

child development



Learning
Opportunities

FACT SHEET: STAGES OF BRAIN DEVELOPMENT

The brain does not develop at an even pace. It tends to develop in waves with different parts of the brain developing at different times. This development takes place, however, in a predictable sequence. Neuroscientists have shown that the brain is affected by environmental conditions throughout the entire process of development, even prior to birth. This includes the type of nourishment, care, surroundings and stimulation the foetus or infant receives. This article gives a fascinating summary of the development which takes place in your child's brain a) before birth, b) during their infancy and c) beyond their third year.

Brain Development before Birth

At conception the sperm and egg meet to form a single cell determining the genetic potential. About 60% of the genes are dedicated to brain development. It is these genes that drive the early stages of brain development.

Three to four weeks after conception a thin layer of cells forms on the embryo. The cells fold and fuse to form a liquid filled tube. This is the basis of the brain and spinal cord. The embryo then starts to produce nerve cells or neurons. In the first month following conception the cells in the neural tube start to multiply at an astonishing rate, reaching a maximum of 250,000 neurons a minute. Most of the brain's lifetime's supply of cells is produced by six months.

At 14 weeks very few of the brain cells are sparked to perform a function. The majority begin to migrate to form different areas of the brain. Most cells arrive at the correct site at the right time. Those which are damaged or go astray tend to die. "In very rare situations some do reach the wrong location and form the wrong connections with the result later seen in eventual disorders such as severe infantile epilepsy, autism, some forms of intellectual delay and vulnerability to develop schizophrenia."

The brain produces many more cells than it will need. By the time the foetus is twenty weeks old, about half of these cells are deliberately shed. The remaining cells are organised into forty different physical areas that will broadly govern senses and skills such as vision, language and muscle movement.

Brain Development in the Infant

By birth the brain has developed the total 100 billion brain cells, or 'neurons', it possesses. However the brain is a work in progress. Most of the neurons are still immature. The cells need to be activated and the connections between neurons are weak or have not yet been formed.

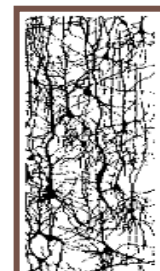
Brain at Birth

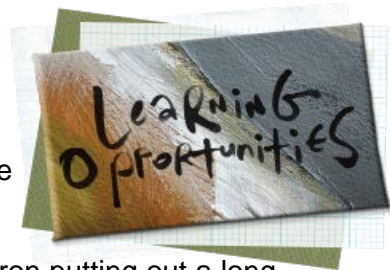


These pictures illustrate how the neurons at birth are mostly unconnected to each other, but by age 3 years have formed dense connections.

At birth the infant can see, hear, smell and respond to touch. Almost immediately after birth the newborn's brain begins to form trillions of connections and pathways between the neurons. These connections and pathways are vital as they enable the infant to see, hear, smell, learn and reason in a more developed way.

Brain at 3 years





Although genes begin the process of brain development, it is the experiences of the child that now start to take over this process. These experiences trigger the electrical activity necessary to enable the brain to develop connections and grow.

These connections are called synapses. The connections are formed by each neuron putting out a long tentacle like fibre called an axon. The neuron uses the axon to send messages to other neurons. The messages are sent as electrical signals and picked up by thousands of short, hair like fibres called dendrites (also produced by the neurons).

Each neuron is able to connect up with thousands of other neurons. Repeated experiences causes the connections to become well worn pathways, permanently etched into the brain. Infrequent experiences result in the loss of developing pathways.

As the brain structure develops, the child will begin to reach the milestones associated with child development, such as grabbing an object, learning to speak, crawling and walking. It is the combination of these neurons, synapses and pathways that will combine to form the unique structure and chemical composition of every individual's brain.

By eight months of age the average infant, living in a stimulating, secure and loving environment, will have sparked 500 trillion of these connections. By the age of two, an infant has developed around 1000 trillion of these connections. Although the connections continue to form throughout life they have reached their highest density (15,000 synapses per neuron).

The root brain structure, which provides the foundation for future functioning, is largely established by the age of three. By then the foundations for thinking, language, aptitudes and attitudes, have been laid down and the structure and design of the brain is almost complete.

Beyond the Age of Three - Practice makes Permanent

In the early years the brain establishes many connections and pathways. The repetition of an action or experience helps to etch these pathways into the brain. Once they have become strengthened sufficiently, they become permanent.

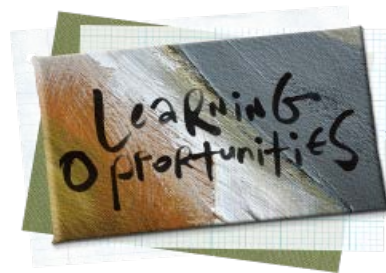
From the age of 10 until late adolescence, the brain begins to prune some of these connections. Those connections which are not sufficiently strong, have been neglected or are used infrequently are lost. Strong connections are exempt from this process.

By the age of 18 the number of connections has been reduced to around 500 trillion - the same number the young adult had as an 8-month old.

The resulting brain is less able to adapt but is stronger and more powerful. These connections remain largely stable in adulthood giving each person a unique pattern of mind, thought and emotions. It is this pattern that determines who we are, and will influence how we think and learn as adults.

“A baby born with a potential for greatness encoded in his genes may turn out to have a gift for logic or a brilliant criminal mind, the direction defined by his early experiences.”

Source: <http://www.ag.ndsu.edu/pubs>



FACILITATED DISCUSSION SHEET:

Facilitator Note

1. Identify what they can do to encourage a child or young person's brain development.
2. Strengthen their understanding of the different stages of brain development and how they can respond appropriately.

Overview

This fact sheet explores the importance of children's early experiences in relation to how the brain develops. It looks at the brain's ability to develop essential connections that are critical for the healthy development of the child.

During the infant years, a child begins to see, hear, smell, and learn. These experiences will enable a child to process its social surroundings and the brain begins to grow when a child experiments by grabbing objects, learning to speak, crawling and walking. And this stage, the 'foundation for future functioning is largely established by the age of three.'

The final stage of brain development is beyond the age of three. The brain should be strengthened continuously through our actions because the connection we make during this stage will create a stable adulthood. Importantly our mind, thoughts and emotions will shape how we think and learn as adults.

Learner Objective

By the end of this facilitated discussion carers will be able to:

- Identify what they can do to assist a child or young person's brain development.
- Strengthen their understanding of the different stages of brain development and how they can respond appropriately at each stage.

Learner Outcome

- Carers will introduce activities that enhance the brain development of a child / young person in care
- Carers will respond appropriately to the child / young person's developmental stage, understanding this may or may not be the same as their biological age
- Carers will assist the development of the child in their care by accessing and implementing appropriate resources

Suggestions for Discussion Starters

- Why is it useful to understand brain development in your role as a carer?
- A child who comes into your care may potentially be developmentally delayed. What might you notice about this child's emotional, physical, cognitive and social state?
- How can you help develop a child / young person's brain development? What resources could you use?
- Think about a time where you had to feel, think, hear, and touch an object? How did you respond to these senses? How do you think this impacted on your own development?
- What are some of the resources (i.e toys, games etc) that you have used to help develop an infant's ability to see, smell, hear, learn and reason.



For further information:

Books

- Nash, J.M. (1997). How a child's Brain Develops. *Time Magazine*, 3 February 1997.
- Sean Brotherson (July 2005), Keys to Enhancing Brain Development in Young Children. *Family Science Specialist*, NDSU Extension Service.
- Gopnik, A., Meltzoff, A.N., and Kuhl, P.K. (1999). *The Scientist in the Crib: Minds, Brains, and How Children Learn*. New York: William Morrow & Co. Inc. *Babies as scientists – this book summarizes all kinds of amazing research findings with babies.*
- Healy, J. (1994). *Your Child's Growing Mind: A Practical Guide to Brain Development and Learning from Birth to Adolescence*. New York: Doubleday. *This easy-to-read book is full of practical suggestions for teaching and learning.*
- Martin, E. (1988). *Baby Games: The Joyful Guide to Child's Play from Birth to Three Years*. Running Press Book Publishers. *This fun book is full of activities, songs and ideas for parents of young children.* Ramey.
- C.T., and Ramey, S.L. (1999). *Right from Birth: Building Your Child's Foundation for Life*. New York: Goddard Press Inc. *By a leader in the field, this book sets forth seven essential factors to help children grow each day from birth to 18 months.*
- Shore, R. (1997). *Rethinking the Brain: New Insights into Early Development*. New York: Families and Work Institute. *Well-written and descriptive book on key aspects of brain development in children and their importance for children and parents.*
- Siegel, D.J. (1999). *The Developing Mind*. New York: Guilford Press. *Profound and interesting insights on how the brain and biology influence who we are and how we develop as human beings.*

Videos

- *The First Years Last Forever*. This video is available from the *I Am Your Child* Campaign sponsored by the Reiner Foundation. For ordering information, visit the Web site (see below) or write to: I Am Your Child, P.O. Box 15605, Beverly Hills, CA 90209.

Websites

- Brainwave Trust Aotearoa: <http://www.brainwave.org.nz/stages-of-brain-development-from-before-birth-to-18/>
- Practice Centre: <http://www.practicecentre.cyf.govt.nz/>
- *The Better Brains for Babies* publication series was done by faculty in the College of Family and Consumer Sciences at the University of Georgia. The Web site is www.fcs.uga.edu/pubs
- *I Am Your Child* is a national public awareness and engagement campaign that the Reiner Foundation created to help people understand the importance of new brain research and its implications for our children's lifelong healthy development. Information can be accessed on the Web site at www.iamyourchild.org
- The Wisconsin Council on Children and Families has educational resources that include *Great Beginnings: The First Years Last Forever* and the *Brain Watch* series. Information can be accessed on the Web site at www.wccf.org
- *The Secret Life of the Brain* is a Public Television site featuring information about the brain at different points in the lifespan. With fascinating three-dimensional imagery, you will want to bookmark this site for future www.pbs.org/wnet/brain/
- Contact your local Child, Youth and Family Caregiver Social Worker