PERENNIAL PROBLEM:

What to do about Nurturing Human Development

CONTINUING PARENTING CONCERN:

Understanding Development

RELATED CONCERN:

Nurturing Brain Development

DESIRED RESULTS FOR STUDENTS:

Students will understand the relationship between healthy brain development and a nurturing environment.

LEARNER OUTCOMES: Students will:

1. Explore the context of early brain development.
2. Examine approaches for assisting parents and caregivers to help each child develop his or her full potential.
3. Analyze the consequences of environmental influences on brain development.

SUPPORTING CONCEPTS:

A. Brain Anatomy

B. Influences on Brain Development
    1. Environmental
    2. Setting the Stage for Learning

BACKGROUND INFORMATION:

"There has been more learned about the brain since 1995 than in the past 100 years" (OCEB, 2003). With the help of new imaging technologies, scientists can penetrate the brain's tough protective shell to see the living brain inside. Advances in molecular biology enable scientists to manipulate genes within living cells and map the creation of neurons. The new brain science is continually evolving and changing. The more we understand brain development the more we can use it to improve the parenting and teaching of young children.

Birth is simply a stage in the baby's development. A baby's brain starts forming soon after conception with a few cells at the tip of the embryo. By the seventh month of gestation there are 100 billion cerebral nerve cells organized into more than 40 systems to direct language, movement, seeing, and hearing. Heredity may determine the basic number of "neurons" (brain nerve cells) children are born with, and their initial arrangement, but this is just a framework. A child's environment has enormous impact on how these cells get connected or "wired" to each other. The brain begins working long before it is finished. And the same processes that wire the brain before birth also drive the very rapid growth of learning that occurs immediately after birth. At birth, a baby's brain contains 100 billion neurons, roughly as many nerve cells as there are stars in the Milky Way. Before birth, the brain produces trillions more neurons and "synapses" (connections between brain cells) than needed. The synapses are formed as a result of stimulation from the brain's environment. Neurons continue to form synapses with other neurons

throughout childhood. Whenever a sense is stimulated, the information is processed in the brain and a connection is made, forming the structure for learning. Repetition is essential to strengthen the synaptic connections. During the first years of life, the brain undergoes a series of extraordinary changes. Then, through a process that resembles Darwinian competition, the brain eliminates connections that are seldom or never used. By age one 1000 trillion synaptic connections have been formed. Those connections that continue to be stimulated tend to remain and the connections that are not used will be eliminated. The brain operates on a "use it or lose it" principle. Those connections that are not used (or not needed) will be pruned away, much like a tree is pruned of excess branches. Pruning is beneficial for both the brain and the tree, creating a stronger, more efficient structure.

The timetable for brain development thus varies by region, and it continues throughout life. Sensory regions, which govern sight, touch, hearing, and other sensations, undergo their most rapid growth early in life, while the brain areas guiding higher forms of thinking and reasoning experience blooming and pruning of brain connections into early adolescence. The recent discovery that the mature adult generates new neurons raises the possibility that brain development continues into maturity in yet unknown ways.

Brain Anatomy: The brain is part of the central nervous system, and plays a decisive role in controlling many bodily functions, including both voluntary activities (such as walking or speaking) and involuntary ones (such as breathing or blinking).

The brain is divided into different sections, each controlling specific functions in the body. The sections are described below, from the most simple to the most complex:

- **Brainstem**: responsible for survival, heartbeat, breathing and "fight or flight" reactions
- **Cerebellum**: responsible for muscle contractions, automatic movements, balance
- **Limbic System**: regulates emotions and long-term memories; can override rational thought and brainstem response patterns
- **Cerebral Cortex:** the outer thin layer of the **cerebrum,** responsible for thinking and more complex learning and is divided into several lobes:
    - **Occipital lobe –** processes vision
    - **Temporal lobes –** processes hearing, speech, and language
    - **Parietal lobe –** processes sensory stimuli
    - **Frontal lobe –** responsible for critical thinking and problem solving
    - **Prefrontal lobe –** allows us to plan and rehearse future actions
    - **Corpus callosum –** connects the right and left hemispheres

Environmental Influences: Early stimulation sets the stage for how children will learn and interact with others throughout life. A child's experiences, good or bad, influence the wiring of his brain and the connection in his nervous system. Loving interactions with caring adults strongly stimulate a child's brain, causing synapses to grow and existing connections to get stronger. Connections that are used become permanent. If a child receives little stimulation early on, the synapses will not develop, and the brain will make fewer connections.

During the early years, the brain is referred to as "plastic" and has an amazing ability to adapt and reshape according to environment. "Windows of opportunity" are critical periods in children's lives when specific types of learning take place. For instance, scientists have determined that the neurons for vision begin sending messages back and forth rapidly at 2 to 4 months of age, peaking in intensity at 8 months. It is no coincidence that babies begin to take notice of the world during this period. Scientists believe that language is acquired most easily during the first ten years of life. During these years, the circuits in children's brains become wired for how their own language sounds. An infant's repeated exposure to words clearly helps her brain guild the neural connections that will enable her to learn more words later on. For infants,

individual attention and responsive, sensitive caregiving are critical for later language and intellectual development. During these sensitive periods, learning comes more easily and naturally, though it can still occur at later times.

The rapid pace and broad scope of early brain growth means that the immature brain is a vulnerable organ. Beginning at conception and continuing after birth, healthy brain development is imperiled by exposure to hazardous drugs, such as alcohol, cocaine, and heroin; viruses, like HIV and rubella; and environmental toxins, like lead and mercury. The brain is also vulnerable prenatally and postnatally to poor diets that lack essential nutrients, such as iron and folic acid. Chronic maternal stress during pregnancy and after birth can also threaten healthy brain development because of stress hormones that have a toxic effect on developing brain structures. Recent research on one of the body's "stress-sensitive" systems shows how stressful experiences shape the developing brain. When children are faced with physical or emotional stress or trauma, one of these systems "turns on" by releasing the hormone cortisol. High levels of cortisol can cause brain cells to die and reduce the connections between the cells in certain areas of the brain. Babies with strong, positive emotional bonds to their caregivers show consistently lower levels of cortisol in their brains. While positive experiences can help brighten a child's future, negative experiences can do the opposite. Too much cortisol in the brain can make it hard for children to learn and to think. And they may have trouble acting appropriately in stressful situations. The greatest dangers to the developing brain arise from the combined and cumulative effects of these hazards, such as when children in poverty are malnourished, exposed to hazardous drugs or environmental toxins, or experience head injuries. Enduring harm also arises when early problems are undetected and are allowed to endure uncorrected.

Healthy relationships during the early years help children have healthy relationships throughout life. Deprived of a positive, stimulating environment, a child's brain suffers. Rich experiences, in other words, really do produce rich brains. The irreducible core of the environment during early development is people. Relationships matter. They provide the nurturance that strengthens children's security and well-being, offer the cognitive challenges to exercise young minds, impart many essential catalysts to healthy brain growth, and help young children discover who they are and what they can do. Remarkably, most of the significant ways that caregivers promote healthy development occur quite naturally during the course of sensitive adult-child interaction. For instance, the "parentese" that facilitates early language, the caregiving routines that promote predictability and memory skills, the patient structuring of an activity to make it manageable for a child, and the protective nurturance that manages a baby's emotions show that when sensitive adults do what comes naturally, their behavior is optimally suited to promoting early cognitive, socioemotional, and neurobiological growth. In a sense, just as children's developing brains intrinsically expect that eyes will see light and ears will hear sound because of their development self-organization, so also do children's developing minds and hearts expect adults will talk in special ways to them and that caregivers will nurture them as they mature. Normal human development draws upon natural and unrehearsed features of everyday early experience far more than it requires special educational toys, Mozart CDs, or flashcards.

Appropriate nutrition between the fifth-month of development through two years of age is especially important to healthy brain development. There appears to be a link between breastfeeding and healthy brain development due to the fatty acids, which contribute to the development of myelin that insulates brain cells. Pediatricians recommend that babies be breastfed for a least the first year. Some research studies have shown that breastfeeding can:

- Help build immunity against illness
- Lead to higher IQ scores
- Decrease the chance for allergies

(*Decrease The Risk of SIDS and Leukemia*. Publication by the Department of Human Services; Oregon Health Division)

Setting the stage for learning: *Oregon's Child: Everyone's Business* is a statewide collaboration of public and private partners working to increase awareness about the importance of healthy brain development during the early years of life. In a pamphlet titled "*Babies are born learning: what they learn is up to you,"* ten simple things are described that a child would want parents and caregivers to do to boost his/her brain power:

- ***Warm, Responsive Care:*** Talk with me, hug me, attend to my needs. Smile at me and make me feel secure. Routines and rituals are important for my development.
- ***Loving Touch:*** Cuddle me, cradle me, and hold me close. Let me know that I am loved. Hugs help me learn to trust and handle stress, now and when I am grown.
- ***Talk:*** My brain is making connections from what I hear you say. So, while we're together --- at home, in the store, in the car – tell me what you are doing and seeing. Your words help me learn.
- ***Safe, Healthy Environment:*** Make sure I eat a variety of good foods, have regular checkups, and that my immunizations are current. Provide a safe environment for me to explore. During my first year, put me to sleep on my back.
- ***Play:*** Play is how I discover the world. Lots of interaction and exploration help my brain form connections that make learning easier. Limit my TV time; watch with me and talk with me to help me understand what I'm seeing.
- ***Music***: Sing lullabies and simple rhymes with me. Play music for me. Music forms pathways in my brain that can help me understand math and improve my thinking skills.
- ***Read****:* Read books with lots of pictures to me. Don't worry if I want the same book read over and over again. Repetition is how I learn. Read to me often and I will learn to love reading forever.
- ***Quality Child Care***: Make sure my caregiver loves me and responds to me. Check to see that my surroundings are safe, bright, and happy. Be sure my caregiver is well-trained and understands my developmental needs.
- ***Teach Limits with Love***: I learn by seeing and doing but need limits to make me feel safe and secure. Give me limits that teach – and expect me to test them.
- ***Take Care of Yourself****:* When you feel tired or upset, it's harder for you to meet my needs. Reach out to friends and family for support, but never hurt or shake me.

DIRECTED ACTIVITIES:

Teacher Preparation:

1. You may want to contact your local Commission on Children and Families Office to obtain a copy of the presentation package, *Early Brain Development Research and Implications.* The notebook contains background information and transparences to use during this unit. If they do not have the resource they may be able to contact the State Office of the Commission for a copy. You may also want to go online to www.oceb.org for additional information and the possibility of a speaker in your local area.

2. For current information and resources use www.pbs.org/brain.

Supporting Concept A: Brain Anatomy

1. **"Student Neurons":** Neurons don't actually touch. There is a tiny space between them, known as the synaptic gap. Electrical signals travel down the axon of one neuron where the signal crosses the gap, facilitated by neurotransmitters, to the dendrite of another neuron.

   To create an understanding of how brain growth works and improves with use, ask everyone in the class to stand and becomes a neuron. Two volunteers start two separate pathways by connecting their axon (arm) with a dendrite (arm) of someone close by. When the sender connects with a receiver they call 'ZAP' to indicate the neuron has 'fired." Participants keep sending the message toward the back of the room. Everyone who has been 'fired' is to put and keep their arms up. There will be two pathways.

   - Point out that the hesitation and confusion is what happens in the brain when a new response is called for and the brain is creating a new pathway. Repeat two more times. Point out how the message route has become faster and more efficient – the pathway is becoming "hard-wired" into the system. Ask people who were not part of a pathway to sit down – they have been pruned! (OCEB Early Brain Development: Research and Implications Curriculum Guide)

   - A similar activity would be to toss a ball of yarn around the room from student to student (the first person with the ball holds on to the end of the yarn), creating a pathway similar to the way information travels through the brain.

2. **"Brain Quiz":** The brain quiz can be used to introduce some of the basic concepts concerning early brain research. Reproduce the "Brain Quiz" (SM-1) for each student in the class. Allow students time to either complete the True/False quiz independently or with a partner, then, using the teacher's information provided below, present the research findings and provide time for discussion of each item. (Source: *zerotothree.org)* If you were able to obtain a copy of the presentation package on *Early Brain Development* from your local Office of The Commission on Children and Families you might want to select appropriate transparencies to use with this discussion.

   1. *Basic brain connections are laid down before birth.* **True**
      - During pregnancy, the basic architecture of the brain is formed. The different parts of the brain are in place (e.g., brain stem, thalamus, and cerebellum). This initial development also provides basic brain functions that help the baby live.
      - Although this "hardware" is laid out during pregnancy, the brain is still immature in that the "software," or the connections between different parts of the brain, are not yet formed.
      - To a certain extent, formation of the connections depends on exposure to our environment—through relationships and experiences.
      - Unlike the other organs of the newborn, such as the heart which is already functioning as it will throughout the child's life, the brain is not yet ready to perform all the amazing functions it will eventually be able to do. It goes through a series of developmental stages. It is following birth that experience begins to have a greater effect on brain development than it did during pregnancy (however, certain experiences do influence the developing brain during pregnancy, such as maternal health and stress, intake of drugs and/or alcohol, and quality of maternal nutrition).

   2. *Babies are born with the ability to learn all languages in the world.* **True**
      - The infant brain is "wired" to seek out and learn language.
      - Amazingly, infants are born with the capacity not just to learn language, but to learn all languages. As researcher Patricia Kuhl from the University of

Washington puts it, infants are "citizens of the world." They are able to perceive the different sounds and patterns of speech of all languages in the world. For example, at birth, Japanese babies can hear the distinction between "r" and "l," although only the "r" sound exists in Japanese. They can still hear the distinction at 6 months of age, but cannot by 12 months of age.

- Even in the womb, the infant is turning towards the melody of its mother's voice. The brain is setting up the circuitry needed to understand and reproduce language.
- Babies learn to talk by hearing language and having language directed at them in "conversation."
- Between 6 and 12 months, babies begin to fine-tune their ability to perceive the speech sounds of their native language as opposed to non-native language.

3. A human baby's brain has the greatest density of brain cells connections (synapses) by age 3. **True**

- Researchers who have studied the brain of both monkeys and humans have shown that there is a pattern of rapid synapse formation during early development.
- However, this density does not remain throughout life. After these connections are formed, there is a "plateau period" and then a period of pruning, or elimination, where the densities decrease and resemble adult levels.
- In humans this period of elimination begins around early adolescence and continues until at least age 16.
- Different parts of the brain undergo synapse formation, plateau, and elimination at different points in development, depending upon when they mature.

4. Because the brain is making so many connections pre-birth to age 3, the first three years of life are the most critical for brain development. After age 3, the "window of opportunity" closes. **False**

- You're sitting here learning something right now, aren't you?!!
- Although brain connector density is at its highest level in the first three years of life, that doesn't mean that the brain has its greatest brain power at that time. A great deal of learning goes on after the first three years of life.
- However, the first three years are important for laying the groundwork for healthy psychological development. We know that from psychological research, particularly research on parent-child attachment, but not from brain development research. What we know from brain development research right now is that for very specific aspects of brain development, such as the visual system, that critical periods exist and thus a window of opportunity.
- The brain continues to grow and mature well into adolescence; thus, it is virtually impossible to make the general claim that the window of opportunity closes at age three.
- The brain is adaptable and flexible, although the ability to adapt changes with age and situation. In reality, there are many windows of opportunity throughout development. Knowing that the brain is more flexible than previously thought doesn't mean that it's easy to change the brain. It's an incredibly difficult challenge. Much more research is needed before we can make claims or suggestions about how to do that.

5. *Good nutrition is one of the best ways we know to aid healthy brain development.*
   True
   - It is important that families provide an environment that supports health in both lifestyle and nutrition.
   - Good nutrition is important for both the pregnant mother and the infant. Pregnant mothers need appropriate amounts of folic acid and iron, and should avoid nicotine, alcohol, and illicit drugs through their entire pregnancy.
   - The developing brain craves iron. Babies need an appropriate amount of iron either via breast milk or formula in the first six months of life and via iron-fortified infant cereals and iron supplementation after that, whether or not their mothers are iron-deficient. Iron deficiency has been clearly linked to cognitive deficits in young children. Iron is critical for maintaining an adequate number of oxygen-carrying red blood cells, which in turn are necessary to fuel brain growth. Bottle fed babies should receive formula that contains iron.
   - Breast milk contains all the amino and fatty acids needed for brain development. Some research has shown that babies who are breast-fed as compared to babies who are formula-fed have scores that are significantly higher on IQ tests.
   - Children who are malnourished---not just fussy eaters but truly deprived of adequate calories and protein in their diet---between mid-gestation and two years of age do not adequately grow, either physically or mentally. Their brains are smaller than normal and they suffer often lasting behavioral and cognitive deficits, including slower language and fine motor development, lower IQ, and poorer school performance.

6. *Reading to a newborn infant is the best way to help a child learn to read in the future.* **False**
   - It is important to recognize that what is most important is providing a language-rich environment for children. Reading is one way, but there are many other ways as well, such as talking, singing, listening to music.
   - There are a number of studies that show that when children hear a good deal of "live" language, when they are spoken to often and encouraged to communicate, they are more proficient with language than children who have more limited language exposure. For example, Janellan Huttenlocher, University of Chicago, found that at 20months of age children of "chatty" moms averaged 131 more words than kids of "non-chatty" moms and by age two the gap had increased to a difference of 295 words. Only live language, not television, produced these vocabulary-boosting effects (Begley, 1997).
   - Risley & Hart, in their 1995 book *Meaningful Differences in the Everyday Lives of American Children*, compared the early language environments of children from 7 to 9 months until 3 years, and then correlated language exposure to achievement test scores in 3rd grade. Children who heard the greatest amount of language when they were young had the highest achievement test scores, while children who heard the least amount of language had the lowest achievement scores.

7. *Living in an orphanage as a baby will likely result in negative, long-lasting effects on the brain.* **False**
   - Non-responsive, inconsistent care can set children up for cognitive, social, emotional, and physical problems.
   - This is a complicated issue; intervention can make a difference.

- Studies of children reared in orphanages in the first few years of life suggest that children's developmental outcomes are better when children are adopted by the time they are 6 months of age (Nelson, 2000c).
- However, there are numerous instances of children who were adopted after the first year of life who experience catch-up growth and developmental improvements.
- Scientists believe that harmful behaviors or neglect in early life can affect the brain, leading to lifelong problems. A healthy and caring environment, however, can create opportunities for the child to develop to his or her full potential.
- High quality caregiving experiences, particularly for young children who experience abuse or neglect, can support the healthy development of the stress system.

8. *There are times when a negative experience or the absence of appropriate stimulation is more likely to have serious and sustained effects on the child.* **True**
    - Early exposure to nicotine, alcohol and/or drugs can have devastating effects on the developing brain, particularly during the time during pregnancy when the brain is being formed.
    - Critical periods in brain development do exist, although we have a long way to go to understand them. We know that the absence of a reasonable amount of light in the first weeks after birth alters the development of the visual system (e.g., development of binocularity is not possible), and that the complete absence of hearing language or receipt of extremely poor care (such as in an orphanage) will likely result in developmental deficits, but we still have much to learn about the persistence of these effects and the ability of the brain to overcome them.
    - In general, although some critical periods do exist, the concept of sensitive periods better explains early development. Sensitive periods are times in development when certain kinds of experiences are essential for healthy development, when the absence of some kind of stimulus results in development going awry, or off-course. Compared to critical periods, sensitive periods are generally longer and suggest that there is more flexibility in the timing of input or experience to the brain and the brain's ability to learn and develop over time.

9. *The large majority of what we've learned about the brain comes from research conducted on animals rather than on humans.* **True**
    - The bulk of cognitive neuroscience research has been conducted on animals, such as rats and monkeys. These animal models provide us with hypotheses about how things might work in the human brain, but they are not perfect analogs. So, what we learn about animals may be meaningful but still needs to be documented on humans.
    - This also means that we need to be careful about the extent to which the claims about brain research can be legitimately made about human brain development.
    - Currently, a great deal of knowledge is being generated about both animal and human brain function. The core, basic knowledge on how brains develop and function is being compiled. However, as the picture is not yet complete, it is difficult at this time to use correct research to inform prevention or intervention in relation to problems in the brain.

10. *Brain research has been misunderstood and misapplied to many contexts.* **True**

- Many are concerned about the potential misuse of the brain research to marginalize oppressed populations, particularly children of color or children living in poverty. For example, the size of the brain and how the brain works has been used to rationalize oppression in the past.
- Recommendations for certain kinds of parenting practices have been offered with the notion that they are based on brain development research, when in fact, they are based in psychological and educational research. They may be fine recommendations, but they aren't based on knowledge from early brain development.
- It is important that accurate information be communicated to parents and child care providers, in making public policy, in prevention and intervention; and in providing opportunity for all children including ethnic minorities or children living in poverty.

3. **"Vocabulary":** Reproduce the glossary of terms (SM-2) related to brain development. Have students individually review the terms. You may want to give them several days to study the terms. Using SM-3 and SM-4, terms and definitions separated and cut apart, have students work in pairs to match the correct definition with each term without the use of their vocabulary list. In preparation for this activity reproduce enough copies so each student pair has a set of terms and definitions. Direct the students to spread the terms and definitions out on the table in front of them and, working together, match the terms with the definitions. Then have students refer to the vocabulary list to determine if they matched them correctly or lead a class discussion on the matching exercise.

Supporting Concept B: Influences on Brain Development

4. **"Poster Activity":** Using the *Babies are Born Learning* pamphlet found online at Oregon's Children: Everyone's' Business, have students either individually or in pairs take one of the items under the section "Help your child's brain develop," create a poster to illustrate that item, and illustrate how it build's brain power. Have supplies available such as magazines, poster paper, pens, paints, etc. for the students to use in the activity. The goal is to educate others about promoting brain development. Have students share with the class and post their work.

5. Using "Babies Are Born Learning Scenarios" (SM-5) have students evaluate the effectiveness of each practice in promoting brain development. Discuss their responses using the information provided on the answer sheet.

RESOURCES:

Brisbane, H. (2004). *The Developing Child.* New York, NY: Glencoe.

Oregon's Children: Everyone's Business. *Early Brain Development Research and Implications: Presentation Package.* Salem, OR: Oregon Commission on Children and Families (2003).

Hart, Betty, and Risley, Todd R. (1995). *Meaningful Differences in the Everyday Lives of American Children.* Baltimore, MD: Brooke Publishing Co, Inc.

I Am Your Child, video series and educational booklets (www.parentsaction.org/store)

Small Wonders: Early Brain Development (video) (1998). National Center for Family Literacy (www.famlit.org)

Shore, R. (1997) *Rethinking the Brain: New Insights into Early Development.* Families and Work Institute.

"The Secret Life of the Brain", www.pbs.org/brain.

University of Maine Cooperative Extension Service, "*Family Issues Facts*", Bulletin #4356 (www.umext.maine.edu/onlinepubs/htmpubs/4356.htm)

BRAIN QUIZ

This brain quiz was created to introduce some of the basic concepts concerning early brain research in a way that challenges you to think critically about what you have heard and know about brain development. Identify each statement with a **T** for True or **F** for False.

_____1. Basic brain connections are laid down before birth.

_____2. Babies are born with the ability to learn all languages in the world.

_____3. A human baby's brain has the greatest density of brain cells connectors (synapses) by age 3.

_____4. Because the brain is making so many connections pre-birth to age 3, the first three years of life are the most critical for brain development. After age 3, the "window of opportunity" closes.

_____5. Good nutrition is one of the best ways we know to aid healthy brain development.

_____6. Reading to a newborn infant is the best way to help a child learn to read in the future.

_____7. Living in an orphanage as a baby will likely result in negative, long-lasting effects on the brain.

_____8. There are times when a negative experience or the absence of appropriate stimulation is more likely to have serious and sustained effects on the child.

_____9. The large majority of what we've learned about the brain comes from research conducted on animals rather than on humans.

_____10. Brain research has been misunderstood and misapplied in many contexts.

GLOSSARY

1. Axon: A slender fiber along which impulses travel, branching out from the cell body to the dendrites of other neurons. Most neurons have only one axon. Takes information away from the cell.

2. Brainstem: The central core of the brain. Concerned with survival. Controls basic automatic functions to keep us alive – like blood pressure, heart rate, breathing, and body temperature. Connects the brain with the spinal cord and nervous system in the rest of our body.

3. Cell Body: The part of the neuron where information is received and stored; contains the nucleus.

4. Cerebellum: Part of the brain in the lower back of the head. Concerned with maintaining the body's equilibrium. Controls automatic movements (e.g., blinking) and integrates balance and muscular coordination. Recent studies indicate it also plays an important role in cognitive functions.

5. Cerebral Cortex (Cortex): The thin, furrowed, neuron-rich, outermost layer of the cerebrum ("cortex" means "bark"). Controls higher mental functions such as reason, logic, planning, and thinking. The most recent part of the brain to have evolved.

6. Cerebrum: The large, rounded structure of the brain that includes the cortex. Controls and integrates motor, sensory, and higher mental functions; including thought, reason, emotion, memory. Divided into two hemispheres, left and right, which are joined by the corpus callosum.

7. Dendrites: The short, branching extensions of a nerve cell that receive stimuli from other cells' axons. One of three parts that make up the neuron. (The other parts are the cell body and the axon.)

8. Frontal Lobe: Area of the cerebral cortex in the brain responsible for critical thinking, problem solving. It has a role in controlling movement and associating functions of other critical areas.

9. Hippocampus: Area of the brain in the limbic system important for organizing memories.

10. Hypothalamus: A part of the limbic system that is regarded as the body's main thermostat; it coordinates basic metabolism and related functions and the alternation between sympathetic and parasympathetic arousal.

11. Left-brained: A figure of speech that refers to the more linear and logical processes associated with the left cerebral hemisphere. Acknowledging the left brain means paying attention to one's need for logic and reason.

12. Myelin Sheath: The fatty substance coating that insulates the neural fiber. The thicker it is, the more efficient the neural transmission. Also, provides substance to the brain. Poor nutrition can prevent normal myelin development.

13. Neuron: A nerve cell, one of the impulse-conducting cells that make up the brain, spinal cord, and nerves. Its major parts are the nucleus, axon, and dendrites. Humans are born with more than 100 billion neurons, most of which are yet to be connected to one another.

14. Occipital Lobe: Area of the cerebral cortex that processes vision (matures early).

15. Parietal Lobe: One of the areas of the cerebral cortex in the brain; primarily processes sensory stimuli.

16. Pituitary Gland: A "master" gland attached to the base of the brain that regulates the release of many hormones.

17. Prefrontal Lobe: Area of the cerebral cortex in the brain that allows us to plan and rehearse future actions; connects to limbic system to regulate emotions.

18. Pruning: The selective elimination of synapses during brain development.

19. Right-brained: A figure of speech that refers to the more creative and holistic processes associated with the right cerebral hemisphere.

20. Synapse: The connection formed between one neuron and another, where an axon terminal of one hooks up with a dendrite receptor of another forming a tiny gap through which message impulses travel. Considered a basic unit of learning.

21. Temporal Lobe: Area of cerebral cortex that processes hearing, speech, and language development.

22. Thalamus: The brain's "relay station." Receives input from the body's sensory, motor, and other systems, and relays it to appropriate regions of the cerebral cortex.

Axon	**Brainstem**
Cell Body	**Cerebellum**
Cerebral Cortex (Cortex)	**Cerebrum**
Dendrites	**Frontal Lobe**
Hippocampus	**Hypothalamus**
Left-brained	**Myelin Sheath**
Neuron	**Occipital Lobe**
Parietal Lobe	**Pituitary Gland**
Prefrontal Lobe	**Pruning**
Right-brained	**Synapse**
Temporal Lobe	**Thalamus**

A slender fiber along which impulses travel, branching out from the cell body to the dendrites of other neurons. Most neurons have only one axon. Takes information away from the cell.

The central core of the brain. Concerned with survival. Controls basic automatic functions to keep us alive – like blood pressure, heart rate, breathing, and body temperature. Connects the brain with the spinal cord and nervous system in the rest of our body.

The part of the neuron where information is received and stored; contains the nucleus.

Part of the brain in the lower back of the head. Concerned with maintaining the body's equilibrium. Controls automatic movements (e.g., blinking) and integrates balance and muscular coordination. Recent studies indicate it also plays an important role in cognitive functions.

The thin, furrowed, neuron-rich, outermost layer of the cerebrum ("cortex" means "bark"). Controls higher mental functions such as reason, logic, planning, and thinking. The most recent part of the brain to have evolved.

The large, rounded structure of the brain that includes the cortex. Controls and integrates motor, sensory, and higher mental functions; including thought, reason, emotion, memory. Divided into two hemispheres, left and right, which are joined by the corpus callosum.

The short, branching extensions of a nerve cell that receive stimuli from other cells' axons. One of three parts that make up the neuron. (The other parts are the cell body and the axon.)

Area of the cerebral cortex in the brain responsible for critical thinking, problem solving. It has a role in controlling movement and associating functions of other critical areas.

Area of the brain in the limbic system important for organizing memories.

A part of the limbic system that is regarded as the body's main thermostat; it coordinates basic metabolism and related functions and the alternation between sympathetic and parasympathetic arousal.

A figure of speech that refers to the more linear and logical processes associated with the left cerebral hemisphere. Acknowledging the left brain means paying attention to one's need for logic and reason.

The fatty substance coating that insulates the neural fiber. The thicker it is, the more efficient the neural transmission. Also, provides substance to the brain. Poor nutrition can prevent normal myelin development.

A nerve cell, one of the impulse-conducting cells that make up the brain, spinal cord, and nerves. Its major parts are the nucleus, axon, and dendrites. Humans are born with more than 100 billion neurons, most of which are yet to be connected to one another.

Area of the cerebral cortex that processes vision (matures early).

One of the areas of the cerebral cortex in the brain; primarily processes sensory stimuli.

A "master" gland attached to the base of the brain that regulates the release of many hormones.

Area of the cerebral cortex in the brain that allows us to plan and rehearse future actions; connects to limbic system to regulate emotions.

The selective elimination of synapses during brain development.

A figure of speech that refers to the more creative and holistic processes associated with the right cerebral hemisphere.

The connection formed between one neuron and another, where an axon terminal of one hooks up with a dendrite receptor of another forming a tiny gap through which message impulses travel. Considered a basic unit of learning.

Area of cerebral cortex that processes hearing, speech, and language development.

The brain's "relay station." Receives input from the body's sensory, motor, and other systems, and relays it to appropriate regions of the cerebral cortex.

Babies Are Born Learning Scenarios

Directions: For each of the following brain development scenarios, decide if the practice is GOOD or POOR. Be prepared defend your choice using the Ten Steps to help boost babies brain power.

_____1. Tania is very excited to have her baby watch the education video she received as a baby shower gift.

_____2. David spends time reading to his newborn baby. He likes to read one of his childhood favorites to the baby every day.

_____3. As Kate diapers her baby, she talks to her, telling her what is about to happen.

_____4. Amy believes she has selected a quality child care center for her children even though the center staff pays attention to her but not her child each morning.

_____5. When his baby cries, Alfonso quickly responds to see what the baby needs.

_____6. Even though their baby was born prematurely, Jenny visits the hospital every day, touching and rocking her baby.

_____7. Maria sings lullabies to her baby before putting her down to sleep. She also sings rhyming songs to baby during the day.

_____8. Megan and Bruce got very little sleep last night because the baby was so fussy. They finally get the baby settled down and decide to clean the house.

_____9. Suzie slaps her son's hand when he tries to grab her friend's cell phone. Suzie lets him play with her cell phone.

_____10. Jana is crawling and is beginning to open cupboards in the kitchen, so her Dad installs safety latches to keep her away from possible hazards in the kitchen.

Babies Are Born Learning Scenarios
Answers

1. Poor – Play
Limit TV watching time; watch with your child and talk to them about what they are seeing. Play is how children discover the world. Lots of interaction and exploration help the brain form connections that make learning easier.

2. Good – Read
Read books with lots of pictures to start with. Don't worry about whether you read the same book over and over again. Children learn through repetition. Read to children often and they will learn to love reading forever.

3. Good – Talk
A child's brain is making connections from what is said to them. While you are with your child explain what you are doing and seeing. Your words help children learn.

4. Poor – Quality Child Care
In a quality center the caregiver will love, enjoy and respond to the child. The center will be safe, bright, and happy. The caregivers will be well-trained and understand developmental milestones.

5. Good – Warm Responsive Care
Responding quickly with a smile makes babies feel secure. Routines and rituals are important for babies development.

6. Good – Loving Touch
Cuddle, cradle, and hold babies to let them know that they are loved. Hugs help me learn to trust and handle stress, now and when I'm grown.

7. Good – Music
Play music for children because it forms pathways in the brain that can help them understand math and improve their thinking skills.

8. Poor – Take Care of Yourself
When parents feel tired or upset, it's harder to meet a child needs. Reach out to friends and family for support, but never hurt or shake a child.

9. Poor – Teach Limits with Love
Children learn by seeing and doing but need limits to make them feel safe and secure. Give them limits that teach – and expect them to test them!

10. Good – Safe, Healthy Environment

Provide a safe environment for children to explore. Make sure that children are provided good nutrition, have regular checkups and have immunizations. During the first year, put babies to sleep on their back.