

Physical Development and Learning

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Learning Targets

- Students will gain an increased appreciation of natural human physical development.
- Students will be able to identify at least 3 aspects of human physical development & describe 2 or more implications of each for classroom learning &/or teaching.
- Students will gain a deeper understanding of practices that support or are detrimental to human physical development and optimal functioning.

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- As you view these slides, a technique that may enhance your learning is to translate the ideas presented into images on a piece of paper using colored pencils, crayons, markers, etc.

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• You already know many things about human physical development from your own observations and experiences.

• Make a list of 10 of these things & share them with another student.

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Some things you listed:

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Physical Development

- Proceeds in an orderly, universal sequence.
- Occurs in "spurts" (periods of rapid growth) interspersed with "plateaus" (periods of slower growth).

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Physical Development:

- Senses become more refined.
- Sensorimotor integration occurs.
- Brain “wiring” becomes more complex, paralleling an increase in thinking & communication skills.

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As children get older:

- **height & weight increase.**
- **muscle strength and refinement of movements increases, first in gross motor then fine motor skill areas.**

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Adolescence

- Adolescence brings changes in physical features and hormonal activity, enabling adolescents to become parents and introducing a number of potential social, physical, & emotional changes and issues.

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Other issues:

- Some lifestyle practices, e.g. exercise, good nutrition, and sleep and rest contribute to healthful physical development.
- Conversely, consumption of alcohol and drugs, smoking, and high-risk behaviors such as reckless driving and unprotected sex can be detrimental to one's physical development & well-being.

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Review and Discuss

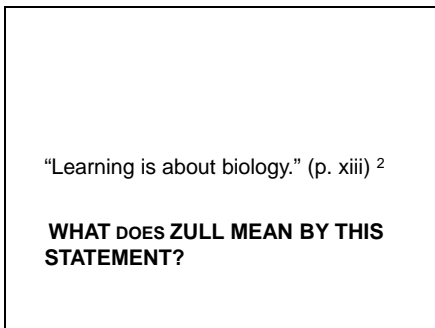
- Describe how physical development occurs through childhood and adolescence.
- During puberty what types of changes occur? What is the impact on learning?

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**WHAT IS THE ROLE OF
PHYSICAL DEVELOPMENT
IN LEARNING?**

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You are a marvel

“... Do you know what you are? You are a marvel. You are unique. In all the years that have passed, there has never been another child like you. Your legs, your arms, your clever fingers, the way you move.

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You may become a Shakespeare, a Michelangelo, a Beethoven. You have the capacity for anything. Yes, you are a marvel. And when you grow up, can you then harm another who is, like you, a marvel?

You must work -- we all must work -- to make the world worthy of its children.”

- Pablo Casals³

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Nature
vs. Nurture
debate

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The “father of behaviorism”, John Watson, stated in 1930:

“Give me a dozen healthy infants, well formed, and my own specified world to bring them up in and I’ll guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist – regardless of his talents, penchants, tendencies, abilities, vocations and race of his ancestors.”

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Watson continued:

- “I am going beyond my facts and I admit it, but so have the advocates of the contrary and they have been doing so for many thousands of years.” (p. 104)⁴

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Review and Discuss

- As a behaviorist Watson focused on observable characteristics. Is his claim possible based on this philosophy? Explain.

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Philosopher John **Locke** believed
that we enter the world as
a blank slate
(tabula rasa)
with a few mental
capabilities

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??? What do YOU think ?
??? Is intelligence fixed at
birth?
??? Do you have a "fixed"
or "growth" mindset ?⁵

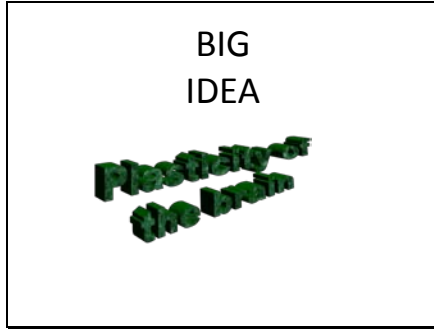
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Review and Discuss

- How does the type of mindset that students have affect development?

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In the beginning...

- During the 1st 18 weeks of life, *neurogenesis* (production of neurons, i.e. nerve cells) occurs at an average rate > 500,000/minute.
- Using glial cells to guide them, these neurons migrate to their genetically preordained place in the brain.⁹

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The result is a human brain  containing 100 billion neurons and 1 trillion glia, cells that support the neurons.¹⁰

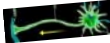
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Subsequently...
other processes,
which continue
after birth, occur:

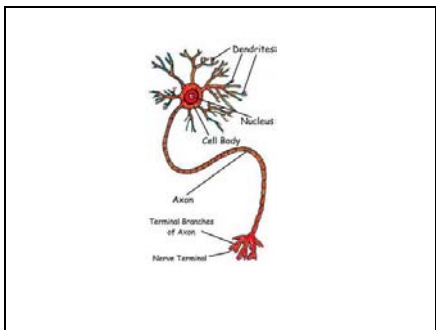
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1) Dendrites branch and form spines
in response to sensory
stimulation and experience.



Diamond & Hopson (1998)
call these structures "Magic
trees of the mind".¹⁰

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
**NOT Nature OR Nurture,
Nature AND Nurture:**

Initial brain development unfolds via genetic instructions. (Nature)

Most dendrite growth (up to about 83%) happens AFTER a baby is born. (Nurture)⁹

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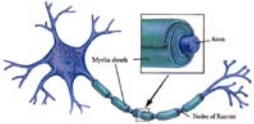
- **2) Synaptogenesis, the formation of junctions between neurons, enables communication among them.^{9,11}**



- **In the human brain, 1,000 trillion junctions are created!¹⁰**

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3) Myelination, the coating of an axon with a fatty sheath, speeds the transmission of messages from one neuron to another.



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Pruning

In order to fit the individual's neural circuitry to the demands of his or her particular environment, little-used synapses (not much electrical & chemical activity) are eliminated.

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Through the
INTERACTION of NATURE and NUTURE,
therefore, a structure (the human brain) is created that can direct thousands of activities at the same time, including:

- perceiving, interpreting, & reacting to sensory stimulation
- solving problems
- initiating thoughts
- generating feelings
- overseeing numerous processes and chemical interactions⁹

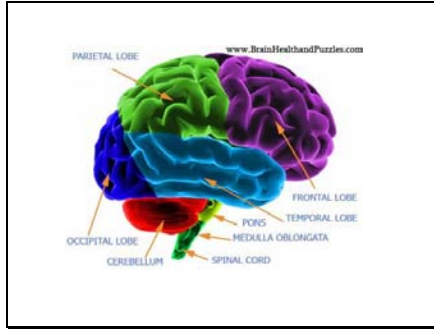
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Review and Discuss

- Why are dendrites described as magic trees of the mind?
- How do nature and nurture affect neurons?
What is the impact on physical development?

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As we learn more about the brain through the use of increasingly sophisticated technologies, we are finding support for various theories that have been proposed regarding learning.

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Edward Lee Thorndike

- For example, Thorndike's Law of Effect- "an act that is followed by a favorable effect is more likely to be repeated in similar situations"¹² (and vice versa) - is congruent with the reinforcing effect of the "pleasure pathway" in the brain.

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Albert Bandura

- Likewise, the discovery of the brain's mirror neurons¹³ -- which appear to play a role in empathy and help humans learn via imitation¹⁴ -- supports the work of Albert Bandura regarding modeling.

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Jean Piaget

- **Developmental stages of cognitive and moral development are consistent with development of the central nervous system.**
Example: the prefrontal cortex (problem-solving, decision-making, judgment) continues to develop into early adulthood.

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Lev Vygotsky

- **Zone of Proximal Development (ZPD):**
With help from adults or more capable peers, children can "grow their brains" through experience and accomplish more than they could do on their own.

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Review and Discuss

- How does the development of the brain affect cognition or thought processes?

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What are key physical factors involved in learning?

- Integration of primitive reflexes
- Movement and exercise
- Integrity of senses & neurological system
- Nutrition including adequate hydration
- Sufficient sleep and rest
- Oxygen, fresh air, and natural light
- Stress level

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Primitive Reflexes

- "...are automatic, stereotyped movements, directed from the brain stem and executed without cortical involvement."
- "...designed to insure immediate response to this [the infant's] new environment and to his changing needs."

-Goddard (2005, p. 1)¹⁵

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Primitive Reflexes

Designed to become inactive and integrated into the child's physiological system according to a natural developmental sequence. Example: Rooting Reflex, Spinal Galant, ATNR

Failure to integrate at the proper time can interfere with the appearance of other reflexes and negatively impact ability to function and learn.

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NDD

- The "omission or arrest of a stage of early development" is known as NDD (Neuro-Developmental Delay).¹⁶

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Some consequences of NDD¹⁵

Problems with:

- eye-hand coordination, cursive writing, reading, telling time by using the hands of a clock, speech/articulation, sitting still
- ignoring non-relevant auditory & visual stimuli
- performance in physical activities
- sense of time & balance
- inconsistency between oral and written work

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Movement...

...is important developmentally as the body's motor and sensory apparatus become integrated and the child learns to crawl, walk, run, etc.

...also serves a number of important functions throughout life, such as toning the muscles and increasing oxygen intake.

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Supervised 'tummy time' when babies are awake is essential¹⁷

- to develop core muscles (chest, back, neck, and abdomen) needed not only for locomotion but also sensory integration (e.g. hand-eye coordination), regulation of breathing, and future speech development. [Newsweek]
- Keeping babies in car seats and other apparatus restricts movement, and therefore, natural development.
- See Tummy Time Tools at http://www.moveforwardpt.com/consumer_tips/ for activities.

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According to Dennison & Dennison, who developed Edu-K (Educational Kinesiology), "Movement is the door to learning."¹⁸

Although more research is needed, there is some evidence to suggest that the use of their Brain Gym exercises may have an integrative effect on a person's nervous system and ability to function effectively. *

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Review and Discuss

- What else have you learned about the importance of movement?
- How might movement be incorporated into various aspects of the school day?
- What are potential results on learning when primitive reflexes fail to disappear?
- Explain the importance of tummy time during infancy.

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Sensory development & Integration

- We take in information from the environment through our senses, which include visual, auditory, vestibular, proprioception, taste, and touch.
- Development and integration of these senses with each other and the CNS (central nervous system) are key tasks of childhood.

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Vision

- Continues to develop for several years after birth
- Is shaped by our experiences with our environment
- Mostly occurs in the brain, which interprets visual inputs – about 50% of the cerebral cortex (more than 24 areas) as well as parts of “lower” brain regions are involved with the process of vision.^{9, 19}

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Ability to see clearly (visual acuity), which is typically checked in school screenings, is just one aspect of vision. Other important aspects include:

- **ability to focus at varying distances (accommodation)**
- **ability of the eyes to work together in a coordinated way (teaming)**
- **tracking (pursuit)-ability to follow a moving target or in the case of reading, to smoothly follow a line of print**

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According to The American Public Health Association, "25% of students in grades K-6 have visual problems that are serious enough to impede learning." ²⁰

The Vision Council of America states: "It is estimated that 80% of children with a learning disability have an undiagnosed vision problem." ²⁰

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Signs of visual problems that interfere with learning:

*While reading or copying- a) skips lines or words b) loses place or c) substitutes words	*Holds head too close when reading or writing (within 7-8 inches)
*Rereads words or lines	*Squints, closes, or covers one eye while reading
*Reverses letters, numbers or words	*Unusual posture/head tilt when reading/writing
*Uses a finger or marker to keep place while reading/writing	*Red or watery eyes
*Reads very slowly	*Headaches following intense reading/computer work
*Poor reading comprehension	*After completing a visual task- a) eyes hurt or feel tired b) person is unusually tired
*Poor spelling skills	*Double vision
*Difficulty remembering what has been read	*Unusual blinking or eye rubbing
*Eye turns in or out	*Avoids near tasks such as reading
*Dislikes tasks requiring sustained concentration	*Carsickness

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Additional signs

*Vision blurs at distance when student looks up from near work	*Unusual clumsiness, poor coordination
*When reading	*Confuses left & right directions
a) letters or lines 'run together' or words 'jump'	*Difficulty with sports involving good eye-hand coordination
b) print seems to move or go in and out of focus	*Sees more clearly with one eye than the other
*Writing is crooked or poorly spaced	*Becomes restless when working at his/her desk
*Misaligns letters or numbers	*Tends to lose awareness of surroundings when concentrating
*Makes errors copying from the board	*Must 'feel' things to see them
*Feels sleepy while reading	*Exaggerated head movements while reading
*Difficulty tracking moving objects	*Homework takes longer than it should.
*Eyes bothered by light	

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<http://fpdc.kent.edu/justice/MOV00442.MPG>

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Recommendations for supporting the visual system

- Encourage far point visual activities such as outdoor play.
- Alternate close up activities, e.g. computer work and reading with those requiring far point vision; take short, frequent breaks when using a computer.
- Limit the time spent in "screen time" activities such as TV and video games.
- Teach stress reduction techniques in order to prevent tension which has a detrimental effect on eyesight.

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Sound & Audition

"Virtually everything on earth vibrates...everything has a sound, a vibration all its own." (Leeds, 2001, p. 120)²¹

Humans typically can hear vibrations with a frequency between 20 and 20,000 Hz.²²

According to Tomatis, sound, especially at higher frequencies, functions as a nutrient for the brain & promotes cognitive development.^{23,22}

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Sound can also have detrimental effects-

- **According to Healy, TV speech may affect children's language development because they need to hear slower pronunciation of words.²³**
- **Environmental noise can create stress,²⁴ affect student achievement^{25, 26}, and at higher levels, cause hearing loss²¹. EPA maximum recommended levels= 45 db. (day) & 35 db. (night)²⁶**

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Very low frequencies, such as those generated by air conditioners, vehicles, and other machines, can be harmful to the body and may cause physical symptoms such as headaches.¹⁹

Could an explanation be the phenomenon of "sympathetic vibration", in which one substance (which may include living tissue) resonates to the frequency from another source? In medicine, for example, the power of resonance is employed in the use of sound to dissolve kidney stones. ²¹

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How might you use your knowledge about sound productively in the classroom?

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Review and Discuss

- What are educational implications for visual problems? How can you as a teacher accommodate these issues?
- What are educational implications for auditory problems? How can you as a teacher accommodate these issues?

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What we eat and drink, of course, is a key to good health and ability to function. Discuss some things you would recommend to your students. Here are some guidelines:

- Be sure you are relaxed and aware of your food when eating; take your time. Breathe in more oxygen to digest and assimilate your food.
- Choose quality foods, including fresh fruits & vegetables, whole grains, high-quality meats & other proteins, quality fats such as olive, sesame, & coconut oil.
- Avoid poor quality foods, including hydrogenated oils & refined carbohydrates, e.g. corn syrup, white flour, white sugar, & artificial sweeteners.²⁷

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Refined carbohydrate intake on a regular basis

Can lead to a functional hypoglycemic cycle in which the bloodstream is flooded with glucose, followed by a drastic decrease in blood glucose, resulting in irritability and difficulty with concentration and clear thinking as well as a desire for more food.²⁸

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Allergies...

... can also result in irritability and reduced ability to function well, including academic performance.

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WATER

As a fetus, you were 99% water. Now your body is about 70-75% water, with water composing an even greater percentage of your brain.²⁹

Adequate water intake is essential for health and ability to function. Coffee, tea, caffeinated soft drinks, and alcohol take water OUT of the body.²⁹

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Why is water so essential to life and learning?

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'Water, the solvent of the body, regulates all functions, including the activity of the solutes it dissolves and circulates'.

-(Batmanghelidj, 1997, p.19)²⁹

Besides dissolving and transporting various substances in the body, water:

- plays a role in chemical reactions & aids digestion.
- generates energy.
- supports the weight of the upper body^{29,30}

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Water also:

- is important in maintaining the architecture & polarity (electric potential) of cells.
- plays a role in message transmission in the brain.
- contributes to efficiency of protein and enzyme functions, promoting development of nerve nets and growth of dendrites.^{29,30}

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In addition, water in the body:

- provides moisture on the surface of the lungs' air sacs needed for oxygen transmission into the bloodstream
- plays a role in hemoglobin's ability to transport oxygen, which is considered "the most fundamental and necessary metabolic nutrient for the body." (David, 2005, p. 42)²⁷

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Dehydration:

May contribute to

- headaches,
- stomach pain,
- allergies,
- asthma, and
- stress.²⁸

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Review and Discuss

- As a teacher, how can you apply your knowledge about water to promote learning and development in your classroom and school?

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Sleep

Discuss:

- Why is sleep important?
- How much sleep do people need?
- What happens when you don't get enough sleep-
 - How do you feel?
 - What effect does inadequate sleep have on your ability to function?

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SLEEP...

- is necessary for processes of growth and repair.

Rapid Eye Movement (REM) sleep...

- may be important in brain development as well as memory formation/consolidation.^{11,31}

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What is stress and how does it impact learning?

"The way we choose to perceive and process our experiences determines whether we handle them calmly or allow them to trigger the stress response...We can choose to see any situation as a learning opportunity or as a threat. It truly is our choice and our children will follow our lead."
- Hannaford (2005, p. 186)²⁰

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Stress Reactions: Fight or Flight

- Mobilizes body resources in response to the PERCEPTION of a threat
- Natural defense mechanism, but chronic elicitation of Fight or Flight response has detrimental effects on the body

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Discuss with a partner:

- What do you find stressful?
- What are some things that may create stress for your students?

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Stress & Learning³⁰

- Eyes look peripherally
- Activation of Tendon Guard Reflex
- Decrease in dopamine levels
- Decrease in receptiveness of thalamus to incoming sensory information
- May cause tension in neck and shoulders, reducing blood flow to the eyes, resulting in a decrease in visual functioning.

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Stress and Learning³⁰

- Decrease in blood flow to digestive system and cerebral cortex of brain, especially non-dominant hemisphere and frontal lobes
- Brain "downshifts" into survival mode
- Incoherent heart frequencies and brain wave patterns in frontal lobe

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Review and Discuss

- What are the implications, for classroom learning and teaching, of the effects of stress?

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Reducing stress

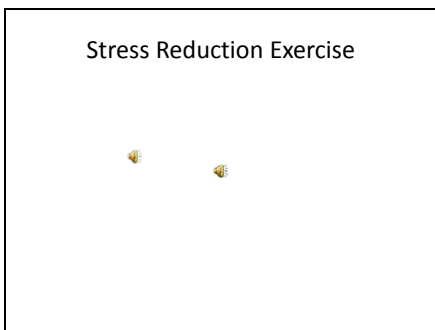
- Sixty-beat/minute music
- Slow, rhythmic breathing
- Visualization exercises
- Self-talk 🗣️
- Positive mental attitude, affirmation
- Environmental changes

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- When practicing stress reduction, be sure you are in a safe environment.
- Avoid activities that require your attention, such as driving a car.
- Allow yourself time after relaxing to become fully alert before doing things that require attention.

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- ### Adolescent Issues
- Hormonal changes
 - Physical awkwardness
 - Sexuality
 - Drugs & alcohol...

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- ⁴Watson, J.B. (1930). *Behaviorism, revised ed.* Chicago: University of Chicago Press. Retrieved January 16, 2010, from <http://education.stateuniversity.com/pages/2543/Watson-John-B-1878-1958.html>
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- ⁷Zull, J.E. (2004). The art of changing the brain. *Educational Leadership*, 62(1), 68-72.
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- ¹⁰Diamond, M. & Hopson, J. (1999). *Magic trees of the mind: How to nurture your child's intelligence, creativity, and healthy emotions from birth through adolescence.* New York: Penguin Group.
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¹³ Gallese, V., Fadiga, L., Fogassi, L., & Rizzolatti, G. (1996). Action recognition in the premotor cortex. *Brain, 119*. 593-609.

¹⁴ Dobbs, D. (2006). A revealing reflection. *Scientific American Mind, Apr/My, 22-27*.

¹⁵ Goddard, S. (2005). *Reflexes, learning and behavior: A window into the child's mind*. Eugene, OR: Fern Ridge Press.

¹⁶ The Institute for Neuro-Physiological Psychology, http://www.inpp.org.uk/idd_neuro_developmental_delay/index.php

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¹⁷ N.A. Remember to flip your baby (over) [Tip Sheet- Milestones]. *Newsweek*, August 18/25, 2008, 64.

¹⁸ Arrendell, A. & Irvin, B.B. (2005). *Brain gym for educators*. [course manual]

¹⁹ Bear, M.F., Connors, B.W., & Paradiso, M.A. (1996). *Neuroscience: Exploring the brain*. Baltimore: Williams & Wilkins.

²⁰ College of Optometrists in Vision Development. www.visionforlearning.org

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²¹ Leeds, J. (2001). *The power of sound: How to manage your personal soundscape for a vital, productive, & healthy life*. Rochester, VT: Healing Arts Press.

²² Thompson, B.M., & Andrews, S.R. (2000). An historical commentary on the physiological effects of music: Tomatis, Mozart, and neuropsychology. *Integrative Physiological & Behavioral Science, 35*, 174-189.

²³ Hannaford, C. (1995). *Smart moves: Why learning is not all in your head*. Arlington, VA: Great Ocean Publishers.

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- ²⁴ Khalsa, D.S., & Stauth, C. (1997). *Brain longevity: The breakthrough medical program that improves your mind and memory*. New York: Warner books.
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- ²⁶ Jensen, E. (2003). *Environments for learning*.
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- ²⁸ Reed, B. (1982). *Nutritional guidelines for correcting behavior*. Manitowoc, WI: Natural Press.
- ²⁹ Batmanghelidj, F. (1997). *Your body's many cries for water*. Falls Church, VA: Global Health Solutions.
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THE END