How Alcohol Can Damage a Teen's Developing Brain Causing Brain Impairment and Early Addiction

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PARENTS EMPOWERED .org
Eliminating Underage Drinking in Utah
Sponsored by The Utah Department of Alcoholic Beverage Control and Utah Prevention

WHY TEACH THESE BRAIN-SCIENCE LESSONS?

These lessons will help you keep your child safe, smart, and free from addiction—and could improve the whole course of his or her life. New research shows that the brain is not fully developed until about age 24 or 25. Mind altering substances like alcohol can alter your child's developing brain in tragic ways, leaving him or her a slave to addiction and rendering your child less than he or she could be. Kids today need your knowledge and your help to stay alcohol free.

To help you educate and motivate your child to protect his or her delicate brain, this lesson is divided into 3 parts:
1. How the brain develops and "wires."
2. How alcohol hinders the development of important brain wiring in a teen.
3. How alcohol hijacks the pleasure-reward center of an under-age drinker's brain, causing an increased risk of addiction.

The critical period of vulnerability for alcohol experimentation is between ages 10-17. But we urge you to begin teaching these lessons in a simplified version while your child is still young—before the age of 8; and review them at least yearly.

Then take the three proven steps to keep your kids alcohol free: BONDING, BOUNDARIES, AND MONITORING.[1] Setting clear rules about children not using alcohol (or drugs) consistently enforcing those rules, and monitoring your children's behavior greatly reduce the likelihood of underage drinking. Research shows that a child who gets through age 21 without smoking, abusing alcohol, or using illegal drugs is virtually certain never to do so.It's not easy, but we know you can do it. Just keep trying—and remember that no matter how hard it may seem, successfully teaching and raising your kids is the most important work you will ever do!

OBJECTIVES OF THIS 3-PART LESSON:

1. Your child will understand the processes of brain development during the ages of ages 12 - 25 that form the basis of a future successful life.
2. Your child will understand how alcohol affects a teen's developing brain differently than an adult brain—that it damages the prefrontal cortex (good judgment/impulse control center) and hippocampus (memory/learning area).
3. Your child will learn how alcohol hijacks the brain's pleasure-reward system and can cause alcoholism in underage drinkers.
4. Your child will identify the risks of binge drinking, alcohol poisoning, and fetal alcohol syndrome.
5. Your child will make a decision to stay alcohol free.

MATERIALS NEEDED

• Attached 8"x11" Posters:
1) "Brain Areas"
2) "The Brain Develops During Teen Years"
3) "How Brain Neurons Communicate"
4) "Stronger Neural Connections"
5) "Myelin Sheath = Brain Insulation."
6) "Teens Choose How Their Brains Wire"
7) "Peaks of Plasticity"
8) "Two Brain Areas To Be Wired During the Teens"
9) "Alcohol Damages the Adolescent Brain"
10) "Alcohol Acts Like A Computer Virus in a Teen Brain,"
11) "The Brain's Pleasure Reward-System,"
12) "Alcohol Hijacks Our Brain's Pleasure-Reward System,"
13) "Teen Alcohol Use Can 'Wire' the Brain for Early Addiction,"
14) "Alcohol Poisoning: A Real Risk."
15) "Under-age Drinking Is a D.U.M.B Thing To Do,"

• Attached Information Sheet: "Alcohol Fact Sheet" from the American Medical Association (also at: www.ama-assn.org/ama/pub/category9416.htm)
• Worksheet 1: "Our Amazing Brain–The World's Most Powerful Computer!"
• Worksheet 2: "Alcohol Damages Our Brain's Pleasure-Reward System"
•Pledge Cards: "I will Stay Alcohol Free"
•Optional Material: • Two clay-dough models shaped to look like brains (see recipe at end) • one left out to dry hard for a few days, the other kept soft in an airtight bag • Small ball or wad of paper to look like a ball

NEW VOCABULARY

neurons: brain cells. The human brain has about 100 billion neurons that look somewhat like trees. Neurons contain (among other things), the following parts:

soma: the power plant that makes and stores electricity

dendrites: tiny branch-like antenna surrounding the soma which are covered with **receptors** that receive information

axon: a trunk-like cable that carries electricity to the axon terminals

axon terminals: tiny root-like structures with tiny "sacks" on each tip that make and store chemicals called neurotransmitters

neurotransmitter: chemicals produced by the brain to transmit messages between neurons

myelin sheath: fatty, waxy coating that grows on neurons as the brain matures, protecting the neuron

synapse: a tiny gap between one neuron and another

plasticity: a term used to describe the brain's ability to physically change its internal structure (by growing new dendrites) with new learning and experiences

prefrontal cortex: brain area governing good judgment and impulse control

hippocampus: brain area involved in learning and memory
pleasure receptors: area of the brain that senses and creates feelings of happiness and pleasure

dopamine: a chemical neurotransmitter made in the brain that creates feelings of pleasure; involved in the pleasure-reward system

LESSON AT A GLANCE

Part I
1. Discuss the brain/computer metaphor
2. Teach about brain neurons and how the brain communicates and wires. Use the various posters found at the end of the lesson.

Part II
3. Discuss how drinking alcohol before age 21 can damage brain wiring.
4. Play "Pass the Neuron."
5. Read and discuss American Medical Association Alcohol Fact Sheet.

Part III
6. Discuss how alcohol hijacks and damages the brain's pleasure-reward system, creating early addiction.
7. Discuss other risks of underage drinking: Alcohol poisoning, high-risk behavior, and fetal alcohol syndrome.
8. Establish family rules and consequences concerning no alcohol use.
9. Have children sign the "No Alcohol" pledge cards, and serve treats!

PART ONE – HOW OUR BRAIN DEVELOPS

INTRODUCTION:
1. Let's pretend that today is your birthday, and when you woke up this morning there was a big, beautifully wrapped box with your name on it sitting right beside you on the bed. A note said that in the box was the best gift you could ever receive.

2. ASK: What gift would you want it to be? (Discuss) When you tore open the package, you found the most advanced high-tech computer that had ever been created. ASK: Once you opened your computer, what is the first thing you would do? (Accept all answers, focus on: "read instruction book"; "find out what programs/ software it had".)

3. EXPLAIN: This situation really did happen to each of you, for when you were born you received the most amazing "computer" ever created. Your computer has more than 100 billion nerve cells called "neurons" that communicate with each other – and every other cell in your body – at more than 200 M.P.H.. What is this computer? (brain)
CONFIRM: Our brain is more powerful than any computer ever made.

4.EXPLAIN: Like any new computer, we need to know how our brain works and how to care for it if we are to get the best use out of it. New scientific discoveries, made through MRI's, PET scans, and SPECT scans (which allow us to see inside the brain as it works), have given us new valuable information in how the brain works and what can harm it.

5. DISCUSS poster # 1, "Brain Areas." The brain is divided into different specialized areas that all work at the same time. Like parallel processors in a computer, each brain area governs different parts of the body and has its own specific neural communication network.

6. ASK: Looking at the drawings, can you guess which brain area directs which part of the body? (Discuss)

7. EXPLAIN: We used to think that the brain we were born with was the brain we'd have for life; but now we know that isn't true. Research shows that a young person's brain is still making the important neural wiring that is needed to be a responsible adult.
EXPLAIN: What you think and do as a teen has a profound affect on how your brain develops. Adding brain wiring is like adding new software to your computer; with it you can become more competent and do more wonderful, exciting things. However, some things can harm your brain development and prevent proper wiring.

8. ASK, "What things do you think can harm your brain?" (alcohol, tobacco, other drugs, inhalants)

9. EXPLAIN: New research shows that alcohol affects a teen's developing brain differently than an adult brain. Drinking alcohol before the age of 21 can actually harm brain development and can cause permanent damage.[2]

10. DISCUSS Poster #2: "The Brain Develops During Teens."

a. READ aloud the quote from the American Medical Association: "The brain goes through dynamic change during adolescence and alcohol can seriously damage long—and short-term—growth processes." [3]

b. POINT OUT: These SPECT images show functional activity levels in the brain of a healthy non-drinker (left) and that of a sober 21-year old with a 4-year history of heavy alcohol use (right.) [4]

c. EXPLAIN: The "holes" indicate areas of significantly reduced brain activity (not physical holes).

d. ASK: Why is it important for you to know this new information?

e. CONFIRM: When you know how your brain works, and what harms it, you can make smart decisions to care for your high-tech brain. That way, it will work right to help you have a happy, successful life.

LESSON BODY

1. **DISCUSS poster #3:** "How Brain Neurons Communicate."

a. Our brain is made of more than 100 billion nerve cells called neurons which send electrical and chemical signals to communicate with other neurons. [5] Some people think a neuron looks somewhat like a gangly tree. It is made up of the:

- Soma – "power-plant" where the neuron-tree makes and stores the electrical power that it uses to send signals.
- Dendrites – They look like branches, but are actually antennae which are covered in tiny "receptors" that sense and receive chemical messages from other neurons. Each neuron has many dendrites and hundreds of receptors.
- Axon – It looks like a tree trunk; but it is actually more like a telephone line that carries an electrical signal from the power-plant or soma to the roots, or axon terminals.
- Axon Terminals – They look like roots that have tiny sacks on each end which are filled with chemicals called "neurotransmitters." (Our body makes over 100 different neurotransmitters; two of them are dopamine and serotonin.)

b. EXPLAIN: But neurons don't touch each other. There is a tiny gap between the dendrites of one neuron and the axon terminals of another. This gap is called a synapse. Neurotransmitters (chemi cals) flow across the synapse or gap from one neuron to another. (Point to the gap; have children repeat the word "synapse") [6]

c. EXPLAIN: Every thought you think, every emotion that you feel, every action that you do is made possible because your neurons communicate with each other. This process takes place in nanoseconds, so fast we are not even aware of it.

d. EXPLAIN: Every time we have a new experience or we learn something new, our neurons form new connections between themselves.

e. EXPLAIN: Neurons communicate by sending electrical and chemical messages. Using our metaphor of a tree, here is a very simplified explanation of how it works:

- The "branches' (dendrites) of one neuron receive a message from a part of the body and send it to the "power-plant" (soma).

- The "power-plant" (soma) sends an electrical signal down the "trunk" (axon) to the "roots" (axon terminals). This triggers the "roots" (axon terminals) to release a chemical neurotransmitter, which flows into the synapse.

- The chemical message is picked up by the "branches" (dendrite receptors) of a neighboring neuron. A "neural connection" is then made.

(NOTE: The following concept of making a neuron using your hand and arm comes from the MADD - Mothers Against Drunk Driving - "Protecting You– Protecting Me" alcohol prevention education program. See www.madd.com.)

3. ACTIVITY: "Make an Arm-Neuron" by doing the following exercise. Ask your kids to follow your instructions and copy your actions, repeating the new words with you:

a."Raise your right hand and pat the palm of your hand. Your palm is the power-plant or soma."

b."Wiggle your fingers. Your fingers are like the branches or dendrites that receive messages."

c."Touch your arm. Your arm is the trunk or axon."

d. "Now, make the 'roots' or axon terminals by putting the back of your left hand against your elbow." (Compliment their neurons.)

e. "Now hold that position and we are going to show our neuron in action." (Children do actions as you say and model the following):

f. "When your branches or dendrites [wiggle your fingers] sense a message..."

g. "They tell the power-plant or soma [slap your palm] ..."

h. "Which sends an electrical signal down your trunk or axon (run your fingers down your arm) to your roots or axon terminals.

i. "Your roots or axon terminals [put your left hand at your elbow and wiggle your fingers] release a chemical neurotransmitter (flick your fingers) into the synapse gap, and it is picked up by a neighbor ing neuron." (Again, compliment their fine neurons.)

4. DISCUSS poster #4 "Stronger Neural Connections," and **poster #5, "Myelin Sheath = Brain Insulation."**

a. EXPLAIN: every time we learn something new or have new experiences, our neurons form new con nections between themselves. If we repeat a thought or action often the sending-neuron begins to make and send a larger amount of chemical neurotransmitter across the synapse (gap).

b. The neighboring neuron then begins to grow more dendrite receptors (branches) to receive the increased neurotransmitter flow. It begins to look like a bushy "neuron-tree" instead of a spindly one. The neural connection thus becomes stronger. Eventually, the connection becomes a dominate pathway for the brain to quickly think, feel, or act. This process is called "wiring" your brain.

c. As a teen matures, many of the axons in the brain become coated with a fatty, waxy coating called a "myelin sheath." The myelin sheath acts like a type of insulation that protects brain wiring. [7] The myelin sheath is not completely formed in the brain until about age 24. (NOTE: If the myelin sheath starts to deteriorate through a brain disease like Alzheimer's, a person will lose brain function.)

d. The myelin sheath increases the speed at which electrical signals travel through the axons (from 200 m.p.h. to up to 400 miles per hour), so you can think and do those things faster and easier.

e. ASK: What are some of the things you can do well—which were hard to do at first? (walking, talking playing sports, musical instruments, dancing, doing multiplication tables, etc.)

f. ASK: Why did these activities get easier? (Your neural connections were strengthened until your brain became "wired" for that activity.)

g. EXPLAIN: About 40% of our neurons are already communicating or "wired" at birth. ASK: Which brain neurons do you think were already wired at your birth? (neurons that control breathing, digestion, sleeping, crying, etc.) EXPLAIN: The other 60% are waiting for outside stimulation to make their neural connections. Which brain neurons did you need to develop after birth? (walking, talking, reading, etc.)

h. EXPLAIN: What we choose to think, feel, experience or do becomes wired into the physical structure of our brain and becomes part of our character or identity – who we are. While you are young, you can help "wire" your brain with good choices and positive learning experiences to make your brain even more powerful and effective.

5. DISCUSS poster #6, "Teens Choose How Their Brains Wire."

a. READ: Have a child read the quote by Dr. Jay Giedd, Chief of Brain Imaging at the National Institutes of Health: "Teens, through their choices and actions, have the power to direct the develop ment of their own brains." [8]

b. ASK: How do we direct the development of our own brain? (What you choose to think, say, or do becomes wired within the neurons of your brain.)

c. EXPLAIN: As you learn and experience new, positive things, your brain develops more positive neural connections, and the smarter and more capable you become. READ Dr. Giedd's next quote:, "Kids who 'exercise' their brains by learning to order their thoughts, understand abstract concepts,and control their impulses are laying the neural foundations that will serve them for threst of their lives." [9]

d. ASK: What activities can you do to help your brain make more positive neural connections? (reading, sports, music lessons, games, doing homework or chores , thinking positive thoughts, being honest, being kind to others, listening to good music, watching movies with positive messages, paying attention in school, learning to control your temper, etc.)

e. ASK: What things do you think could harm our brain's neural development? (alcohol, tobacco, drugs, inhalants, head injuries)

6. DISCUSS poster #7, "Peaks of Brain Plasticity"

a.While our brain continues to learn things throughout life, there are important periods of time when our brain is pre-programmed to increase the brain chemicals that allow us to make more neural connections.

b. This poster shows the periods of time during which the brain has an increased level of "plasticity." Plasticity refers to the brain's ability to physically change its structure (by adding new branches or dendrites) when we have new learning and experiences. [10] These times of increased plasticity are sometimes called "peaks of plasticity." [11] Our brain is pre-programmed to wire specific areas of the brain at specific times in life.

c. EXPLAIN: An example of brain-wiring "timing" is eyesight. Our ability to see is not fully wired in the brain at birth, but continues to develop until the age of six months. On rare occasions a baby is born with a cataract covering an eye. The cataract must be removed during the first six months of life. If not, the time to wire the brain for sight passes and even if the cataract is removed later, the child will always be blind in that eye because the brain didn't receive visual information to wire it for sight.

d. EXPLAIN: The area of the brain that encourages risk-taking and impulsivity develop very early in a teen helping them venture out of childhood and try new things. But the brain area that improves impulse control and good judgment doesn't fully develop until the early twenties. [12] That is why it is important to listen and obey your parents and teachers when they tell you to do good things. The "good judgement" part of their brains have more mature wiring.

e. ASK: What period of brain plasticity are you in now? (Have child point to it.)

f. CONFIRM: One of the key brain wiring periods takes place during the ages of 12-24 years. Research shows that drinking alcohol during this period of time can disrupt and harm brain wiring.

PART 2 – HOW ALCOHOL CAN DAMAGE OUR BRAIN

7. DISCUSS poster #8, "Two Brain Areas To Be Wired During Teens"

a. EXPLAIN: We wire different brain areas at different times in life. Two brain areas that must be wired during the teen years for a person to become a responsible, caring, thoughtful adult are the "prefrontal cortex" and the "hippocampus."

b. The prefrontal cortex governs good judgment, planning ahead, decision-making, and impulse control. It helps us avoid antisocial behavior and become a thoughtful, responsible adult. [13]

c. The majority of prefrontal cortex brain wiring takes place during the ages of 12 to 16, and continues to develop until about age 24. By the time we reach adulthood, the ability to wire our prefrontal cortex is much reduced. [14]

e. EXPLAIN: The hippocampus is part of the brain responsible for learning and memory. It goes through a developmental "spurt" during the ages of 12-24. [15]

8. Discuss poster #9, "Alcohol Damages the Adolescent Brain."

a. ASK: What do you think would happen to you if the prefrontal cortex area of your brain became damaged? (make bad decisions; lack impulse control, have relationship problems, do risky behaviors)

b. ASK: What do you think would happen if the hippocampus area of your brain were damaged? (have a bad memory; do poorly on tests; not be able to learn things as well)

c. ASK: What things can harm our brain's ability to form neural connections in our prefrontal cortex and our hippocampus? (alcohol, drugs, inhalants)

9. DISCUSS poster #10, "Alcohol Acts Like A Computer Virus in a Teen Brain"

a. EXPLAIN: Alcohol is a chemical which, if consumed before our brains are fully developed, interferes with our own chemical neurotransmitters and damages our brain neuron wiring. Alcohol acts like a computer virus in our brain. It slows or shuts down brain activity, thus keeping a teen brain from making connections and properly wiring. Drinking alcohol as a teen is like turning off the power when you are trying to download new software.

b. ASK: What would happen if you had a power-outage right when you were trying to load new software on your computer? (It wouldn't be there when the power came on.)

c. CONFIRM: Alcohol acts the same way on a still-developing brain. Important neural connections that we need to be a responsible, thoughtful adult may not be wired into our brains, making life more difficult for us, and those who will depend on us. We may be harmed in ways we cannot predict, becoming less than we could be.

d. Alcohol damage can cause young people to:

- develop social problems.
- have poor judgment.
- get into trouble.
- struggle in school.
- experience failure in achieving life-long goals. [16]

e. EXPLAIN: Most alcohol brain damage doesn't show up right away, until your brain is needed to handle complex jobs or relationships, and then it may be too late. Why is it important for teens to understand brain development and wiring? (So they can protect their brain while it is developing)

f. EXPLAIN: Alcohol use not only harms a teen's brain wiring, it also hijacks the brain's pleasure-reward system, causing the brain to crave alcohol pleasure and leading to a great increase in the risk of alcohol addiction. 40% of kids who begin drinking at age 15 will become alcohol dependant as adults. We will discuss more about this in part 2.

10. ACTIVITY: Play "Pass the Brain Message" game using the MADD "Make An Arm-Neuron". (NOTE: Before beginning this activity secretly arrange with a child to toss the ball away at your signal instead of letting it go around the circle; otherwise toss it away yourself.)

a) Ask family members to stand and all form a circle with each member of the family making a neuron with his or her arm and hand.

b) Pass a message (a small ball or a paper rolled up into a ball) from one person's "neuron" to another, all around the circle. See how fast you can pass the message around the neuron chain.

c) Now pass the neuron again. But EXPLAIN: "This time we will pretend that our brain neurons belong to a kid named Jack who is visiting his cousin in the country. They decide to climb a fence and cross a field to go swimming in the river. They don't realize that an ill-tempered bull was just put in the field. Halfway across the field they notice the bull come running toward them.

They have less than a minute to run the rest of the distance to safety. We need to get a neural message (our ball) sent from Jack's eyes to his brain, and then to his feet, telling them to run. If we can get this message-ball all the way around and make a neural-connection, everyone gets a treat. (As you start the ball, add the following): "I forgot to mention that these kids found some beer in the fridge and decided to have a few drinks before they went swimming. How is that going to affect their brain?" (At this point, the designated child throws the ball away instead of passing it.)

ASK: How did alcohol affect these kids' brain connections? (harmed them)

ASK: What were the consequences? (couldn't run away from danger)

CONFIRM: That is how alcohol affects brain wiring – it hinders messages from being sent and slows down brain development. What could the consequences of underage drinking be in real life? (make poor decisions, get in trouble etc.)

11. Show the "American Medical Association Fact Sheet". Read and Discuss as age appropriate.

12. DISCUSS your family rules about no under-age drinking, and ask each child for a commitment to live by this important family rule.

PART 3: HOW ALCOHOL HIJACKS THE BRAIN'S PLEASURE-REWARD SYSTEM

13. BRAIN CLAY ACTIVITY:

Show children the soft fresh clay-dough brain. Toss it to a child and have him/her describe what the clay-dough feels like. (soft, pliable, easy to shape) Then show the dried clay dough "brain." Toss this to a child as well, and have him/her describe what this clay-dough is like. (hard, set, not easily shaped)

EXPLAIN that both these clay brains are made from the exact same material and they are only different because one was allowed to "mature" longer in the air than the other.

ASK: Which clay brain is more susceptible to damage? (the new soft brain)

ASK: How could we compare these two clay brains to an adult and teen brain? (adult brain is fully developed and protected with a myelin sheath; a teen brain is not.

REVIEW: How does a brain continue to develop? (It makes more neural connections when we have new learning and experiences.)

ASK: What is the term we use to describe the ability of the brain to change its physical structure as it wires itself with new neural connections? (brain plasticity)

REVIEW: What things harm the formation of neural connections? (alcohol, drugs, inhalants, tobacco, etc.)

14. CONFIRM and EXPLAIN:

Alcohol, tobaco, drugs, and inhalants all negatively affect brain wiring. Some drugs, like "meth" (also called "crank" or "speed") are made from such toxic chemicals that they can cause large-scale brain cell destruction and make you stupid. All illegal drugs should be absolutely avoided.

Even legal prescription drugs should only be used if prescribed for you personally by a doctor. A person needs to follow prescription instructions carefully because many unsuspecting people have become addicted to pain killers when they were not careful with their use.

Inhalants, like glue, white-out, or other household chemicals, are actually poisons to the human body, and not drugs. If breathed, they can cause severe brain damage and even death. A child should never intentionally breathe chemicals because it not only cuts off needed oxygen to the brain, but the chemicals get in the brain and can cause destruction of the delicate neurons.

ASK: If your child knows any kids who breathe chemicals. ASK for a commitment that they will never try it.

15. Display and discuss poster #11, "The Brain's Pleasure-Reward System"

a. Our brain is hard-wired to reward positive actions—those that contribute to personal survival and the well-being of the human race—with feelings of happiness or pleasure, so that we value and want to repeat those actions. [17]

b. Feelings of pleasure can range from an intense emotional high, to a happy sense of satisfaction for doing something good. Our feelings of pleasure are generated and stored in our brain. We remember the feelings of pleasure because of a brain chemical called "dopamine."

c. Dopamine is a neurotransmitter which is made in the brain from the foods we eat and stored in the roots (axon terminals). When an electrical charge comes down the trunk (axon), the dopamine is secreted from the roots (axon terminals) and flows across the synapse (gap) where it is picked up by the branches (dendrite receptors) of a neighboring neuron. As it makes a neural connection, it creates a feeling of happiness or pleasure within us. Your brain then connects the pleasure-feeling you experienced to the thing you enjoyed.

d. Ask children to each think of three things people can do, see, experience, or feel that creates a feeling of pleasure within them. Share ideas with the family. (Examples: eating a nice, juicy hamburger when you're really hungry, making a soccer goal or dunking a basketball during an exciting game, holding hands or kissing someone you like, or doing a kind deed for someone in need.)

e. EXPLAIN the reason you start to feel pleasure just looking at a juicy hamburger when you are hungry, or seeing a person you like coming down the hall, is because your eyes send a signal to the brain that something good is about to happen—and the dopamine starts flowing across the previously-made neural connection. You've wired your brain to remember the feeling; and you are motivated to repeat the action that brought the pleasure.

16. DISCUSS poster #12, "Alcohol Hijacks Our Brain's Pleasure-Reward System"

a. EXPLAIN: Alcohol affects the way your brain experiences pleasure by hijacking and manipulating the brain's pleasure-reward centers. [18] Alcohol stimulates the production of the neurotransmitter dopamine and tricks your brain into generating a pleasure-reward feeling from a harmful chemical instead of a real experience. [19] If a teen continues drinking, the brain changes and adapts to the presence of alcohol and soon the teen needs more and more alcohol to create the same amount of pleasure.

b. Because the teen brain produces an abundance of dopamine, it can rapidly go from liking, to wanting, to needing alcohol, programming it for alcoholism. [20]

c. However, while the alcohol is creating a feeling of temporary pleasure, it is also damaging the brain's ability to sense pleasure from normal, healthy things and experiences. After a while, a teen will need more and more alcohol to receive the same amount of pleasure. This leads to addiction, meaning that your craving for the alcohol-pleasure becomes so strong that you feel uncomfortable, sometimes even extreme discomfort, without it. You will neglect important things, or risk serious consequences, to get it.

What is worse, your ability to sense ordinary pleasure from real things and experiences will also be diminished. After awhile, things you previously enjoyed may leave you feeling flat. [21]

17. Read and discuss the following true story.

"Carlos loved playing soccer, and he was a very good player. But in high school he started hanging out with friends who drank. After a while, he began drinking a little as well. Then he began to drink with them every weekend, and the drinking activities became more and more important to him. Pretty soon Carlos began to lose interest in soccer. One weekend he didn't even show up for a key game. When his teammates confronted him, he blew them off, saying, 'Hey, it's just not fun for me anymore'."

ASK: What might have been happening to the neural wiring in Carlos' brain that caused him to value drinking with his new friends over playing soccer with his team?

18. Discuss the illogic of underage drinking using the following questions:

a. Why do some young people drink? (to feel pleasure, have fun)

b. What are they really doing to themselves? (damaging their pleasure center)

c. Why is damaging your pleasure center one of the D.U.M.B-est things you can do? (The short-term pleasure-buzz of alcohol is never worth the diminishing of your ability to sense real pleasure, nor the risk of damaging your brain, or becoming an alcoholic.)

19. Discuss poster #13, "Teen Alcohol Use Can Wire the Brain for Addiction":

a. EXPLAIN: In addition to damaging the good judgment and memory areas of our brain, drinking alcohol under the age of 21 can also program the brain to become addicted to alcohol.[22]

b. EXPLAIN: Research shows that if people begin drinking alcohol at age 15, they have a 40% chance of becoming an alcoholic. If people wait until age 21 to drink, they have less than a 7% chance of becoming an alcoholic. [23]

c. In 2004 it was estimated that there were 16 million alcoholics in the United States and 4 million of them were teens.

d. ASK: What problems do some alcoholics have in life? (Discuss)

f. EXPLAIN: It is important to know that there is no cure for alcoholism – the pleasure center of an alcoholic's brain is permanently altered. Alcoholism can be "treated" through counseling and support groups like Alcoholics Anonymous to help a person get off alcohol and build more positive brain wiring around the alcohol-wired circuits, but the person must usually then abstain completely from alcohol for the rest of his or her life, or they may revert back to alcoholic behavior.

g. ASK: How is society harmed when people become alcoholics? (Alcoholics often have extra health problems; sometimes they drive drunk and get in accidents, injuring or killing others. This takes police and court resources, and causes insurance rates to go up. They sometimes abuse spouses or children when intoxicated, lose their jobs, become depressed or develop mental illness—things that put a strain on the social system.)

h. EXPLAIN: Some people are genetically predisposed to alcoholism, and may become an alcoholic even if they begin drinking after age 21. Research shows that these people's brains often produce less serotonin, a neurotransmitter that makes a person feel calm and happy. Their pleasure centers also have an increased sensitivity to the pleasure alcohol provides – making them feel the pleasure alcohol provides much more intensely than the average person. They thus become more easily wired for addiction.

i. ASK: How do you know if you are genetically predisposed to alcoholism? (If a person has a family member who has a drinking problem, then he or she likely has a genetic predisposition to alcoholism and, to be safe, should probably never drink.)

j. EXPLAIN: About 60% of the U.S. population doesn't drink at all. Some make the choice not to drink for health reasons; others, for religious reasons, or because they don't like the taste. Their children may not know if they are predisposed for alcoholism or not, because no one drinks in their family. These teens should also be especially careful to avoid underage drinking.

k. ASK: What is the only sure way to stay safe from alcoholism? (stay alcohol free)

20. DISCUSS poster #14 "Alcohol Poisoning: A Real Risk":

a. EXPLAIN: There is another huge danger with underage drinking. Because the adolescent brain is not fully formed, in many cases it has not yet developed the "shut-off" switch that adults have developed, which makes a person get sleepy or pass out from too much alcohol—and thus stop drinking. As a result, most teens can drink dangerous amounts of alcohol before passing out — in most cases much more than an adult. It is important to know that the lethal dose of alcohol (that can cause death) is just a tiny bit more than the passing-out dose.

b. EXPLAIN: Some teens participate in "binge drinking" which is defined as 5 or more drinks at a sitting, or in drinking contests. Because teens lack the shut-off switch, they can consume dangerous amounts of alcohol in a short period of time, which can result in alcohol poisoning or death.

c. ASK: How can you protect yourself or a friend from alcohol poisoning?
(Never drink before age 21, and then if you choose to drink after that, always drink in moderation, which means no more than one drink a day for a woman and two drinks a day for a man. NOTE: This is the amount set by the US Government as "moderate" consumption.)

d. ASK: What should a person do if they have a friend who passes out from drinking and starts to turn blue around the mouth? (He or she should be taken to a hospital emergency room immediately. If left untreated, he or she could die.)

21. DISCUSS the dangers of drinking and getting a hangover with the following "Light Switch Object Lesson":

a. ASK a child to turn a light switch off and on.

b. EXPLAIN: Most brain cells have a "go" switch that tells the power-plant (soma) in the neuron to fire off an electrical impulse, passing on information necessary for memory formation.

c. EXPLAIN: Excess alcohol turns off this "go" switch, preventing cells from properly firing. When we get drunk, it is like turning off a light switch in our brain, causing brain activity to slow down. The brain tries to compensate for the slow-down by increasing the activity of neurons. Many of the over-stimulated cells break down and die in their own membranes. This causes the intoxicated person to experience a "hangover" effect: headache, nausea, etc.

d. EXPLAIN: The effects on an adult brain from getting drunk diminish after about 24 hours and the brain resumes to normal activity. In a teen brain, however, the negative effects of getting drunk can continue to linger in the brain for several days, affecting the "go" switch and interrupting neural brain development during this time.

e. ASK: Why do teens who get drunk every weekend hinder their ability to properly wire their brain and lay down memories? (In some cases the brain of a teen doesn't recover from the effect of getting drunk for several days– preventing the brain from effectively laying down new information and making needed neural connections during this period of time.)

22. EXPLAIN: Teens who drink heavily often engage in risky or dangerous behavior because the area of their brain that governs good judgment and coordination are slowed down by the alcohol. ASK: What might some of these risky behaviors might be? (Discuss)

One of the most terrible risks of young women drinking is engaging in unprotected sex, which can result in an unplanned pregnancy. The brain of a baby begins developing before most women realize they are pregnant. Any drinking after conception can put a baby at risk for severe brain damage called **fetal alcohol syndrome.** A child can never recover from fetal alcohol syndrome, but will remain with brain damage for life. Drinking while pregnant is one of the cruelest things you can do to a baby. If a woman who has an alcohol problem becomes pregnant, she should immediately tell her doctor or a social worker to get help to stop drinking.

23. DISCUSS poster # 15, "Underage Drinking Is D.U.M.B" but keep the words "Drinking Underage Maims the Brain" covered at first.

a. EXPLAIN: After reviewing all the latest scientific research on teen alcohol brain damage, the American Medical Association issued this slogan: "Underage Drinking is a D.U.M.B. Decision"

b. ASK: What does "underage" mean? (Under the age of 21. It is against the law to drink alcohol before the age of 21. It is also against the law for a someone under 21 to possess or attempt to purchase alcohol.)

c. ASK your children to brainstorm an answer to what they think the initials D.U.M.B. stand for.

d. After they share answers, uncover the A.M.A. definition of D.U.M.B. (Drinking Underage Maims the Brain).

e. ASK: After learning how alcohol harms a teen's brain, what will you do to make sure you're not pressured into drinking before age 21? (Discuss and role-play answers.)

f. Post the D.U.M.B. poster where the family can easily see it.

24. EXPLAIN: Many states, including Utah, have a "Not A Drop" law. That means that it is against the law for anyone under the age of 21 to have any alcohol in their body; and those who are found violating this law can be arrested and charged with a misdemeanor.

ASK: Why do you think it is against the law for people under age 21 to drink alcohol? (Discuss)

EXPLAIN: Adults can be fined or go to jail for providing alcohol for people under the age of 21.

ASK: Why is it also illegal for an adult to provide alcohol for teens? (It can harm a teen's developing brain, which can cause addiction and brain impairment, which can harm both a teen and society.)

CLOSURE:

25. ASK: What are some of the most impressive things you have learned about from these lessons?

a. ASK: What will you do differently because of this new knowledge?

b. EXPLAIN again your family rules about no alcohol before age 21 (and no drug use at any time.)

26. INVITE the family to participate in the "Pledge Card" signing activity

a. ASK: After considering the damaging effects of alcohol on the developing brain, would you be willing to make a commitment and promise to stay alcohol free from now on — at least until age 21?

b. Children who are willing to make a serious commitment may complete and sign the pledge cards. (Offer ample praise and acceptable rewards.)

OTHER IDEAS

1. Have kids make up a Rap song to the pledge taken. Include "dance" actions and rap along to the pledge.

2. Children study their completed worksheets and within 24 hours teach another person: 1) how the brain becomes wired, 2) what two areas need to be wired during adolescence, 3) and how alcohol harms a teen brain.

Websites for parents to talk to their kids about alcohol:

1. www.ParentsEmpowered.org
2. www.StopAlcoholAbuse.gov
3. www.thecoolspot.gov
4. http://www.alcoholfreechildren.org/en/audiences/youth.cfm
5. English: www.niaaa.nih.gov/publications/children.pdf; or Spanish: www. niaaa. nih.gov/publications/Span Parents.pdf
6. http://www.madd.org/under21/

Videos on alcohol-brain damage worth watching:

1. "Brain Scans" video and "Don't Drain Your Brain – How Alcohol Damages Your Brain" (Human Relations Media, 1-800-43 1-2050 or www.hrmvideo.com).
2. "The Truth About Alcohol" (AIMS Multimedia, www.aimsmultimedia.com)

CLAY-DOUGH BRAINS: Mix together:

1 cup flour
½ cup salt
2 teaspoons cream of tartar
1 cup water
Heat 1 tablespoon of oil in pan. Add flour mixture; cook for three minutes, stirring constantly until it forms a ball. Dump clay-dough onto an oiled countertop. Knead until soft. Make two "brains"; leave one out to dry for a week. Store the other in a plastic bag until ready to show children.

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Wolfe, Patricia. Brain Matters: Translating Research into Classroom Practice. Alexandria, VA: Association for Supervision and Curriculum Development, 2001.
Videos: "Brain Scans" and "Don't Drain Your Brain – How Alcohol Damages Your Brain" (Human Relations Media, 1-800-43 1-2050 or www.hrmvideo.com).

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2. Institutes of Medicine National Research Council, Reducing Underage Drinking: A Collective Responsibility, 13,14, 35,39.
3. American Medical Assn. report on Alcohol's Adverse Effects on the Brains of Children, Adolescents and College Students, 2003 Fact Sheet. www.ama-assn.org/ama/pub/category/9416.html
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12. Preventing and Reducing Underage Drinking: Using SAMHSA's Strategic Prevention Framework to Get Outcomes, 1.
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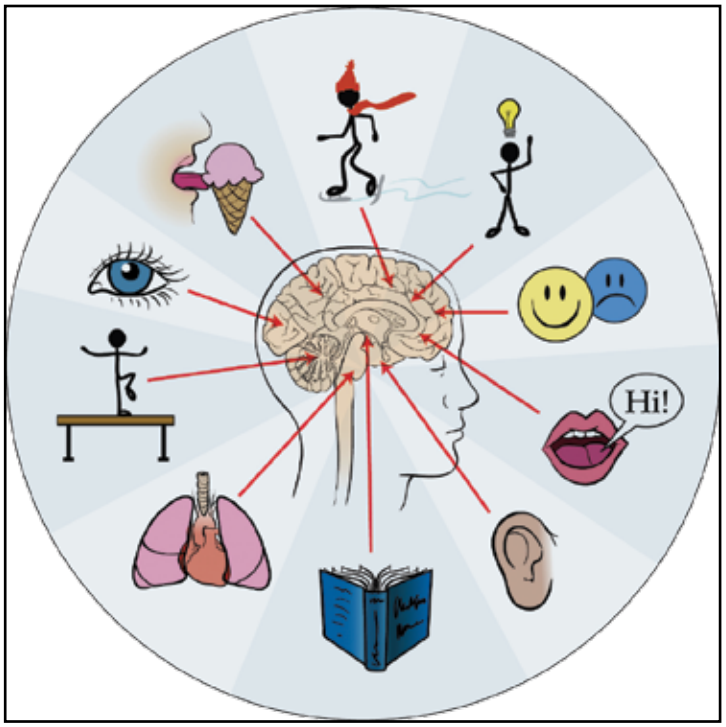
19. Prevention Talk, Issue Number 14, U.S. Department of Health and Human Services.
20. http://captus.samhsa.gov/western/resources/prevtalk/documents/newsletter-2005-03.pdf
21. http://teens.drugabuse.gov/parents/parents_brain1.asp
22. Chambers, R., Taylor J.R., Potenza, N.M (2003) American Psychiatry, 160, 1041-1052.
23. The NSDUH Report, November 22, 2004.

BRAIN AREAS
in the world's most powerful computer

Our brain is divided into specialized areas:



Each area has its own unique "neuron communications network" that governs and controls different parts of the body.

- **Like a powerful computer with parallel processors, each different brain area processes vast amounts of information, separately and together, all at the same time.**

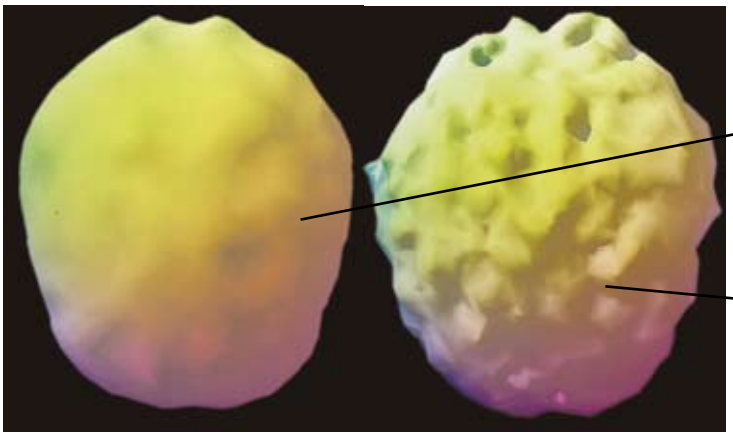
- **Can you guess which brain area directs which activity or part of the body?**

Hint:
Movement; Thinking; Emotions; Language; Hearing; Memory; Automatic Functions; Balance; Eyesight; Taste.

Brain Develops During Teen Years

"The brain goes through dynamic change during adolescence (ages 12 to 21) and alcohol can seriously damage long – and short-term – growth processes."

(American Medical Association Fact Sheet, 2003)



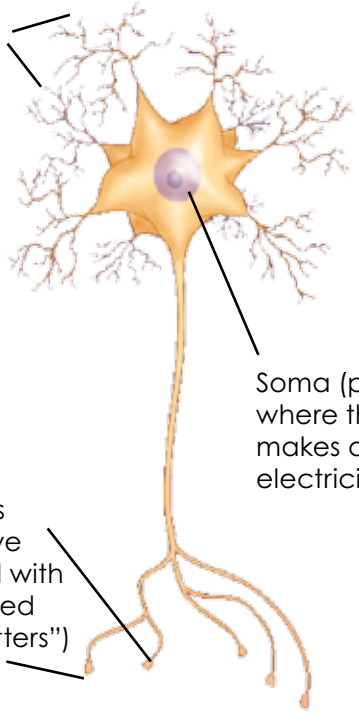
These S.P.E.C.T. images show activity levels in the brain of a healthy non-drinker (left)…

…and that of a sober 21-year old with a 4 year history of heavy alcohol use (right).

***The "holes" indicate areas of significantly reduced brain activity**

Brain Neurons

Your brain has about 100 billion neurons that look something like this:



How Brain Neurons Communicate

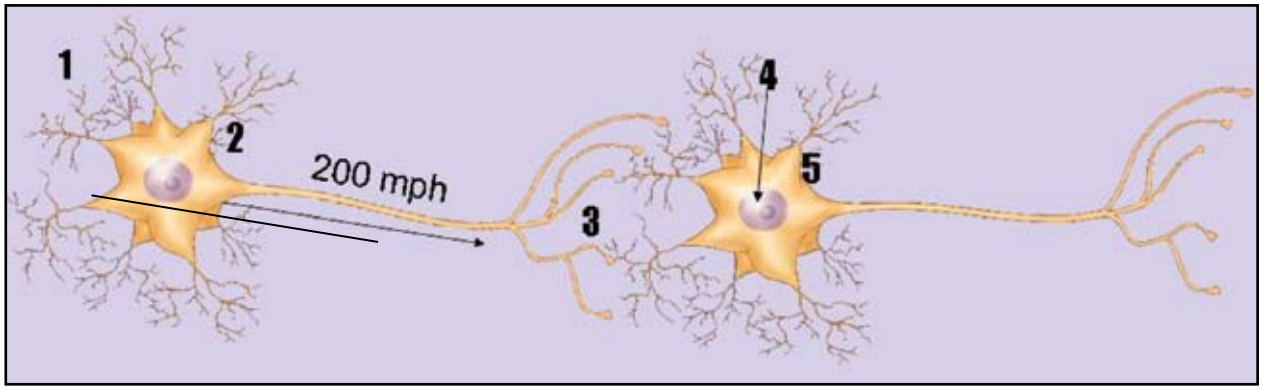
1. The branches (dendrites) receive a message from somewhere in the body and send it to the power-plant (soma)

2. The power-plant (soma) sends an electrical impulse down the trunk (axon) to the roots (axon terminals)

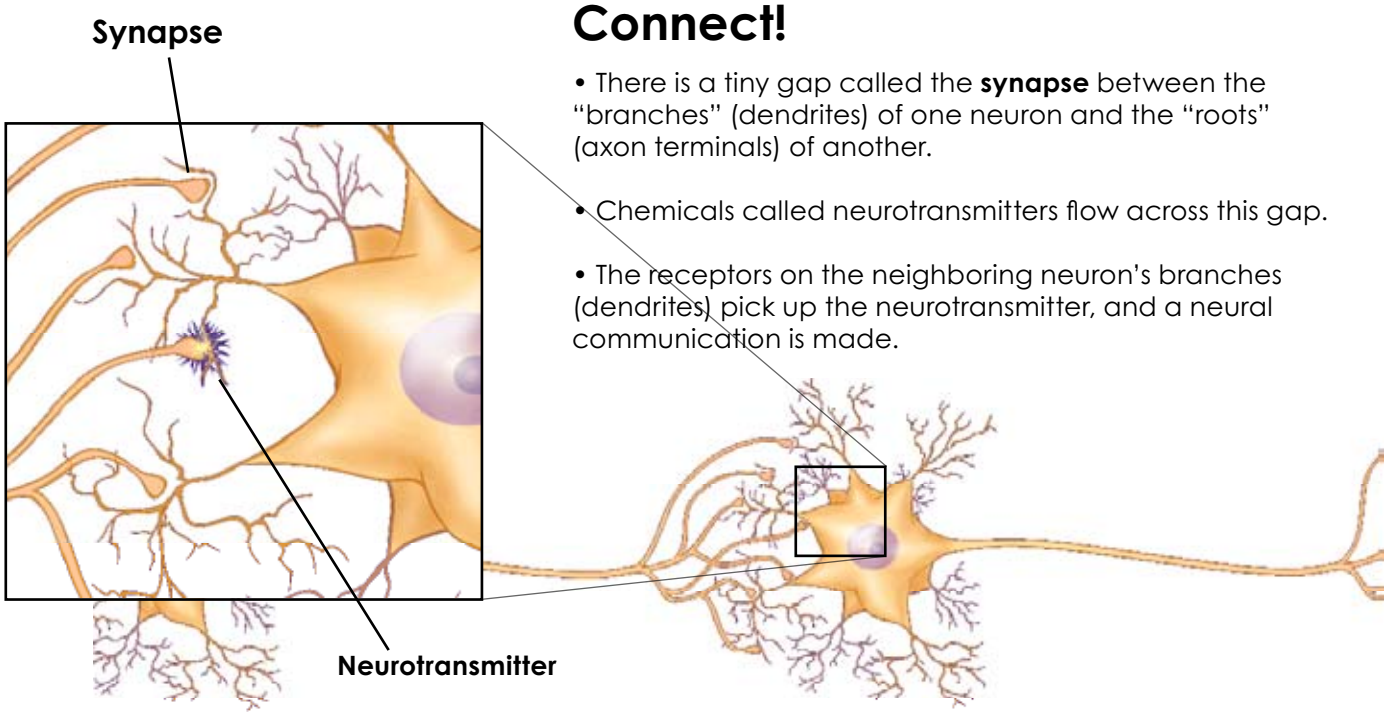
3. The roots (axon terminals) give out a chemical message (neurotransmitter)

4. The neighboring branches (dendrite receptors) pick up the chemical message and send it to the power-plant (soma)

5. A neural communication is then made!



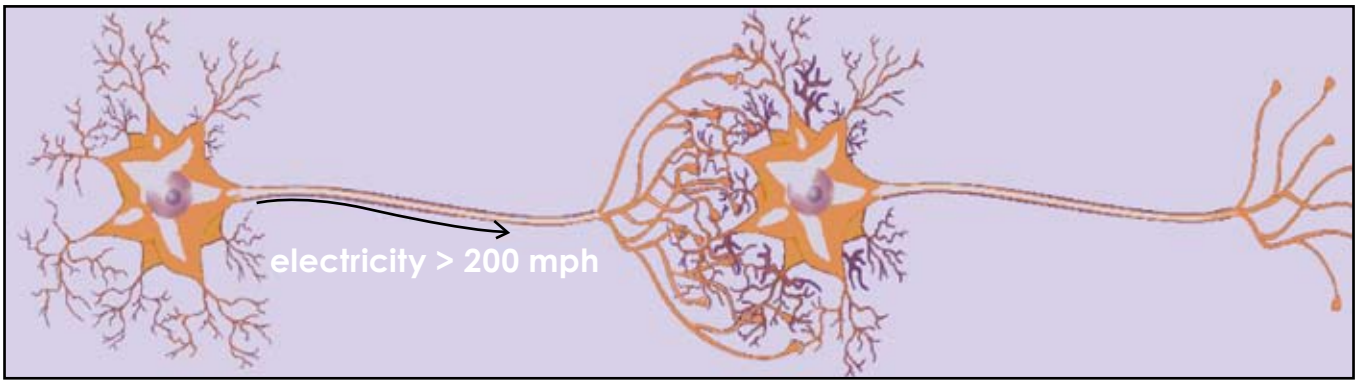
Neurons Don't Touch - But They Connect!



- There is a tiny gap called the **synapse** between the "branches" (dendrites) of one neuron and the "roots" (axon terminals) of another.
- Chemicals called neurotransmitters flow across this gap.
- The receptors on the neighboring neuron's branches (dendrites) pick up the neurotransmitter, and a neural communication is made.

Stronger Neural Connections

- If a thought or action is repeated often, the sending neuron makes and sends MORE neuro-transmitter…
- The receiving neuron then has to make MORE branches (dendrites) to receive it…

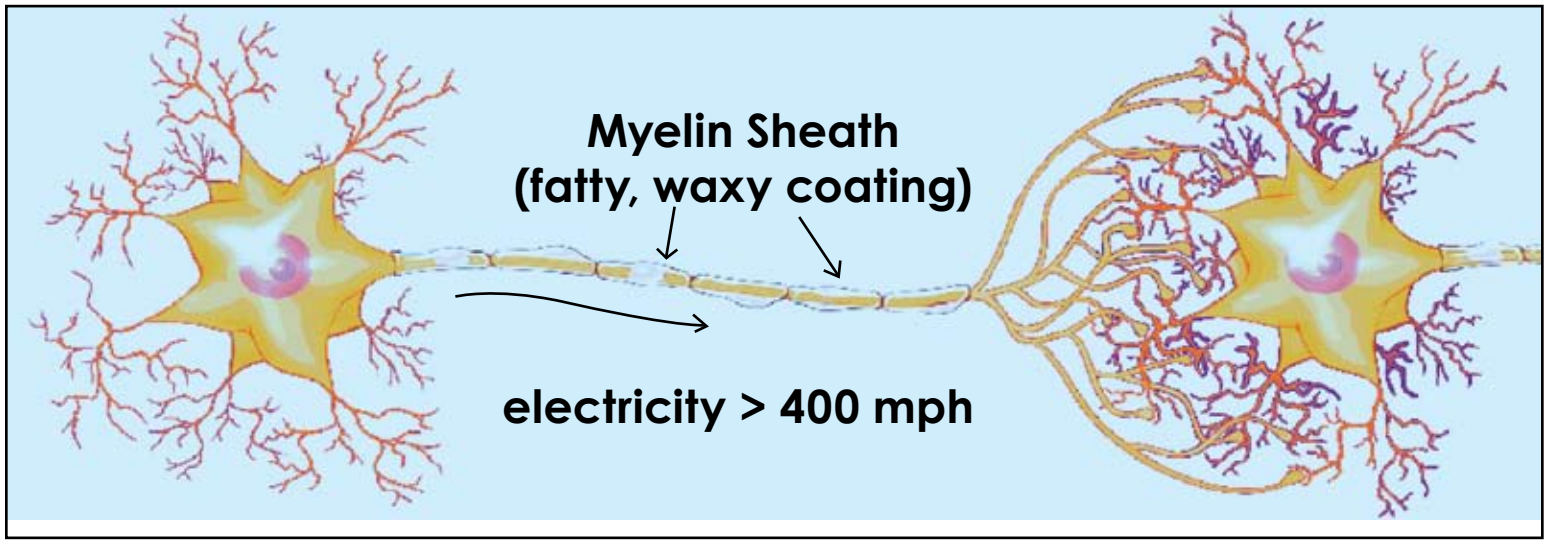


- The neuron grows to look more like a bushy "neuron tree" instead of a spindly "neuron-tree."

This process makes the neural connection become stronger and stronger – until it becomes a dominant neural pathway.

Myelin Sheath = Brain Insulation

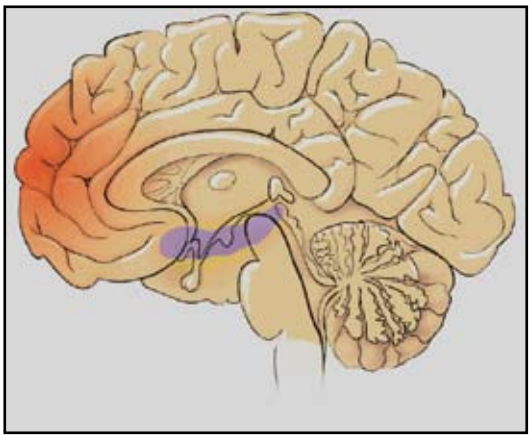
- As new neural connections are made—and the teen brain matures—part of the neuron then becomes coated with a fatty, waxy coating called the myelin sheath.
- This process is called "wiring" the brain and is not completed until about age 25.



Electrical impulses from the soma then travel down the axon at 400 mph!

*** The more neural wiring we have, the smarter and more capable we become!**

Teens Help Decide How Their Brains "Wire"



"Teens, through their choices and actions, have the power to direct the development of their own brains."- Dr. Jay Giedd, Chief of Brain Imaging at the National Institutes of Health

"Kids who 'exercise' their brains by learning to order their thoughts, understand abstract concepts, and control their impulses are laying the neural foundations that will serve them for the rest of their lives."

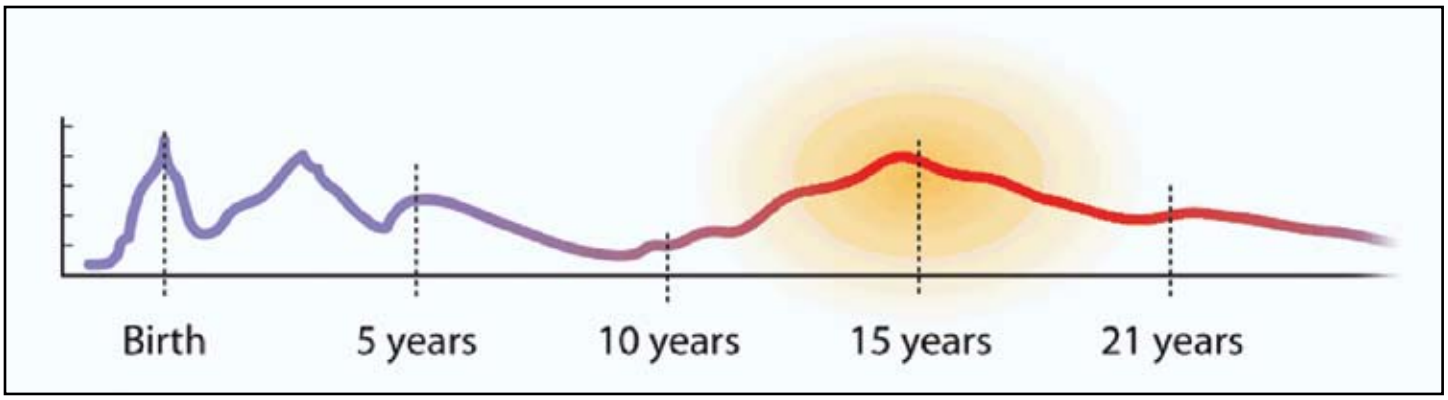
- Dr. Jay Giedd

Peaks of Brain Plasticity

- **The word "plasticity" is a term used to describe the brain's ability to physically change its internal structure (by making more dendrites) when we learn new things or have new experiences.**

- **During peaks of plasticity the brain must make key neural connections to wire us to become a responsible, thoughtful, intelligent adult.**

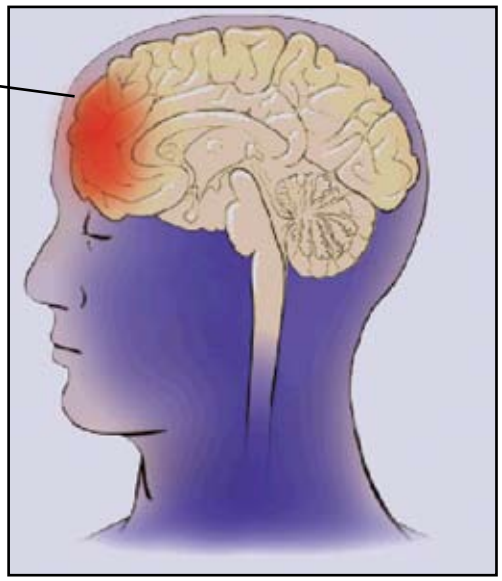
Peaks of Brain Plasticity



Drinking alcohol during peak periods of plasticity can seriously damage brain wiring!

Two Brain Areas Are Wired During the Teen Years:

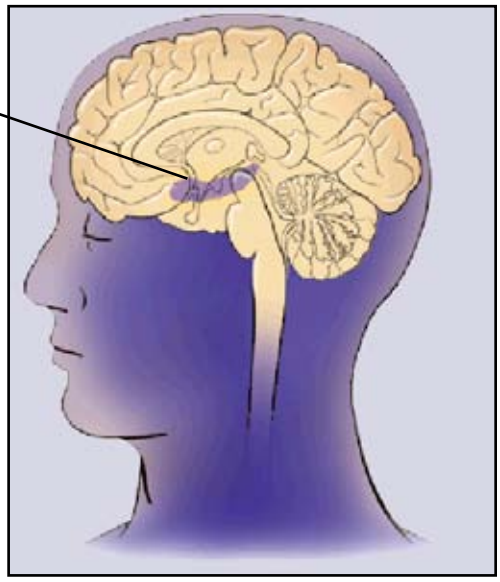
The **Prefrontal Cortex** is the boss or director of the brain.



- It governs good judgment, complex thinking, decision making, planning and impulse control.

- The majority of prefrontal brain wiring takes place by age 16, and continues to develop until about age 24-25.

The **Hippocampus** is part of the learning and memory area.



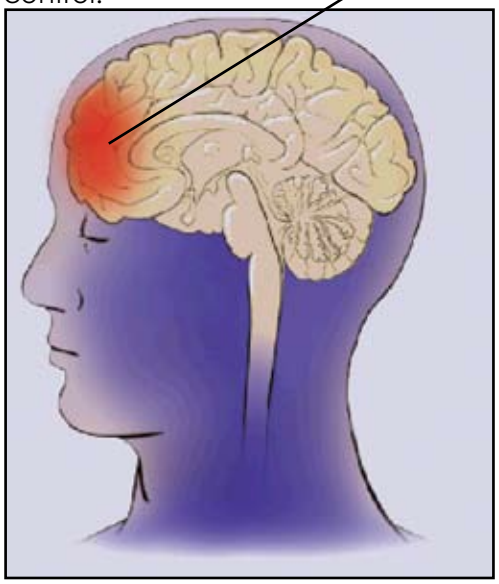
- Ages 12-25 is a key period of time for learning that wires the hippocampus for future successful learning

Alcohol Damages the Adolescent Brain

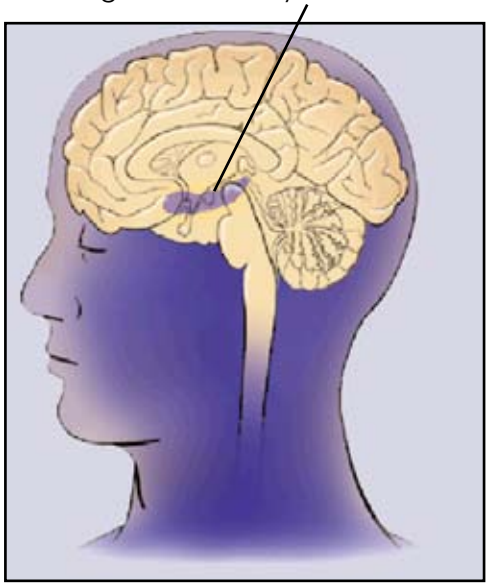
"The prefrontal area undergoes the most change during adolescence. Researchers found that adolescent drinking could cause severe changes in this area… which plays an important role in forming adult personality and behavior… Damage from alcohol at this time can be long-term and irreversible."

(American Medical Association Fact Sheet, 2003)

The Prefrontal Cortex (behind the forehead) governs good judgment, decision making, planning and impulse control.



The Hippocampus is involved with learning and memory.



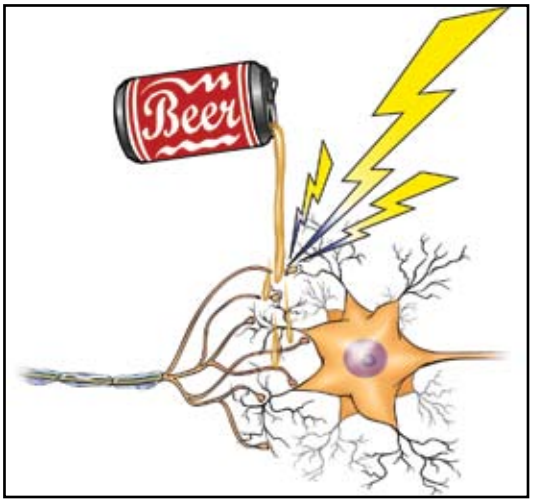
"The hippocampus handles many types of memory and learning and suffers from the worst alcohol-related brain damage in teens. Those who had been drinking more and for longer had a significantly smaller hippocampus (10 percent)… Frequent drinkers may never be able to catch up in adulthood, since alcohol inhibits systems crucial for storing new information."

(American Medical Association Fact Sheet, 2003)

Alcohol Acts Like A Computer Virus in A Teen Brain

Alcohol acts like a computer virus in a teen brain that:

- **Slows or shuts down brain activity**
- **Damages neuro-connections**
- **Negatively alters the brain's pleasure-reward circuitry**
- **Decreases the ability to learn**
- **Hinders brain wiring that a teen needs to become a responsible, thoughtful adult.**



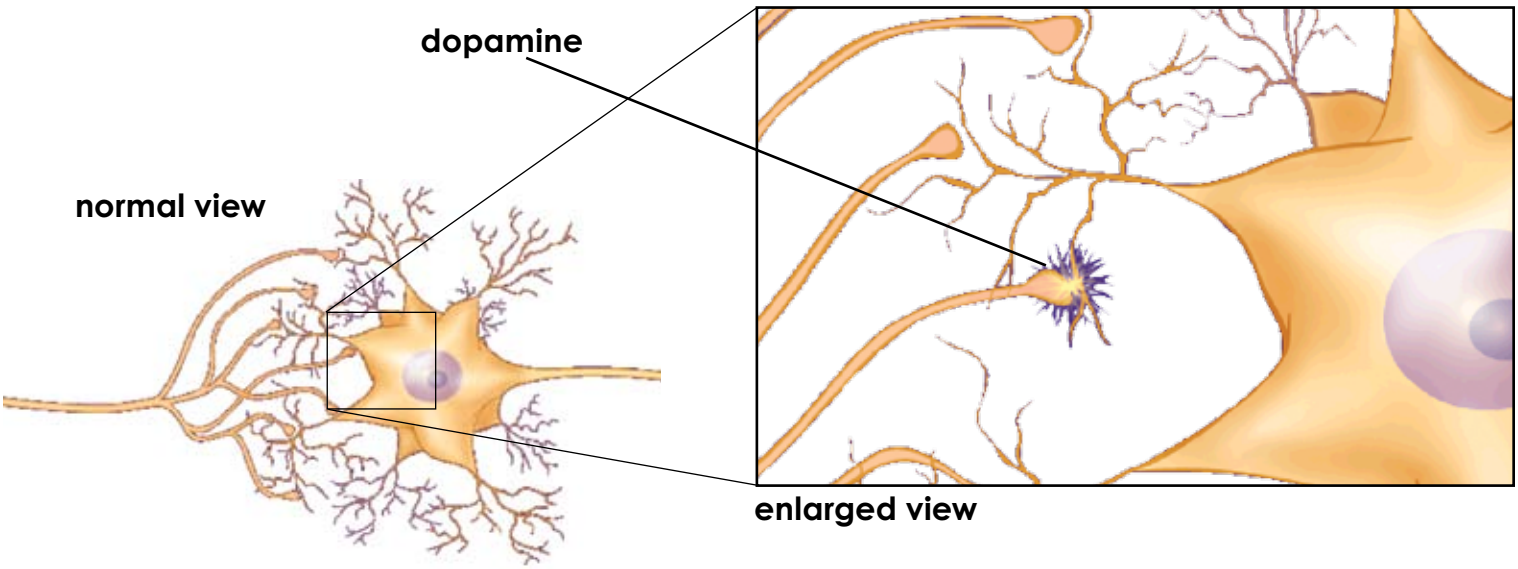
The Brain's Pleasure Reward-System

Our brain rewards positive actions – those that are important to the survival of the human race – with feelings of pleasure, so we value and want to repeat those actions.

Feelings of pleasure range from an intense emotional high, to a happy sense of satisfaction from giving service, or doing a job well.

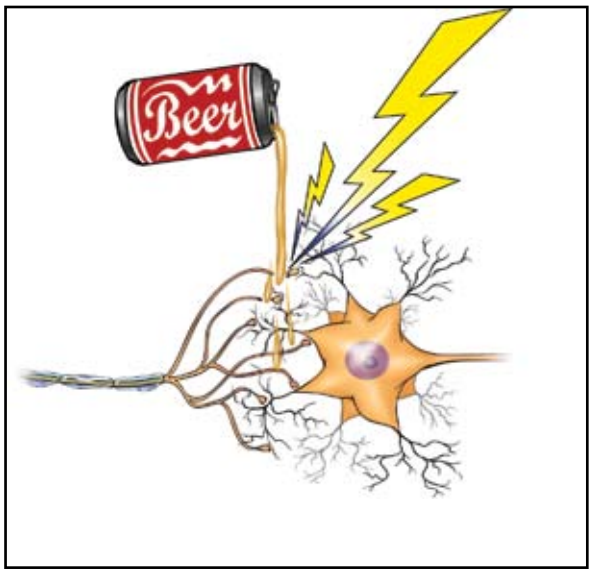
We remember feelings of pleasure from the neurotransmitter dopamine.

Dopamine sends "feel-good" messages to our brain and body, connecting the pleasure we experienced to the thing we enjoyed.



Alcohol Hijacks Our Brain's Pleasure-Reward System

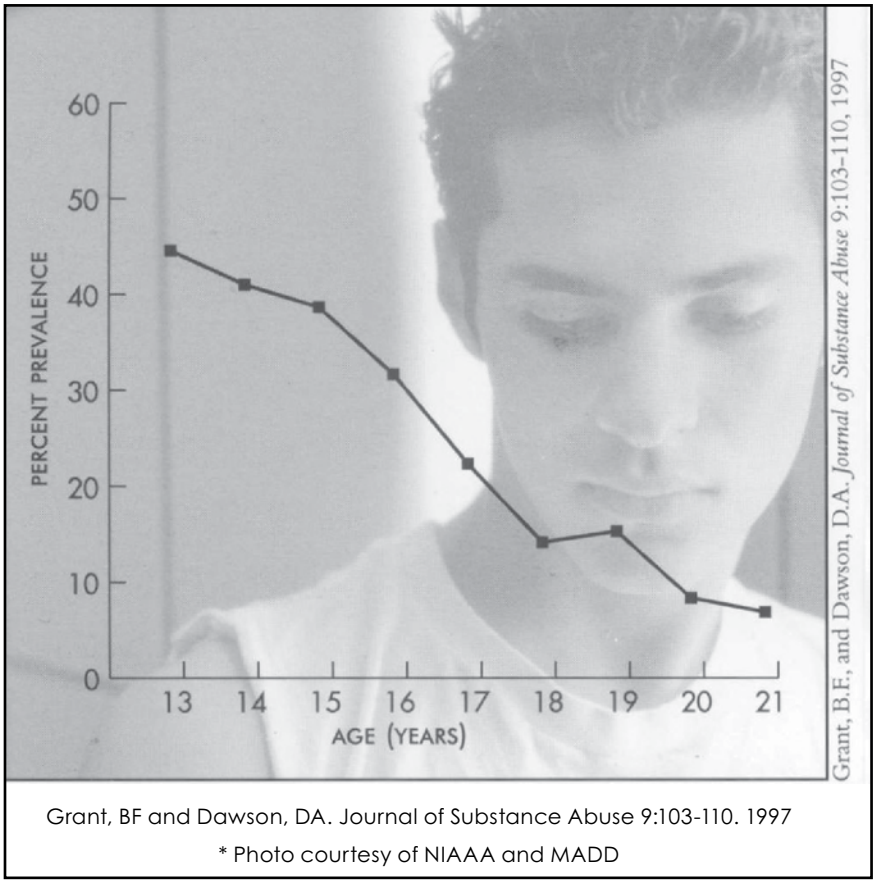
Alcohol stimulates the production of the neurotransmitter dopamine, tricking your brain into generating pleasure-reward feelings from a harmful chemical instead of a real experience.



Alcohol also damages the ability to sense pleasure from real things and experiences – leaving a young person feeling "flat" about things he or she previously enjoyed.

Drinking **under the age of 21** can program your brain to crave the **fake pleasure** alcohol provides, causing **addiction.**

Teen Alcohol Use Can "Wire" The Brain for Early Addiction



Grant, BF and Dawson, DA. Journal of Substance Abuse 9:103-110. 1997

* Photo courtesy of NIAAA and MADD

40% of kids who begin drinking at age 15 will become alcoholics.

Only 7% of those who begin drinking at age 21 become alcoholics.

Drinking underage is a D.U.M.B. decision!

Alcohol Poisoning: A Real Risk

Because most teen brains have not yet developed the "shut off" switch that causes a person to feel sleepy or pass out from drinking too much alcohol, many young people can drink dangerous quantities of alcohol without realizing the harm it is causing—until it is too late.

This is referred to as Alcohol Poisoning

The alcohol "pass-out" dose is just a tiny bit less than the lethal dose.

"Binge Drinking" Contests cause adolescent brain damage and can cause

DEATH

Beer? No thanks. I'll keep my brain cells.

After viewing all the latest alcohol brain-damage research, the American Medical Association came up with this new slogan:

Drinking underage is a

D.U.M.B.

decision!

(Drinking **U**nderage **M**aims the **B**rain!**)**

Decide NOW:

"What will you do to keep your brain smart, happy, and free from addiction?"

Fact Sheet: Effects of Alcohol on Brains of Adolescents

Fact Sheet from an American Medical Association Report on Alcohol's Adverse Effects on the Brains of Children, Adolescents and College Students

What is the summary report?

Harmful Consequences of Alcohol Use on the Brains of Children, Adolescents, and College Students is a compilation and summary of two decades of comprehensive research on how alcohol affects the brains of youth. The report's aggregation of extensive scientific and medical information reveals just how harmful drinking is to the developing brain and serves as a wakeup call to parents, physicians, elected officials, law enforcement, purveyors of alcohol – including the alcohol industry – and young drinkers themselves.

Why is this report important?

The average age of a child's first drink is now 12, and nearly 20 percent of 12 to 20 year-olds are considered binge drinkers. While many believe that underage drinking is an inevitable "rite of passage" that adolescents can easily recover from because their bodies are more resilient, the opposite is true.

The Adolescent Brain

The brain goes through dynamic change during adolescence, and alcohol can seriously damage long- and short-term growth processes. Frontal lobe development and the refinement of pathways and connections continue until age 16, and a high rate of energy is used as the brain matures until age 20. Damage from alcohol at this time can be long-term and irreversible. In addition, short-term or moderate drinking impairs learning and memory far more in youth than adults. Adolescents need only drink half as much to suffer the same negative effects.

Drinkers vs. Non-Drinkers: Research Findings

- Adolescent drinkers scored worse than non-users on vocabulary, general information, memory, memory retrieval and at least three other tests
- Verbal and nonverbal information recall was most heavily affected, with a 10 percent performance decrease in alcohol users
- Significant neuropsychological deficits exist in early to middle adolescents (ages 15 and 16) with histories of extensive alcohol use
- Adolescent drinkers perform worse in school, are more likely to fall behind and have an increased risk of social problems, depression, suicidal thoughts and violence
- Alcohol affects the sleep cycle, resulting in impaired learning and memory as well as disrupted release of hormones necessary for growth and maturation
- Alcohol use increases risk of stroke among young drinkers

Adverse Effects of Alcohol on the Brain: Research Findings

Youth who drink can have a significant reduction in learning and memory, and teen alcohol users are most susceptible to damaging two key brain areas that are undergoing dramatic changes in adolescence:

- The hippocampus handles many types of memory and learning and suffers from the worst alcohol-related brain damage in teens. Those who had been drinking more and for longer had significantly smaller hippocampi (10 percent).
- The prefrontal area (behind the forehead) undergoes the most change during adolescence. Researchers found that adolescent drinking could cause severe changes in this area and others, which play an important role in forming adult personality and behavior and is often called the CEO of the brain.

Lasting Implications

Compared to students who drink moderately or not at all, frequent drinkers may never be able to catch up in adulthood, since alcohol inhibits systems crucial for storing new information as long-term memories and makes it difficult to immediately remember what was just learned.

Additionally, those who binge once a week or increase their drinking from age 18 to 24 may have problems attaining the goals of young adulthood—marriage, educational attainment, employment, and financial independence. And rather than "outgrowing" alcohol use, young abusers are significantly more likely to have drinking problems as adults.

What can be done to stop this epidemic?

The AMA advocates numerous ways to combat this growing epidemic, including:

- Reducing access to alcohol for children and youth
- Reducing sales and provision of alcohol to children and youth
- Increasing enforcement of underage drinking laws
- Providing more education about the harmful effects of alcohol abuse
- Reducing the demand for alcohol and the normalization of alcohol use by children and youth

A major source of the normalization of alcohol use by children and youth is alcohol advertising. Television networks and cable stations have profited tremendously from the alcohol industry's aggressive marketing to underage drinkers. These ads are proven to heavily influence the normalization and glamorization of drinking in the minds of children, and television has continued to endanger the health of these young viewers in spite of such findings.

With these new findings of the adverse effects of alcohol on the brain of children and adolescents, the AMA calls on cable TV and the TV networks to pledge not to run alcohol ads targeted at underage youth. This means no alcohol ads before 10 p.m., none on shows with 15 percent or more underage viewers and no commercials with cartoons, mascots or other youth-focused images.

What can I do?

Please visit our Web site, www.alcoholpolicysolutions.net, to learn 10 things you can do to combat underage drinking as well as to send an e-mail or a fax to the TV networks and cable TV about your concerns about advertising alcohol to youth.

Sources:

Office of Applied Studies, Substance Abuse and Mental Health Services Administration. "Results from the 1997 National Household Survey on Drug Abuse: Volume I. Summary of National Findings." 1998.

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Worksheet 1

Our Amazing Brain – The World's Most Powerful Computer!

"The brain goes through dynamic change during adolescence (ages 12-21) and alcohol can seriously damage long – and short-term – growth processes." (American Medical Association Fact Sheet, 2003)

Using the words below, fill in the blanks in the following statements:

neurons	**alcohol**	**brain**	**software**	**hippocampus**
waiting	**brain**	**illegal**	**plasticity**	**prefrontal cortex**

1. The brain is made up of billions of nerve cells called _____.

2. 40 % of our neurons are "wired" at birth. The other 60% are _____ to be wired by our learning and experiences.

3. The _____ goes through rapid change and development during ages 12 to 25.

4. Adding new brain wiring is like adding new _____ to a computer—we become more capable and can do more things.

5. The ability of the brain to rewire itself with our new learning is called _____.

6. Drinking _____ during a time of peak plasticity is like shutting off the power when you're trying to load new computer software, and can damage brain development.

7. Two brain areas that can be badly damaged by drinking alcohol during the teen years are the

_____ and the _____ _____.

8. It is _____ to drink alcohol before you are 21 years old.

9. Below are parts of a neuron. Write the number of the correct definition next to each neuron part:

a. _____ Soma	1. the cell body where the neuron stores its electrical energy
b. _____ Dendrites	2. brain chemicals stored in the axon terminals
c._____ Axon	3. branch-like antennae that pick up messages from other neurons
d._____ Axon Terminals	4. root-like tentacles ending in tiny pockets which store chemicals
e._____ Neurotransmitter	5 a cable-like structure that carries electrical signals from the soma to the axon terminals

ANSWERS:
1. neurons
2. waiting
3. brain
4. software
5. plasticity
6. alcohol
7. hippocampus and pre-frontal cortex
8. illegal
9. a- 1 b- 3 c- 5 d- 4 e- 2

Name_____

Worksheet 2

Alcohol Damages Our Brain's Pleasure- Reward System

Fill in the blanks using the words below:

rewards alcohol damages alcohol poisoning
pleasure alcoholic 991 alcohol free neurotransmitters

1. Our brain _____ us with feelings of pleasure when we do positive things that contribute to our survival and well-being of the human race.

2. _____ can range from an intense emotional high to a sense of happy satisfaction for doing something good.

3. Pleasure is generated by brain chemicals called _____ that connect the feeling of pleasure to the thing we enjoyed.

4. _____ pretends to be a neurotransmitter that tricks the brain into generating a pleasure reward feeling from a harmful chemical instead of a real experience.

5. Alcohol also _____ the brain's ability to sense pleasure from real things and experiences.

6. Drinking alcohol before the age of 21 can program your brain to become an _____.

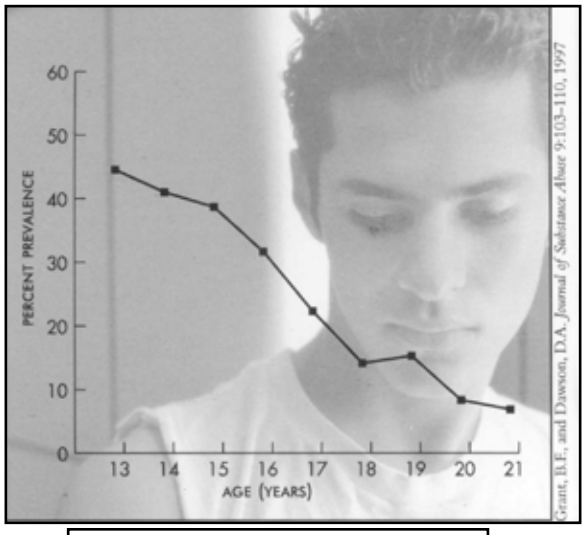
7. The only sure way to avoid becoming an alcoholic is to stay _____ _____.

8. Drinking too much alcohol at once can result in_____ _____.

9. If a friend passes out from drinking alcohol, you should call _____.

10. Looking at the graph to the right, if a person begins drinking alcohol at age 15 they have a _____ _% chance of becoming alcohol dependant as an adult.

    If they begin drinking at age 21 they have only a _____ % chance.



Graph courtesy of NIAAA and MADD

ANSWERS:
1. rewards
2. pleasure
3. neurotransmitters
4. alcohol
5. damages
6. alcoholic
7. alcohol free
8. alcohol poisoning
9. hospital
10. 40% / 7%

ALCOHOL-FREE PLEDGE CARD

I choose to protect my brain and be the best that I can be.
I will stay alcohol free.

Signature_____ **Date**_____

PARENTS EMPOWERED.org *Eliminating Underage Drinking in Utah.*

ALCOHOL-FREE PLEDGE CARD

I choose to protect my brain and be the best that I can be.
I will stay alcohol free.

Signature_____ **Date**_____