in mathematics, to making free throws on the basketball court. Long-term memories also can be made instantly when you experience something very exciting or frightening, like your first roller coaster ride or most embarrassing moment. What are some of your most vivid memories from a long time ago?

Are all memories the same?

Our "memory banks" hold a record of our past experiences. They include what we have learned about people, events and facts of the world. These kinds of memories are processed through pathways in the cerebrum, the "thinking" part of the brain. By thinking about certain memories, we can recall them. (This is called declarative memory.)

We also have memories of how to do things, like riding a bike or playing a video game. Most of our "how-to" (or procedural) knowledge has improved with practice and becomes almost automatic. The cerebellum is especially important for remembering procedures. We don't have to think about these memories to use them.

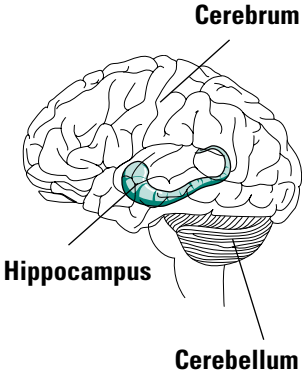


A neuron

How are memories formed?

Sensory receptors in our eyes, ears, nose, mouth and skin provide most of the information for learning and memory. Signals are sent to different areas of the cerebral cortex by way of special cells called neurons. The information is stored as memory through lasting changes in the physical and chemical connections between neurons in the brain. Sometimes signals are ignored, and the information is not remembered.

One small part of the brain, the hippocampus, is especially important in forming new memories. This is where new information is processed for short-term and then, perhaps, long-term storage. When the hippocampus doesn't work well, people have trouble forming new memories of events and facts, even though they still can remember things that happened a long time ago. They even can learn new motor skills and solve puzzles, but they can't remember doing it. The hippocampus is a handy little part of the brain!

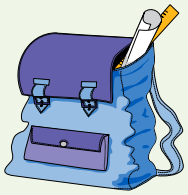


Where are memories stored?

Neuroscientists still do not know exactly where all of our memories are stored. Certainly, some memories are stored in the cerebral cortex, the uppermost layers of the cerebrum, but several different areas of the brain may be involved. This is one of the many things left to be discovered by "neuro-explorers" of the future!

MEMORIES

Your memory is a backpack
where you keep all your notes.
All the ones you want to keep,
and even those you don't!



It takes them and it files them
in pockets made for you.
They all have special places,
some for longer, it is true.

There's a place for short-term memories
of what happened just today.
And then there's also long-term space
for things that need to stay!

BRAIN FLASH

The curved shape of the hippocampus reminded early neuroscientists of a seahorse. In fact, hippocampus means "seahorse" in Greek. You have a hippocampus in each half of your brain.

BRAIN FOOD!

One of the best ways to keep your brain in top form is to eat a varied diet that follows the My Plate guidelines shown below. The foods you eat can affect the way your brain works. This is especially important at breakfast time. A good basic breakfast, consisting of fruit or juice, milk or other protein and cereal or bread, provides your brain with the nutrients it needs to learn and remember during a busy morning at school.

Try keeping a journal of the breakfasts that you and other members of your family eat during the next week. *Is everyone getting enough brain food?*

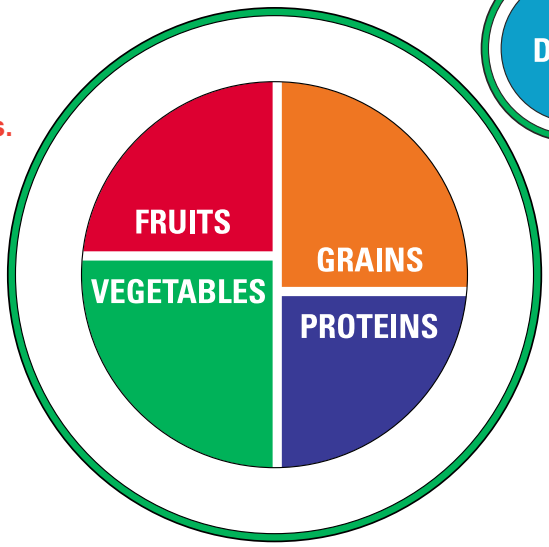
Make half of your plate fruits and vegetables.

Select whole fruit over juices.
Fruits: Any raw or cooked fruit, dried fruit, or 100% fruit juice.

Try raw crunchy veggies.
Vegetables: Any raw or cooked fruit, dried fruit, or 100% fruit juice.

There are healthier fats.
Fats and Oils: Use healthier liquid fats, such as olive or canola oil.

Avoid "super-sized" portions.



Drink water or milk instead of soft drinks.
Dairy: Milk, soymilk, yogurt, or cheese.

Choose whole grains.
Grains: Bread, mini bagel, muffin, tortilla, crackers, popcorn, cold cereal, or cooked pasta or other grain, like oatmeal.

Go lean with protein!
Proteins: Meats, poultry, seafood, dried beans, nuts, tofu, hummus, or peanut butter.

Eat less of these.
Empty Calories: Eat just small amounts of foods with high levels of sugar or solid fats, such as butter.

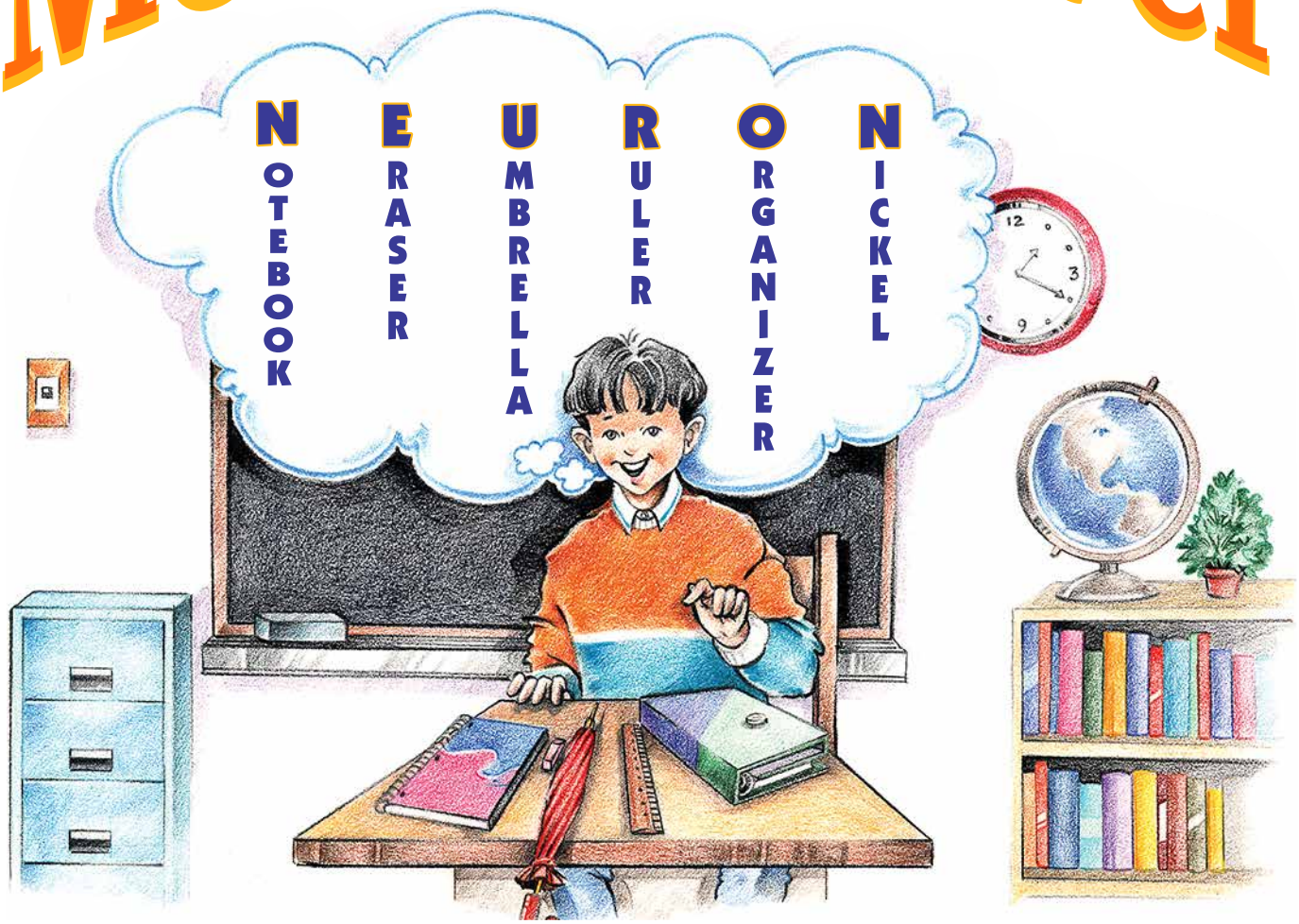
Did You Know?

For learning and memory to take place, many different parts of your brain must be working together properly. Did you ever wonder how neuroscientists find out which parts of the brain are working when you read or speak, or when you try to learn or remember something? One way is through laboratory research. Most laboratory studies on the brain are done with animals other than humans. Many different kinds of animals are used in investigations that produce important information about how the brain works.

One little animal, the sea slug (*Hermissenda*), has such a simple nervous system that it is easy for scientists to see the neuron pathways used as the animal learns. These animals can be "trained" to move in certain ways when they see a light. With billions fewer cells to observe than in humans, scientists can actually see the physical, chemical and electrical changes that take place in a *Hermissenda's* nervous system when it learns. Information from these and other animal studies helps scientists understand how the human nervous system works. This knowledge then helps physicians treat human patients whose brains have been damaged or changed by disease or accident.

Hermissenda photo by Dr. T. Crow, The University of Texas Health Science Center at Houston

Memory Power



Do you think you could memorize a string of 26 letters? Does it sound hard? Actually, it's something you've already done. Most of us learned to say the letters of the alphabet in order by singing the "alphabet song." Using rhythm or rhyme is one way to boost your memory power.

Memory boosters like the alphabet song are called mnemonics. You also can use a phrase or word to remember a longer list. For example, the word "HOMES" helps us remember the names of the Great Lakes: **H**uron, **O**ntario, **M**ichigan, **E**rie and **S**uperior.

You even can create a picture in your mind to help you remember a difficult word or phrase. Imagining a hippopotamus at camp, for example, is a mnemonic to help remember the word, "hippocampus."

Can you think of any other mnemonics that you already use? Try creating one of your own to help you remember everything that you need to bring to school in the morning.

BRAIN FLASH

Often, we become so used to hearing, seeing or feeling something that we learn not to notice it. For example, do you pay attention to the feeling of your clothes on your skin or to everyday sounds at home or in the classroom? "Getting used to" the things around us is a kind of learning called habituation.

Ruff Stuff

Ivan Pavlov, a scientist in the 1800s who was interested in how we learn, observed that dogs' mouths watered when they ate, smelled or saw food. He wondered if anything else could make dogs react that way. He rang a bell each time he fed the dogs. Soon the dogs' brains made a connection between the bell and food, and their mouths watered whenever they heard the bell, even when no food was there.

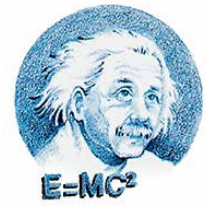
Pavlov called this kind of learning, "conditioning." Can you think of anything you have learned by conditioning?

BRAIN FLASH

People and other animals know how to do certain things by instinct. This kind of knowledge is "wired" into the nervous system at birth—like a baby's knowing how to smile at its mother or a bird's knowing how to build a nest. Everything else must be learned.

Mixed Signals

Thomas Edison
Inventor



Albert Einstein
Scientist

What did these five famous people have in common?

Like 10% of the people in the U.S. today, they all had "learning disabilities," which made it much more difficult for them to learn in school than it was for their classmates.

One kind of learning disability that gives many people trouble in school is called dyslexia. Dyslexia is caused by incorrect "wiring" in some part of a person's brain. People with dyslexia may find it difficult to write, read, spell, do math, speak, listen or remember what they have seen or heard.

Here is an example to help you understand what it might be like for some people with dyslexia. Suppose that a boy named Jason saw or heard this sentence.

Ludwig von Beethoven
Composer

Louis Pasteur
Chemist

Hans Christian Andersen
Author

Two people went down to the edge of the potato field after dinner.

When he tried to write it down, it came out looking like this.

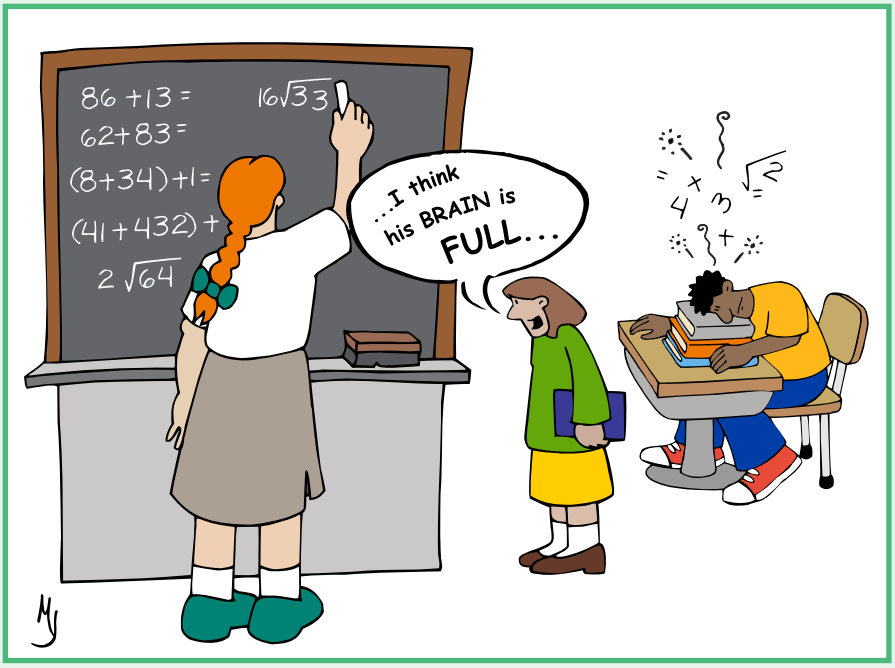
Tow pepl wnet bwon to the edg fo the ptato feld afrte biner.

This make–believe example may look silly to you, but it is similar to what really happens. Imagine how frustrated Jason would be! He is smart, and he knows something is wrong. Other people can write the sentence, and he doesn't know why he cannot. To Jason, written words seem like riddles or codes for which he doesn't have the key. When he tries to write the sentence another time, it might look entirely different–but still not like the sentence that was given to him. You can see how difficult it would be for him to learn in school.

With special help, children like Jason *can* find ways to work around their learning differences. They still can do other things without any trouble, and one day they even could become as famous as Albert Einstein!

Photo of Mozart the dog courtesy of M. Young, Baylor College of Medicine

Brain Busters!



Have you ever tried to learn and remember so much that you thought your brain must be full? It may feel that way sometimes, but it doesn't really happen. Scientists tell us that our brains can hold more information than we will ever put into them, even though we learn new things every day of our lives.

Nobody's brain ever gets "full"! When we feel like we just can't learn any more, it probably means that we are tired and don't want to pay attention any longer. Can you think of some ways to keep from getting tired at school, so that you will be able to keep learning more and more?

Careers for NeuroExplorers:

Neuroscientist

Would you like to be able to figure out why some people get diseases like Alzheimer's, or how to prevent or cure these illnesses? Neuroscientists are neuro-explorers who work in laboratories to find out the "hows" and "whys" of the nervous system. They look for ways to cure diseases or to heal damage to the brain, spinal cord and nerves.

NeuroExplorer:
Dane Chetkovich, Ph.D.
Medical Student
Baylor College of Medicine
Houston, Texas

Dr. Chetkovich, what do you do?

I am a neuroscientist, but I'm also training to become a physician. As a medical doctor, I will be able to treat patients who have neurological diseases, and as a neuroscientist I will do research, hoping to find better ways to prevent, treat or cure these illnesses.

What is the most fun or most interesting part of your work?

I'm fascinated with the wonders of the brain and nervous system. The idea of working with people who have problems and trying to find out why they got sick and how to make them better is very exciting. It's also fun for me to visit classrooms and share science with young students.

What advice do you have for future neuroscientists?

Be creative! Be original, and always keep your eyes and your mind open.

Remember What You've Learned?

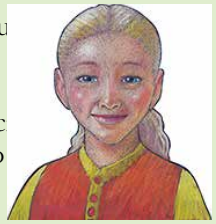
Many kinds of learning are taking place in the picture below. How many can you identify? (The answers can be found in this *Explorations*.) Memories of what we've learned are stored in the brain. Find the images of a brain, a skull and a neuron hidden below.

How's *Your* Memory?

(Continued from page 2)

- What color is the Professor's tie?
- How many people are in the picture?
- What is on top of the bookcase?
- Where is the dog?
- What is the Professor holding in his hand?
- What time is it?
- How many books are on the table?
- What animal is drawn on the board?

How did you go about trying to remember things in the picture? Did you use any special tricks (mnemonics) to help you?



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Activities described here are intended for school-age children under direct supervision of adults. The publisher, Baylor College of Medicine and the authors cannot be responsible for accidents or injuries that may result from the conduct of the activities.

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