Early Words

Language and literacy
training initiative

Books, Babies, and Brains

Remember, understanding brain development is a journey, not a destination. Enjoy the Ride!

"Babies are born learning"

This training package is a project of Oregon's Child: Everyone's Business Speakers Bureau and the Oregon Commission on Children and Families. It is based on material from many sources, including the Florida Starting Points Initiative 1997 Training, and incorporates the core concepts from the National Research Council and Institute of Medicine report, From Neurons to Neighborhoods: The Science of Early Childhood Development.

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Contributors to Curriculum Development

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Session Agenda

- To learn about recent research in early brain development.
- To discuss implications for providers of services to children and their families; for parents; for policy makers.
- To identify ways to apply knowledge about brain development in order to help each child develop his or her full potential.

Reflective Activity:

Choose a positive descriptive word and a movement to add to your name as they introduce yourself. The next person will repeat the name and action before adding their own.

(Example: "I am Sunny Susan" – and puts arms over head in arch to make a sun.)

How did this make it easier to learn new names?

Using an enjoyable activity, repetition, and combining movement with words—which engages more parts of the brain—can make learning more effective. (This can be especially helpful for people who are kinesthetic learners, and, particularly, for young children.)

- Why do we need to learn about the brain and its development—particularly in the early years?

Neuroscience: Study of the Brain

The human brain is the most complex and fascinatingly organized three pounds of matter on this planet, perhaps in the universe. The study of the physical brain, "the hardware of the mind", is called neuroscience.

- There has been more learned about the brain since 1995 than in the past 100 years.

- So recent is the renewed interest in the brain, that nearly 90% of neuroscientists who have ever lived are alive today.
  Recent brain research reveals that the infant's and young child's brain is vastly more complex and active than previously assumed. While neuroscientists believe that some neurons (those controlling heart-beat, breathing, body temperature) are "hard-wired" from the moment of conception, most synaptic connections develop rapidly after birth in response to environmental stimuli.

At birth, the brain is remarkably unfinished. Sights, sounds, noises, smells, touches, language and eye contact literally "sculpt" the brain from birth through or into childhood.

What Can We Do?

Appreciate how the competent behaviors you see in the newborn on the first day of life have emerged out of development during the prenatal period. Appreciate how immature the brain is at this state – in the first few months, most behavior is controlled by "lower" brain centers; a newborn's crying, spitting up, or soiling a just-changed diaper is not deliberate, and she cannot respond to praise or punishment at this age.

Brain Development 101

The human brain is made up of cells, or neurons, that regulate all our thinking.

Brain development begins before birth:

- In process within a week of conception.
- Most brain cells form during prenatal period. Prenatal cells send and receive messages about touch, hearing, and movement.

Cells are not yet connected, as they will be when the brain matures:

- By birth most brain cells have formed and have traveled to different places in the brain where they are beginning to connect with one another.
- At birth, we have over 100 billion brain cells; a child's brain is about 25% the weight of an adult's brain and is beginning to develop.
- In the first three years the brain grows faster than any other time in life.

A healthy human brain will eventually form more connections than all the stars in the universe--*some one thousand trillion*—and yet much about the brain is still a mystery.

Synapses, the connections between brain cells, form the neural network that becomes the basis for social, emotional, and cognitive development.
The over 100 billion neurons a child has at birth will connect as a result of stimulation from her environment.

What Can We Do?

Recognize that the baby's brain is a work in progress, and that its development is shaped by the external environment absorbed in "bits and chunks" through the senses. It is important to provide the kind of environments for our children that we want them to "absorb"... ones that will offer them healthy experiences.
Interesting and challenging environments and educational experiences that stimulate curiosity and interaction will increase the development of synapses.

Neurons: The Brain Cells

Neurons are similar to other cells in the body because they are surrounded by membrane, and have a nucleus that contains genes.

Neurons differ from other cells in the body because they communicate with each other through an electrochemical process.

We are born with over 100 billion brain cells. Every neuron has an **axon**, a nerve fiber which sends electrical signals to other neurons. Every neuron has many hair-like structures, **dendrites**, which receive incoming signals. A **synapse**, or connection, is produced when the axon of one neuron connects with the dendrite of another. **Neurotransmitters** are chemicals which facilitate the passage of electrical impulses across the resulting synapses.

Most of the 100 billion neurons are not yet connected at birth. Forming and reinforcing these connections are key tasks of early brain development. Connections are formed as a result of stimulation from the environment in which the child exists, forming the mechanism for learning. "Brain development depends on genetically based avenues for incorporating experience into the developing brain."

Beginning in the first years of life, axons will be insulated with myelin, specialized glial cells, allowing neurons to function more rapidly and efficiently and providing substance for the brain.

Neurons don't simply pair up. Each neuron forms up to 15,000 separate synaptic connections synapses. During some phases, the brain may form millions of new synapses in a matter of seconds.

The more actively engaged you are, the more your brain will respond and grow. Our brain does not wear out with use; instead it grows and gets better.

What Can We Do?

When we play simple games with babies, such as repeatedly handing a toy back and forth, we are helping develop synapses for learning in many domains. For example, as we hand a teddy bear back and forth, we can say: "Do you like this brown teddy bear? ... Here, I'll give it to you ... Now, can you let me hold the teddy bear? ... Thank you."

We are not only building a trusting relationship, but we're also helping language development and supporting physical learning (such as, improved eye-hand coordination) and social learning (such as, taking turns).

How the Brain Communicates

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. If you have ever walked through the snow along the same route, you may have noticed that you have created a path. So too, neurons tend to reconnect along the same pathway each time the brain responds to similar stimuli. Pathways create connections that are the keys to learning and remembering.

Neurotransmitters: The "Chemical Switchboard"

Neurotransmitters are chemicals secreted at the synapse that regulate the brain's input (senses) and output (behavior) by sending an excitatory or inhibitory message to the receiving neuron.

Over 150 neurotransmitters have been identified; some of the more common are:

Endorphins—Reduce intense pain and enhance euphoria; released in the presence of pain, relaxation exercises, vigorous exercise, and "hot chili" peppers.

Serotonin—High levels are associated with people being so very mellow that they may not be able to show initiative or compete in life. High levels also appear to inhibit REM (rapid eye movement) sleep. Moderate levels are associated with relaxation and sleep. Low levels are associated with aggression and depression. The medication Prozac regulates serotonin levels.

Dopamine—Heightens awareness, increases our ability to focus our senses and aids in learning, dilates pupils. In an emergency, it is converted to adrenaline, the chemical we rely on in life threatening situations.

Melatonin—Is activated naturally by calcium and darkness. It helps promote our circadian rhythm, and regulates our sleep-wake cycle.

Noradrenaline—Leads to heightened awareness, rapid heart beat, and changes in internal circulation which puts the body into a fight or flight mode (autonomic nervous system).

Acetylcholine—Essential to the health of the neuronal membrane (cell wall) and necessary for activating REM sleep, the stage of sleep in which we dream. It is metabolized from dietary fat, so at least a minimum level of fat is required in our diets.

Calpain—Associated with efficiency of synaptic transmissions. Activated by calcium which is also an important dietary requirement.

GABA (gamma aminobutyric acid)—A major inhibitor in the brain. Low levels in combination with low levels of serotonin are associated with violence and aggression. High levels of these two chemicals are associated with passive behavior. Alcohol mimics and decreases GABA. Some anticonvulsant medication works via this neurotransmitter.

Most synapses are created after birth as a result of stimuli coming from the child's experiences. These same connections form the mechanism through which the child learns.

What Can We Do?

Building a baby's brain begins long before the baby is born; building a relationship with one's baby starts before birth as well. Talking, reading and singing to an unborn baby may seem strange at first, but after the baby is born, you will see that an infant can pick out her parents' voices from other voices.

The connections made in the womb will continue to develop after birth. They are setting the stage for healthy emotional and social development in order for cognitive development to be optimal.

Synapse Development

At birth, a baby's brain has 50 trillion synapses. The brain continues to rapidly create those pathways for social, emotional, and cognitive development in direct response to what the infant takes in through their senses:

- 50 trillion at birth
- 1000 trillion at 1 year
- "pruning" stabilizes at mature levels around age 16
- 500 trillion at 20 years

There is a remarkable increase in synapses during the first year of life. The brain builds, retains and reinforces those connections that are repeatedly used and eliminates those that are not. However, we do not need to simply provide more input. We need to have greater understanding, sensitivity and awareness of children's developmental needs in order to provide quality input which assists the brain in creating connections.

Pruning

In the second decade of life, as children move toward adulthood, trillions of extra connections are eliminated. Those connections that have been used repeatedly in the early years have become stronger and tend to remain. Where there has been little activity the synaptic connection will literally dissolve. During the first eight months following birth, the rate of creating new synapses far outstrips the rate of reabsorbing unused connections.

By age one, however, and from then through early childhood, the rate of reabsorbing new connections is faster than the rate of creating new synapses. By adolescence, in most cortical areas, this process again reaches equilibrium. The process of shedding excess synapses is perfectly natural, and in fact, beneficial for the human brain. The result is a brain whose "circuitry" is better organized and better suited for learning the more difficult concepts and skills that young adults need to master.

Babies are born with very underdeveloped brains that are un-insulated and mushy"—similar in consistency to soft butter, or a raw egg. A baby's brain is much more susceptible to damage than an adult's brain. Shaken Baby Syndrome is a form of child abuse. There may be no visible signs of abuse at first, but shaking can lead to brain damage, learning problems, mental retardation, impaired judgment, blindness, deafness, seizures, paralysis, or even death.

What Can We Do?

1. Never shake a baby.
2. Don't toss babies in the air, even in play.
3. For parents and other caregivers who may be experiencing severe stress it is critical to provide help with respite care and support, including referral to organizations in the local community that can be of help.
4. Sharing this information with parents, siblings, and caregivers, may save a baby from death or serious injury caused by ignorance.

A Child's Brain Is Not Just a Smaller Version of an Adult's Brain

Although other organs in a newborn are fully developed, the brain is not.

- Neurons are still moving into position; synapse development is exploding.
- Nerve fibers (axons) have not yet developed a protective myelin coating.
- The newborn baby has a "soft spot."
- There is more space between the brain and the cranium, thus the brain is more susceptible to damage.

The "Soft Spot"

The skull of the newborn is not yet fused. The "soft spot," or anterior fontanel, is thought to allow for the brain's rapid growth.

- Found in the top front part of the skull.
- Diamond-shape, covered by a thick, fibrous layer.
- Normally pulsates with each beat of the heart.
- Normally closes with bone between 9-12 months.
- Touching this area is quite safe.

A shaken baby's brain may be damaged in the front and/or the back, which can impair the brain's ability to store information and memories that serve as a foundation for later learning. For example, damage to the front of the brain is known to effect the development of empathy. Frontal brain damage can also result in impaired judgment, such as an inability to understand cause and effect.

Every child has a unique timetable for cognitive, social and emotional development. Resist pressure from those who too quickly push "academic achievement" before the child is ready. Children need appropriate experiences at the right time for their brains to fully develop.

What Can We Do?

Help a child find and develop his or her own area of solid competence. Children prefer to do things they can most easily master and in which they can most easily demonstrate competence. When you acknowledge such activity with attention and praise, you are helping the child feel capable and valued.

To help recognize when an infant or child is going through a specific sensitive period for a certain kind of learning, we must carefully observe each child. We must provide relevant experiences, without over-stimulating, that will meet his or her interests and developmental needs.

Windows of Opportunity

Children's brains have optimal times early in life for growth, particularly mental and emotional development, often referenced as "windows of opportunity." These are "sensitive periods" when parts of the brain become much more active in response to what the senses absorb.

Brain growth and learning occurs faster during sensitive periods than at any other time in life. Windows of opportunity never fully close, however during the first three years of life, as the human brain develops to 90% of adult size, it puts in place the majority of systems and structures responsible for all future emotional, behavioral, social and physiological functioning during the rest of life. For most functions, it is never too late to form new connections. But very little is known about the ability of replacement experiences later in life to "replace" or repair early insults to the brain.

Optimum windows of opportunity are times when the brain is especially receptive to certain signals. During these sensitive periods, certain kinds of development and learning are most natural and easier, though they can still occur at other times.

Developmental "Hot Zones"

Bruce Perry, M.D., PhD., The Child Trauma Academy, speaks to teaching in the "Hot Zone" so that challenges match the needs of each child, providing the right opportunities at the right time:

- Be sure that children have mastered the precursors to new skills before introducing the skills to them.

Recognize that within each group of children are a broad range of capabilities; each child will have a different comfort zone. Over time, comfort zones will expand and "hot zones" will shift as new challenges are mastered.

Do We Use Only 10% of Our Brain?"

No, we use all of our brain. It analyzes and processes information beyond the world's fastest computer. But, unlike a computer, your brain actually changes as you learn.

What Can We Do?

- Encourage children to leave their "comfort zone" and take on new challenges

The Brain's Development

The brain develops sequentially from the brainstem (with the fewest cells) up to the cortex, which has the most cells and synapses and develops last and continuously throughout life.

Prenatal brain development follows the same sequence as the evolutionary development of the complex human brain. The various functions of the brain, from most simple and reflexive (such as regulation of body temperature) to most complex (abstract thought, for example) are mediated in parallel with the following areas:

Brainstem: responsible for survival including heartbeat, breathing, and reactions such as "fight or flight". Most sensory-motor information flows through our brainstem; it is the conduit to and from the brain for the nervous system in the rest of the body.

Cerebellum: primarily responsible for automatic movements and balance, and the contraction of muscles.

Limbic System: the brain's principal regulator of emotions and long-term memories: It is powerful enough to override both rational thought and innate brainstem response patterns. We tend to follow our emotions. Many old memories are paired with emotional responses.

The **amygdala** is especially tied with emotions and the **hippocampus** tied into memory.

Cerebral Cortex: A thin layer on the surface of the **cerebrum**. It is composed mainly of billions of neuronal cell bodies. While only the width of two dimes held together (about 6 mm), the cerebral cortex contains up to 80 billion cell bodies and almost three-quarters of all synapses.

The brain has an "off switch" for emotional outbursts. When the prefrontal area in the cortex of the brain has developed normally, it helps us make rational decisions about how to respond to emotional triggers.

What Can We Do?

During times of relative calm, we can help children to learn and practice "thinking ahead" about "What might happen if...?" and to learn skills for problem-solving and self-regulation.

The Cerebral Cortex: Functional Areas

The cortex has several **functional areas**, including:

Motor Cortex—concerned with control of most activity.

Somatosensory & Sensory Associative Cortexes—serves mainly to interpret sensory signals.

Visual Associative & Visual Cortexes—serve to process sight.

Primary Auditory Cortex—processes hearing.

Wernicke's Area—interprets ultimate meanings of almost all the different types of sensory information.

Prefrontal—important for elaboration of thought.

Broca's Area—a frontal lobe structure considered crucial for language use.
All areas of the cortex interact with lower structures (such as the limbic system or the cerebellum), allowing the brain to:

- receive, categorize, and interpret sensory information;
- make rational decisions;
- activate behavioral responses;

The frontal lobe is the "ultimate integrator," it acts as the CEO.

"The human brain is made up of many parts. Each has a specific function: to turn sounds into speech; to process color; to register fear; to recognize a face or distinguish a fish from fruit ... It is probably so complex that it will never succeed in comprehending itself. Yet it never ceases to try."

—Rita Carter, *Mapping the Mind*

The Cerebral Cortex: Lobes

Occipital lobe—processes vision and matures very early.

Temporal lobes—processes hearing, speech, language development and social interaction (one on each side of the brain).

Parietal lobe—primarily processes sensory stimuli. It helps the brain understand and react to all the sensory signals.

Frontal lobe—is responsible for critical thinking, judgment, and problem solving. It also controls speaking, movements and conventional behavior.

Prefrontal lobe—allows us to plan and rehearse future actions; connects to limbic system to regulate emotions (very front of the brain).

Corpus callosum—connects the right and left hemispheres of our brains. These different parts of the brain are continuously interacting, from front to back and side to side via the corpus callosum. The corpus callosum enables us to function and make sense of our environment.

Many factors can influence fetal brain development, including nutrition, alcohol consumption and smoking. A baby's birth weight—and brain size—do depend on the quality of his or her mother's nutrition during pregnancy.

Implications: What Can We Do?

1. Pregnant women should gain about 20% of their ideal pre-pregnancy weight (e.g., 26 pounds for a 130-lb woman) to ensure adequate fetal growth. This requires consuming an extra 300 calories per day, including 10-12 extra grams of protein.
2. Don't use alcohol, cigarettes, and narcotics. Even a small amount can impair the formation and wiring of brain cells. It is important to note that some people are more vulnerable than others.
3. Programs such as Oregon MothersCare, Women, Infants and Children (WIC), Healthy Start, and Early Head Start, as well as early and regular visits to your health care provider can help you support the healthy prenatal development of your baby.

Prenatal Brain Development

Blood is pumped out to the tip of the placental root threads by way of the two umbilical arteries.

This process:

- provides oxygen and nourishment for the fetus from the mother.
- gets rid of fatal carbon dioxide and waste products.

The placenta has a thin cell layer that serves as a barrier against certain infections and some noxious substances, but can only offer so much protection to the developing fetus.

The cerebral portion of the fetal or fetus's brain undergoes a major period of nerve cell division between the 10th and 20th weeks. This development makes the brain especially sensitive to damage from drugs, alcohol, viruses, and other agents that the placenta is unable to protect against.

"There was a child went forth every day, And the first object he look'd upon, that object he became, And that object became part of him for the day or a certain part of the day, Or for many years or stretching cycles of years."

—Walt Whitman, "Autumn Rivulets," *Leaves of Grass*

The Prenatal Environment

Building your baby's brain begins before birth, yet:

- 16% of women who give birth in the U.S. receive inadequate prenatal care, and
- approximately 10% of [birth defects] seen at birth can be traced to a specific agent; environmental agent, drug, biologic, or nutritional factor.

Drinking During Pregnancy

Fetal Alcohol Syndrome (FAS) is a leading identifiable cause of mental retardation and neurological impairment. Drinking during pregnancy has been associated not only with fetal alcohol syndrome and Fetal Alcohol Effected (FAE) which is what the rest of this is sometimes diagnosed as but with learning and
behavioral problems, such as a lack of empathy, hyperactivity, short attention spans, and aggression.

Smoking During Pregnancy

Newborns and children of smokers are smaller in stature and lag behind other children in cognitive development and educational achievement. They are more likely to have hyperactivity and attention disorders.

Nutrition and the Developing Brain

Brain development is most sensitive to a baby's nutrition between mid-gestation and two years of age. Breast-feeding seems to contribute to rapid growth of brain weight because of the fatty acids, which help build myelin, a thin fatty coating that insulates brain cells.

The American Academy of Pediatrics (AAP) recommends that mothers nurse their babies for at least one year. 79% of Oregon women start out breastfeeding their babies. Many quit nursing early because they don't get the support they need.

What Can We Do?

Mothers nurse longer when they get support from the baby's father, family, friends, and their employers.

Infants in child care whose mothers cannot nurse them during the day can be given their mother's milk in bottles. USDA regulations permit reimbursement to providers for mothers who choose to bring their milk to the child care setting.

Breastfeeding Nurtures a Child's Mind and Body

During the first year of life, the brain is growing rapidly—the size of the head increases by 4 to 5 inches—and most babies will triple their birth weight during the first year. Breastfeeding is the natural way to feed one's baby, and breast milk has all the nutrients a baby needs in the right amounts:

- contains fatty acids, which are critical in building the myelin sheath that strengthens the synapses and gives greater substance to neurons;
- has antibodies from the mother's body, which helps keep
- the baby from getting certain types of illnesses.

Breastfeeding helps build an infant's emotional security and development of the limbic system. Whether breastfeeding or bottlefeeding, establishing intimacy with infants during feeding is important for all caregivers. Babies need eye contact and nurturing.

Pediatricians recommend breastfeeding children for at least one year. Some research studies have shown that breastfeeding can provide:

- better immunity against illness
- fewer allergies
- higher I.Q. scores
- decreased risk of SIDS and leukemia.

Each breastfed infant saves $1,000—$3,000 per year in health care costs. Oregon Senate Bill 744, signed into law in 1999 as Act, SB 744 (see Chapter 306 Oregon Law 1999), states: "A woman may breastfeed her child in a public place."

"Human development is shaped by a dynamic and continuous interaction between biology and experience."

Sequential Brain Development

Throughout life, our brains make memories that correspond to various sights, smells, sounds, tastes and movements.

Everything we experience is filtered by our senses. Over time, the brain creates many "templates of experience" through which all new input is filtered. These experience templates can be crucial for survival. For example, your brainstem and spinal cord tell you to take your hand away from a flame even before the signal can get to the cortex.

Dr. Bruce Perry refers to the brain as a conservative organ which does not like to be surprised: what you recognize as safe and comfortable has only become so through your experience. Something safe and comfortable to you in the present matches a stored, associated memory of previous safe, pleasing or rewarding experience.

The same holds true for feelings of terror or threat. All unknown or unfamiliar environmental cues are judged to be threatening until proven otherwise.

Cortical Modulation Ratio

A cortical modulation ratio (CMR) indicates the relative 'power' of the maturing brain to adjust/temper (modulate) the more primitive, reactive and reflexive output of the brainstem and midbrain.

A healthy CMR develops when the child experiences a variety of optimal experiences—emotional, behavioral, cognitive and social—at key times during their development.

Any disruption of development, which either overdevelops the midbrain and brainstem, or underdevelops the limbic and cortical areas, will result in an imbalance in the Cortical Modulation Ratio, which can predispose the child to aggressive and violent behavior.

"These behaviors are not senseless, they are not beyond our understanding. They arise from children adapting to and reflecting the world in which they have been raised."

Impact of Trauma and Neglect on the Brain

A maltreated child is characterized by deprivation of sensory experiences. A traumatized child experiences over-activation of important neural systems during sensitive periods of development.

Research on the impact of early, prolonged trauma and neglect on brain development by Dr. Bruce Perry, The Child Trauma Academy finds:

- Traumatic stress is often accompanied by emotional and cognitive neglect.
- Neglect can alter the brain's modulation and regulation capacity.
- *Over*development of the brainstem and midbrain functions (anxiety, impulsivity, motor hyperactivity) takes place.
- *Under*development of limbic and cortical functions (empathy, problem solving skills) occurs.

If a child is raised in an unpredictable, chaotic, violent environment, he is highly likely to adapt by having a hyper vigilant, hyperactive arousal system.

If a young child is frequently assaulted or witnesses assault, he can exhibit necessary, adaptive and appropriate responses such as over-interpreting non-verbal cues, acting quickly on impulses, and striking out or withdrawing before being abused.

Other responses include:

- Hyper-vigilance
- Cognitive distortion
- Physiological and behavioral hyperreactivity
- Dissociation
- Intimacy avoidance

Children with disabilities are almost twice as likely as other children to experience abuse and neglect. They also are more likely to have the maltreatment go unreported and to have the disability go unrecognized during the early states of investigation.

What Can We Do?

When reporting maltreatment of children with disabilities, help ensure that these children receive more adequate services by alerting the person taking your report that the child has special needs. A good resource is the Oregon Institute on Disability and Development, Portland, 503-494-8699.

Impact of Maltreatment on the Brain

These images from the Child Trauma Academy illustrate the negative impact of neglect on the developing brain. In the CT scan on the left is an image from a healthy three year old with an average head size. The image on the right is from a three year old child suffering from severe sensory-deprivation neglect. This child's brain is significantly smaller than average and has abnormal development of the cortex.

Dr. Perry, nationally recognized author on brain development and children in crisis, has done extensive research in this area. Perry found that the human cortex grows in size, develops complexity, makes synaptic connections and modifications as a function of the quality and quantity of sensory experience.

Kaspar Hauser, a feral child, was abandoned and raised from age two until 17 in a dungeon. He experienced extreme sensory, emotional and cognitive neglect. At death, an autopsy of his brain revealed a small cerebrum. This condition is consistent with the cortical atrophy, or underdevelopment, reported by Perry and Pollard (1997) in children after their experiences of severe and total global neglect in childhood.

Neuroarchaeology

Dr. Perry describes the impact of adverse events on the developing brain as "neuroarchaeology": experiences leaving a "record" within the brain matrix. The nature and location of the neuroarchaeological record are set by the nature of experience and the time in development when the event took place.

> *"The neuroarchaeological record of maltreatment has pervasive and chronic impact on the child. An event that lasts a few months in infancy, can rob a child's potential for a lifetime."*

Children's early development depends on the health and well-being of their parents, yet the daily experiences of many children are burdened by untreated mental health problems in their families, recurrent exposure to family violence, and the psychological fallout from living in a demoralized and violent neighborhood.

What Can We Do?

Human relationships are the building blocks of healthy development. Resources are needed to help families in circumstances characterized by multiple, interrelated and cumulative risk factors. These factors impose heavy developmental burdens, and are most likely to incur substantial costs to the individual and society in the future. Help parents become aware of the varied resources in your community.

Primary Relationships

Families, child health professionals, pediatricians and caregivers all play an important role in the growth and development of infants.

Countless researchers have found that the best way to ensure healthy development is to make sure that children have nurturing and reliable care and support.

This goes beyond the basics of love, nurturance, and security. It also includes responsive interaction in order for the child to develop a basic trust beginning in the earliest relationships.

Attachment

Attachment is defined as the special, enduring form of "emotional" relationship with a specific person during the early months and years of life. Important research on attachment from the University of Minnesota, tells us that children who feel secure in their early attachment with their primary caregiver(s) will:

- be more secure moving out into the world, and exploring;
- be more likely to do well in school and in relationships in the years to come.

Their research also demonstrates that the effect of attachment is psychological as well as biological. During the first two years of life when the brain is developing rapidly, attachment experiences influence the structure of the brain, which, in turn, later influences social and emotional development, as well as behavior.

If primary relationships are characterized by violence, neglect and unreliability, intimacy may become difficult later in life. However, researchers investigating the life histories of traumatized children who have succeeded have consistently found that these children had at least one stable supportive relationship with an adult, beginning early in life.

What Can We Do?

1. Provide nurturing and loving care, and a stimulating, safe environment for our children as soon as they are born.
2. Promote a genuine inner enthusiasm for learning by exposing children to music and other languages and cultures while they are very young.
3. Seek professional help for physical, mental or emotional barriers as soon as possible, so problems can be resolved or compensated for more easily.

The "Plasticity" of the Brain

The ease with which the brain can change, continually add or subtract connections, adapt and adjust itself is called plasticity. Plasticity of the developing brain allows children to:

- Adapt to the environment
- Learn so much, so fast
- Compensate for physical, emotional and/or developmental disabilities, especially with early support and appropriate intervention.

Contrary to earlier beliefs, plasticity remains throughout our lives.
Scientists are now finding new ways to use this plasticity to increase adult learning, overcome new barriers, and even address some diseases. Plasticity is simply greater in early childhood because the brain is busy making neural connections for early physical, mental, social and emotional growth and development.

These positron emission tomography (PET) scans show the developing brain of a healthy, nurtured child and the brain of an institutionalized Romanian orphan who was neglected in infancy.

The black and blue tones in the image show virtually no activity in the temporal lobes where language and social interaction are normally processed.

The absence of neural activity shows the effect of extreme lack of stimulation and deprivation in infancy.

A number of Romanian orphans were adopted as toddlers and were provided with a nurturing and stimulating environment. Many are now in school, have developed language, and are learning to read. Because of the brain's enormous capacity for recovery, many children are able to overcome or compensate for the effects of deprivation, if intervention is early enough.

Vision and the Brain

A full quarter of cerebral cortex is devoted to sight. Research on the occipital lobe (the visual system) has been fundamental in understanding the brain, in part because it is easier to study than the other senses.

Scientists have learned that while we perceive a unified scene, the brain is dissecting the view into many parts. Each part triggers a different set of neurons, called a visual map:

- one map responds to color and form
- one map responds to motion

There are at least five such maps in the visual system alone, and recent work is showing that other senses are similarly encoded in the brain.

85% of Early Learning is Visual

Typically sighted babies watch the people, objects and activities within their world hundreds of times before they attempt to do something by themselves.

- At 2-4 months there is a neuron-growth spurt, which corresponds to when babies start to really notice the world.
- This peaks at 8 months, when neurons may connect to an astonishing 15,000 other neurons.

Babies with visual impairments miss out on this huge volume of incidental learning. They can have many cognitive gaps in how they understand the world and require early and intense intervention by their families and the professionals who work with them.

Because learning is initially dependent on the spoken word, it is critical to test for hearing problems at birth and periodically thereafter in the early years. It is so important, the 1999 Oregon Legislature passed a law requiring newborns to be tested for hearing impairments.

Hearing and the Brain

Hearing is one of the earliest senses to develop. Research tells us that ear development starts the first week after conception. Newborns are especially sensitive to the sound of human speech.

Prenatal Beginnings

Hearing development follows a general pattern after conception:
1 week: beginning ear development
14 wks: first reaction to sound
28 wks: full hearing

Importance of Hearing

Hearing is critical to a child's ability to learn and develop speech and language. That is why it is important to test for possible hearing loss at birth and periodically thereafter. Genetics, trauma, neonatal complications, disease, and infections are some factors that can affect hearing.

Hearing Problems

Hearing loss can range from profound hearing loss to mild hearing impairment. It can be temporary or permanent. Unfortunately, infants do not have a way to tell us they cannot hear and hearing loss cannot be easily observed in the early years of development.

Dyslexia, a condition in which the brain has difficulty translating written words, was originally thought to be a visual problem. However, researchers have found that auditory, not visual, areas of children brains behaved abnormally.

In addition to having our children periodically tested, there are also some signs we can observe, such as:

1. Failure to pay attention when spoken to.
2. Requests from the child to repeat words.
3. Frequent earaches, colds, allergies, upper respiratory infections, or pulling on ears.
4. Speech development problems.
5. Discharge from the outer ear.

We can also protect our children from loud noises, trauma, accidents and infections, where possible. For example, avoid having babies drink milk from a bottle while lying down—the milk can then flow into the ear canals where bacteria can grow and cause infections. We can also be especially alert to a history of allergies, ear infections or other contributing factors to hearing loss in the family.

Communication and the Brain

Communication takes many forms, but it always requires interaction with another living being. Adults "read" the newborn's communication by responding to facial expressions, crying, gurgling, outstretched or waving arms and legs. The adult's response helps to teach the child about communicating and establishes these actions as a means of communication:

- By 9 months, these actions become an intended means of communication.
- By 12 months, the toddler will point or gesture to indicate their interest.
- Around 12 to 15 months, single words emerge, gradually progressing to multi-word expressions between 16 to 22 months.

Language is a major part of the process of learning. It is the process of commonly shared symbols and the rules using those symbols. Babies are born with the ability to learn any language. Children learn language by hearing the ongoing speech around them and by interacting with objects and people. By 6 months of age, Swedish babies and American babies "have totally different perceptions of the exact same sound."

Speech is the oral process of expressing language. It reflects what we hear and see around us. It can be limited by hearing or vision loss, physical abnormalities, social, cognitive or motor problems.

Neural connections for the development of speech and language are already being made at birth. Talking, singing, reading, and playing with infants and children stimulate and strengthen the neural connections for speech and language.

Self Regulation

Developing self-regulation is necessary for all children to adapt, cope, participate, and cooperate. How caregivers respond to an infant's emotions lays the foundation for the child's developing self-regulatory skills.

Relationships with infants, which are consistent, predictable, responsive, loving and sensitive help them feel safe and secure. This is important for the child to be able to successfully regulate his or her emotions and behavior.

Unpredictable responses to a child's needs result in anxiety; and such stress and/or fear produces chemical changes which can destroy brain cells, affect brain development and the later ability to self-regulate behavior.

How children regulate is influenced by:

- their past experience and their level of development;
- the circumstances and who is present;
- their culture.

"There is almost nothing that a person can do while interacting with a child under three, while caring for a child under three, that is not cultural. Everything that one does is cultural."

Emotions and the Limbic System

The limbic system, located near the center of the brain, controls the following functions crucial to human emotion and behavior:

- Regulates appetite and sleep cycles
- Processes smell
- Activates the "fight or flight" response system
- Stores emotional long-term memories
- Dictates emotional mind frame
- Provides "emotional coloring" to experiences
- Influences bonding and attachment

A person's emotional "blueprints":

- are defined early in life and stored by the limbic system;
- can be heavily influenced by the relationships formed between an infant and its caregiver;
- throughout life, can trigger emotional reactions and memories that bypass rational thought and problem solving areas of the cortex.

The limbic system also sets the emotional tone of the mind by filtering daily experiences. The more positive the early experiences are early in life, the more positive and stable the tone of the mind will be later in life.

What Can We Do?

Engage children's emotions to positively influence their memory and learning. Have patience and realistic expectations for the accomplishments of children who have been in continual emotional distress, such as children who have been neglected or abused.

Don't give up on children. Meet them "where they are" with understanding to help them carry out the challenges of taking the next step. Children who have been maltreated have extremely high needs. Parents (especially foster and adoptive parents), teachers, caregivers, and others working with such children need training and extensive support to help them succeed and maintain their own equilibrium.

The Effects of Electronic Media on Children's Development

We know that children's brain development and learning are greatly influenced by their culture and environment. TV viewing and computer use are often a very large and influential part of a young child's experience. 66% of Americans regularly watch TV while eating dinner.

In 1999, the American Academy of Pediatrics (AAP) reported that "increased television use is documented to be a significant factor leading to obesity and may lead to decreased school achievement as well."

Physical activity in childhood builds the motor control centers in the "reptilian" brain, ensuring proper large and small muscle coordination and developing a mature sensory-motor system. This system is critical for accurately perceiving and processing input from the physical world.

Vision—Because the screen is flat, children may have difficulty developing three-dimensional perceptual vision. Children tend to stare at the screen without blinking which creates eyestrain.

Movement—Developing motor skills and coordination and the mind-body connections early in life are essential for healthy neural development. Children sitting in front of a television or computer aren't developing these skills and connections.

Outcomes for children who spend a lot of time in front of the TV set may be gaining weight, social isolation, social aggression, poor school performance, or poor social cooperation.

Children under the age of 2 years should not watch TV. Children younger than seven years are not yet able to distinguish between fantasy and reality, and are especially influenced by what they see on television. They cannot think critically about people's motives, have difficulty understanding subtle behavior, and are vulnerable to the powerful images of violent behavior portrayed in the media.

The Effects of Media Violence on Children

Research consistently identifies three problems associated with repeated viewing of television violence:

1. Children are more likely to behave in aggressive or harmful ways toward others.
2. Children may become less sensitive to the pain and suffering of others.
3. Children may become more fearful of the world around them.

Additionally, the more subtle effects of overexposure to television violence are:

- harm to child's social development
- limited models of language development
- limited development of children's imaginations

A particular child's nature, experiences, cultural norms and other environmental factors lay the foundation and play a major role in development, affecting how that child will be influenced by media violence.

"The resilient child is a child who emerges competent and confident from a family when everyone else seems to be a victim of 'risk factors' or negative circumstances such a chronic poverty, alcoholism, criminality, community violence, or child abuse."

—Robin Karr-Morse and Meredith Wiley,
Ghosts From the Nursery: Tracing the Roots of Violence

What Can We Do?

Children typically have a strong drive to explore and investigate their world through play. This is in their nature. We nurture a child's learning by supporting her play in a safe environment. One of the ways we do this is by providing developmentally appropriate play materials, such as containers of different sizes and things that can be placed inside them for a baby or young child interested in experimenting with size and space.

On a larger scale, focus public policy on addressing issues such as quality schools, good nutrition and decent, affordable housing for all in order to create healthy communities.

"Consistent, nurturing relationships with the same caregivers early in life are the cornerstones of emotional and intellectual competence."

—Stanley Greenspan, MD
Growth of the Mind