WHAT IS GOING ON IN MY HEAD, BRAH?!
Your lolo po‘o (brain, in English) controls all your thoughts, actions, and emotions. It even controls your body in ways that you don’t think about, such as your breathing and digestion. Deep in the gray matter of your noggin, electrical and chemical processes are happening all the time, and scientists are studying them up close! They already know a lot about how we learn … stuff that could make learning easier for you!

SYNAPSES ARE A SNAP! How your brain learns is like this:
1. You do something new & your brain’s neurons say - Wow!
2. Your neurons want to share this “wow” as an electrical “message” with other neurons, but some neurons need it translated into chemicals called neurotransmitters
3. The neurotransmitters flow across a tiny gap called a synapse (see diagram above on left)
4. Then these chemicals bind with receptors on the other side of the synapse & set off another electrical impulse that travels down the dendrites of the next neuron. All of this happens as fast as a computer … or not at all! Huh?

KEY CONCEPT:
Dendrites
Branches of neurons in the brain which allow mammals to learn

SMART KINE WORDS:
❖ CORTEX - large area in the brain where most major functions take place
❖ INHIBIT - to stop from doing something
❖ NEURON – nerve cell in the brain
❖ RECEPTOR - cell that receives stimuli
❖ SYNAPSE - point where an impulse passes between neurons
WHAT GOES WRONG WHEN YOU DON’T LEARN

To learn anything at any age, we have to connect it to something we already know. In our mind, we try to make a conscious connection: e.g. if you know what a tree is, you can link the same word in Greek which is “dendron” to both the picture at right, and the new science word dendrites.

Meanwhile, in our brain sometimes neurotransmitters might not be able to make the connection right away. Some neurotransmitters will inhibit electrical impulses, leading to less or no electrical impulses going down the dendrites of a receiving neuron. Synaptic Pruning is the process of “cutting back” the connections between neurons that aren’t used. Individual neurons form thousands more connections than are needed. Over time, those that are used become stronger, and those that aren’t, disappear! Synaptic sprouting is the process of increasing the connections among neurons that are being used. These changes depend entirely on the actions and experiences you choose in life.

YOUR BRAIN CAN CHANGE! Neuroplasticity refers to the brain’s natural ability to change or adapt. These changes occur in the complex network of neurons that make up your brain. Many experiences, thoughts, or memories create new or stronger connections among neurons. Even in the adult brain, some new neurons are born and migrate out into the cortex, looking for new roles. At the same time, neural connections and neurons that aren’t used or are ineffective wither away and die. This means … Use or lose it, dude!

WHY IT’S AKAMAI TO KEEP LEARNING 4-EVAH!
The more you try learn, the easier it gets. The more you resist, the harder it gets. Kinda like when you do sports … ya gotta practice! In fact, champion athletes train their brains to win as much as they train their bodies. Check out the website!

FIRE YOUR SYNAPSES HERE:

- Go to: www.wiredtowinthemovie.com
& check out Brain Force, Mind Trip, & Century Tour, plus peak at a movie trailer about how cyclists’ brain power helps them win the Tour de France - a 3 week bike race!

Yo – Dendrite! Were you callin’ me?

Yah, T-cell … I t’ink I stay sick. Can you immune guys attack it for me?
LOLO PO’O READING: QUESTIONS/ACTIVITY

A. Directions: Work in pairs on these questions. (5 points)

1. **Talk story** with a classmate about a time when you learned something new that was really cool for you (last week, last year or when you were very young). Listen to each other’s stories, then try remember what knowledge you already had that you must have connected this new learning to. Share connections with the class.

2. **Beat the clock.** Read the terms below, then write them (or their letters) on this diagram of a neuron where 8 lines point to each part. Compare your answers with others after 10 minutes.

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a) Axon – a long, slender fiber a nerve cell (neuron) that conducts electrical impulses away from the neuron's cell body (soma)
b) Axon Terminal – the end of an axon
c) Dendrite – branches of a neuron that conduct the electrical stimulation received from other neural cells to the cell body, or soma, of the neuron
d) Myelin Sheath – an electrically-insulating layer that surrounds the axons of many neurons
e) Node of Ranvier – the gaps (about 1 micrometer in diameter) formed between myelin sheath cells along axons (nerve fibers)
f) Nucleus – a membrane-enclosed organelle found in most cells and containing most of the cell's genetic material (DNA)
g) Schwann Cell – a cell that mainly provides myelin insulation to axons
h) Soma - the bulbous end of a neuron, containing the cell nucleus
Part B

3. **BONUS OPTION. Talk story with the class.** Check out the data on a study of London cab drivers who, in just a few months, had to memorize the name of every street and building in England’s capital city (population 7½ million … nearly 20 times more than Honolulu!!). Discuss with the class what these data on the handout mean. Did Hawaiians ever have to do anything like this? How about you? Can anyone do this?

![Image of Dendrites](Retrieved 5/20/08 from: www.dendrite.org/Site/About_us.html)

4. **Set a learning goal.** Write down something challenging you’d like to learn and in the space below explain how your brain is going to help you do that in 4 steps or more. (5 points)
Navigation-Related Structural Change in the Hippocampi of Taxi Drivers

At left is a night-time image of London, England, with main roads superimposed on it. In the brightest area, 10,000 people live in each square kilometer. In comparison, the population density of Honolulu is about 1,600 people per square kilometer. Think you could memorize all the streets and building names of this city in a few months? You could!! Just ask your dendrites!

The hippocampi (posterior & anterior) are twin areas of the brain responsible for navigating and understanding spatial relationships.

a. The images at the top are MRIs (magnetic resonance images) of the brains of humans with extensive navigation experience: licensed London taxi drivers. These images were analyzed and compared with those of control subjects who did not drive taxis. Which picture highlights a larger hippocampi? That’s the cabbies!

b & c. Voxel-based morphometry (VBM) identifies differences in gray matter density in MRI brain scans. These charts show how the posterior hippocampi of taxi drivers were much larger relative to those of control subjects. These data support the idea that the hippocampi store a spatial representation of the environment (i.e. a map of London) in the mind, and expand in people with a high dependence on navigational skills. It seems there is a capacity for change in the structure of the healthy adult human brain in response to environmental demands.


MRIs and Scatter Plots for Taxi Drivers & “Control Subjects” (not taxi drivers)

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LOLO PO'O HANDOUT: ANSWER KEY

A. Directions: Work in pairs on these questions. (5 points)
Working together allows students to discuss this information, and hopefully use their dendrites to help them retain it longer!

1. Talk story with a classmate about a time when you learned something new … Share connections with the class. Teachers may want to give their own examples to start (e.g. an outrigger steersman might learn to steer by using surfing knowledge s/he already knows). (1 pt. for participating)

2. Beat the clock. Read the terms below, then write them (or their letters) on this diagram of a neuron where 8 lines point to each part. Compare your answers with others after 10 minutes.

Answers can be figured out from definitions. Clockwise from top left, answers are: Dendrite, Soma, Node of Ranvier, Axon Terminal, Schwann Cell, Myelin Sheath, Axon, Nucleus (see labeled diagram at www.wikipedia.org)

3. BONUS OPTION. Talk story with the class. Check out the data on a study of London cab drivers … Discuss with the class what these data on the handout mean. Did Hawaiians ever have to do anything like this? Yes! Ocean voyagers knew all the visible constellations & kept this information in the hippocampi of their brains. How about you? Students may have a spatial map of a videogame in their heads, a distant place, or even the exact location of every item in their homes. Can anyone do this? Yes! Some of us seem naturally better at this than others, but this study proves we can all learn it at any age, especially if we really need to (like when it’s our job!)

4. Set a learning goal. Write down something challenging you’d like to learn and explain how your brain is going to help you do that in no fewer than 4 steps.

Let students enjoy learning by setting any goal they want: sports, career, relationships, or any kind of learning (not just school). You may want them to choose both a goal for this class, and a personal one. (5 points) 1 point each for writing a goal and linking the 4 steps on page 1 of the reading (bottom) to this goal.

Teacher’s Notes: Extra

More background on dendrite image, page 2 of reading: This T cell (blue), one of the immune system’s principal means of defense, identifies the molecular signature of a dendritic cell (green) at a contact point called the immunological synapse. If the immunological synapse signals the presence of a foe, the T cell will attack.