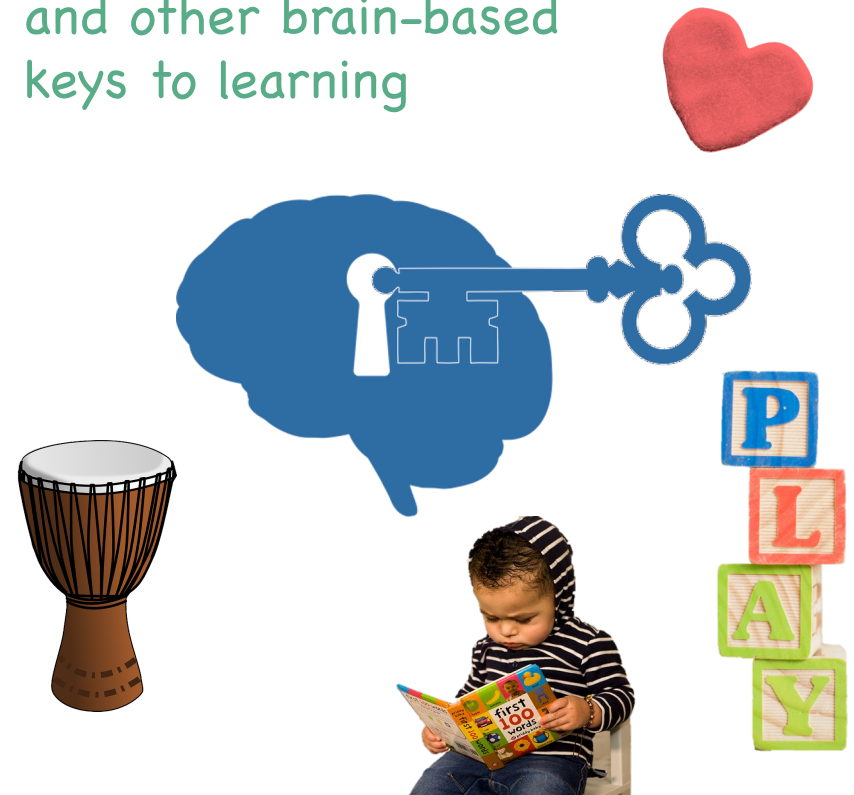


# Neuro-Sequential Brain Development

and other brain-based  
keys to learning



**Information for Educators**

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*For a range of reasons, a child's brain development may not follow the usual trajectory. This may be because of separation from their primary carer at a crucial stage of brain development, a traumatic event, or other Adverse Childhood Experiences, in utero or as a baby or young child. This guide is intended to give teachers a basic understanding of neuro-sequential brain development, potential issues and some activities to develop particular areas of the brain. Many can be done as "brain breaks" or activities with the whole group..*

# Useful Web Pages

Adverse Childhood Experiences:

<https://www.cdc.gov/violenceprevention/childabuseandneglect/acestudy/index.html>

[https://www.ted.com/talks/nadine\\_burke\\_harris\\_how\\_childhood\\_trauma\\_affects\\_health\\_across\\_a\\_lifetime?language=en](https://www.ted.com/talks/nadine_burke_harris_how_childhood_trauma_affects_health_across_a_lifetime?language=en)

Neuro -Sequential Brain Development

<https://beaconhouse.org.uk/useful-resources/>

Learning and Trauma

<https://www.theactgroup.com.au/documents/makingspaceforlearning-traumainschools.pdf>.

<https://education.qld.gov.au/student/Documents/calmer-classrooms-guide.pdf>

Neurodiversity and Learning

<https://www.education.sa.gov.au/sites/default/files/ready-to-learn-interoception-kit.pdf>

[https://cdn.shopify.com/s/files/1/1502/9380/files/FASD\\_2nd\\_Ed-2018.pdf?16416399905192529973](https://cdn.shopify.com/s/files/1/1502/9380/files/FASD_2nd_Ed-2018.pdf?16416399905192529973) (FASD)

<https://suelarkey.com.au> (Autism – Resources and Training))

<https://www.education.vic.gov.au/Documents/school/principals/participation/tipsmanagingadhdinclass.pdf> (ADHD)

<https://getintoneurodiversity.com/faq/>

Yoga, Brain Breaks etc

<https://www.uaex.edu/publications/PDF/FSFCS24.pdf>

<https://childhood101.com/yoga-ideas-for-kids/>

<https://sph.uth.edu/content/uploads/2014/06/APAL-Brain-Breaks-Guide.pdf>

<https://inrhythm.com.au/facilitator-training-home/body-percussion-online-training> (Body Percussion Training)

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11. Hull Services. Brain Boosters Neurodeck: irresistible activities that support sequential brain development. 2014
12. Echo. Echo Resources. 2019 <https://www.echotraining.org/resources/>

## Overview of Brain Development

A child's brain is 90 per cent of adult size by the time they are four years old.<sup>1</sup> This amazing development of the brain occurs from the bottom up and also from side to side.<sup>2,3</sup> There are critical periods for the development of each area of the brain.<sup>1</sup> Ideal growth in each area requires exposure to specific types of experiences.<sup>1,4</sup> Adverse experiences or trauma can disrupt the development as the brain prioritises survival. This booklet will give you an understanding of how and when each area of child's brain develops - and some activities and games which are suitable to promote brain growth in this region. When intervention is needed, a therapist uses this knowledge to target the area of the brain that needs development.<sup>4,5,6</sup>

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*Connection with a primary care giver and a safe, predictable environment allows the baby's brain to develop in the best way possible.<sup>1</sup>*

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While the brain is "plastic" and is able to make new connections throughout life, the lower regions are the hardest to heal or change after the initial developmental period.<sup>1,6</sup> This is one of the reasons why the first few years are so important. The upper regions are more responsive to intervention.<sup>1,6</sup>



**4. Cortex 3-6yrs<sup>1</sup>**

**3. Limbic System 1-4yrs<sup>1</sup>**

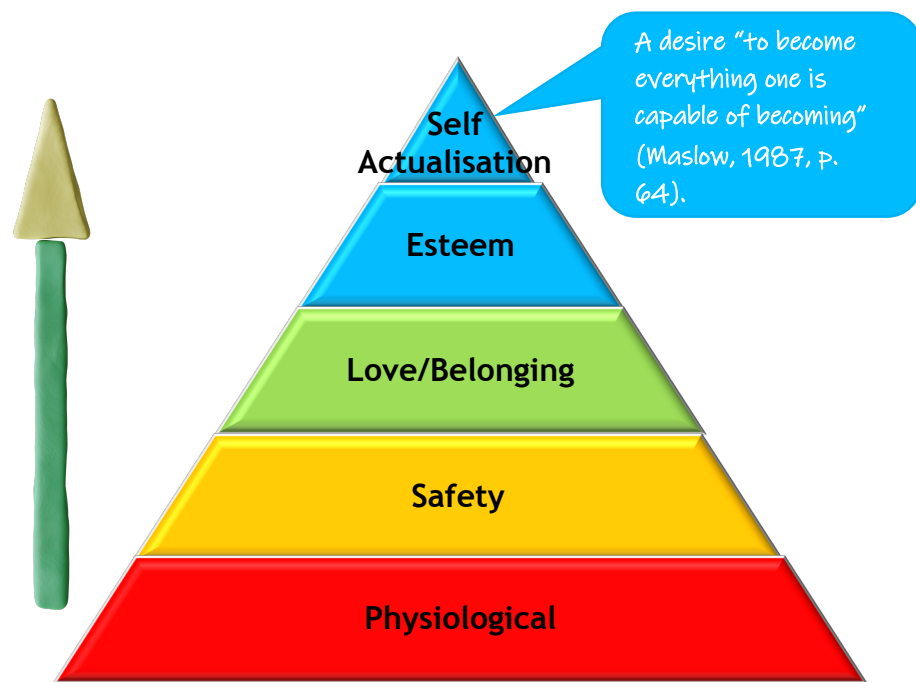
**2. Diencephalon 6mths -2yrs<sup>1</sup>**

**1. Brainstem 0-9mths<sup>1</sup>**

# Maslow's Hierarchy of Needs<sup>9</sup>

According to Maslow (1943), an American Psychologist, an individual's lower order needs have to be met sufficiently before their growth needs become important or achievable<sup>9</sup>. This theory fits with Dr. Bruce Perry's model of bottom up brain development<sup>5</sup>, however there are overlapping needs at each stage of development. As we look at how each part of child's brain develops, we will also see how they link to Maslow's Hierarchy of Needs<sup>9</sup>.

*In order to become everything they are capable of becoming<sup>9</sup>, our children require these needs to be met throughout their lifetime. This is especially important as their brain is developing.*



Maslow's Hierarchy of Needs

# General Trauma-Informed Strategies<sup>12</sup>

**5. Practice 'power-with' strategies:** One of the hallmarks of trauma is a loss of power and control. When someone is wielding power over you with no regard to your thoughts or feelings, the toxic shame of the original trauma may come flooding back. As adults, we should use our power well. If we model a 'power-with' relationship with children it's our best chance of creating adults who will treat others with dignity and respect<sup>12</sup>.

**6. Build social emotional and resiliency skills:** Trauma robs us of time spent developing social and emotional skills. The brain is too occupied with survival to devote much of its energy to learning how to build relationships and it's a good chance we didn't see those skills modelled for us. Learning to care for one another is the most important job we have growing up<sup>12</sup>.

**7. Foster post-traumatic growth:** We know that there are qualities and skills that allow people to overcome the most devastating trauma and not just survive but find new purpose and meaning in their lives. Problem solving, planning, maintaining focus despite discomfort, self-control and seeking support are all known to lead to post-traumatic growth and are skills we can foster in children<sup>12</sup>.

# General Trauma-Informed Strategies<sup>12</sup>

**1. Create safety:** If the child is overwhelmed, perhaps guide them to a quiet corner or allow them to decompress by visiting the restroom/get a drink. If you are in a classroom, maybe you have a peace corner that you've outfitted with blankets or a screen so that it feels like a safe place<sup>12</sup>.

**2. Regulate the nervous system:** Stress brings a predictable pattern of physiological responses and anyone who has suffered toxic stress or trauma is going to be quickly stressed into hyperarousal (explosive, jittery, irritable) or hypo arousal (depressed, withdrawn, zombie-like). Assist the child to find what works for them<sup>12</sup>.

**3. Build a connected relationship:** This is the number one way to regulate the nervous system. When we are around people we care about, our bodies produce oxytocin, which is the hormone responsible for calming our nervous system after stress. If we stay connected, then eventually the calm discussion of each person's feelings and needs can take place<sup>12</sup>.

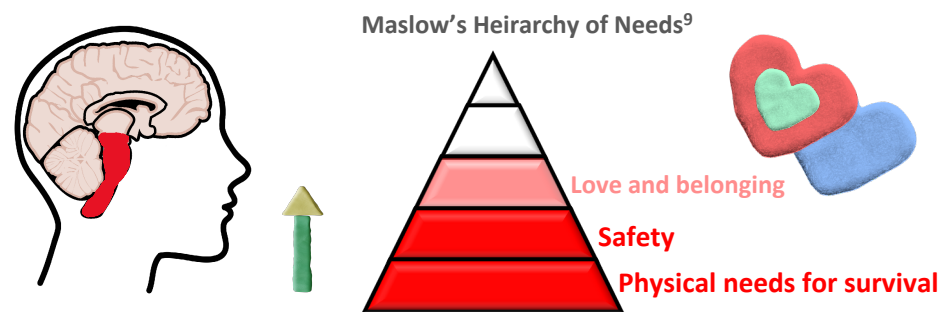
**4. Support development of coherent narrative:** Creating predictability through structure, routines and the presence of reliable adults helps reduce the chaos a child may feel and allows them to start creating the kind of logical sequential connections that not only help them understand their own narrative, but are also the fundamental requirement of many types of learning<sup>12</sup>.

# Brainstem

## Most Active Growth: 0-9 months<sup>1,4</sup>

The brainstem is responsible for our basic survival.<sup>1</sup> It controls breathing, heart rate, swallowing and body temperature.<sup>1,6</sup> The brainstem is also a highway for motor and sensory information and is associated with the survival modes of fight, flight, freeze or collapse.<sup>1</sup> Important developmental functions relate to the baby being able to trust that their needs will be met consistently by an attentive care giver.<sup>1</sup>

*Meeting the baby's physical and safety needs and providing connected and attentive care is essential to healthy brain stem development.<sup>1,6</sup>*



## Interventions that regulate or develop the brainstem

Rocking & cuddling	Music & Movement
Drumming	Play with clay
Patterned massage	Play with sand
Swinging	Tapping
<b>Games:</b> Peek-a-boo; Pat-a-cake in sand	
<b>Therapies that target the Brainstem:</b> EMDR, Massage; Drumming, Reiki Touch. <sup>1,4</sup>	



## Difficulties associated with brainstem development<sup>2</sup>

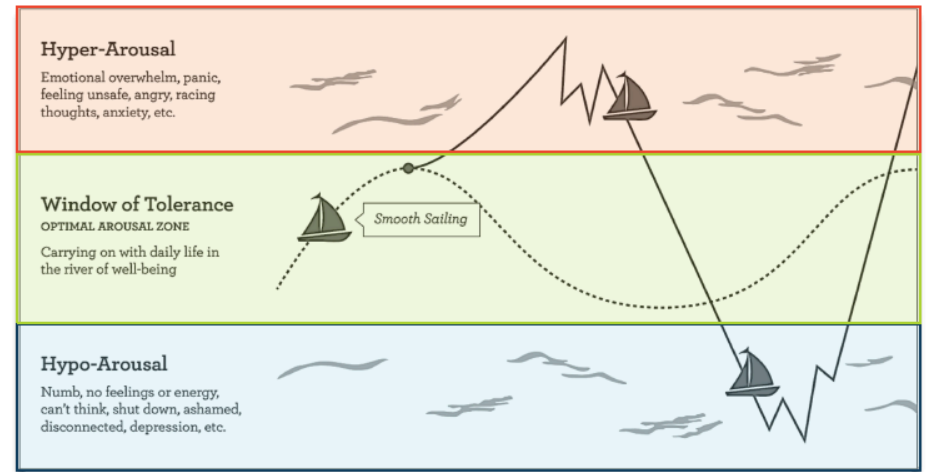
### Sensory/motor & survival<sup>2</sup>

- Difficulty with concentration and attention
- Overwhelmed by noisy, busy classroom
- Difficulty throwing & catching a ball
- Poor handwriting and pencil grip
- Difficulty with co-ordination and balance
- Shutting down/zoning out frequently throughout the day.<sup>2</sup>

### Dissociation<sup>2</sup>

- Frequent “day dreaming” & lack of focus: leading to under achievement
- Abilities to read, write, learn change drastically from one task to the next
- The child is forgetful and confused about things s/he should know
- Confusion about day and time
- They get back homework they have no memory of doing etc.<sup>2</sup>

## The Window of Tolerance



When people have experienced trauma their window of tolerance is narrowed. Lower levels of stimuli may provoke overwhelming responses.

Remember Regulate, Relate, Reason (see page 10).

## Activities to aid Cortical Development<sup>11</sup>

These activities are cognitive predominant

**Suits and Sorts** – Need: Decks of Cards

- Time yourself/or compete to accurately sort cards into suits, colours, or numbers, even numbers, cards that add to ten – or any variation<sup>11</sup>.

**Paper Towel Tunnel Race** – Need: empty paper towel roll per student, large marble or toy car that fits through roll, bucket or hat for finish point.

- Choose a start and finish point
- Allow students problem solve how they can get marble from start to finish point using the tubes and without it touching the ground.
- Get students to rate (by holding up between 1-5 fingers) to show how well they used teamwork<sup>11</sup>.

**Drawing Directions** - Need: Samples of simple line drawings, very specific, concise, step by step instructions on how to draw the picture, pencil and paper.

- instructions can be provided verbally giving the student plenty of time to follow instructions. At end compare to target picture<sup>11</sup>.

**Desert Island** – Need: Cards with possible items to take – both essential and luxury. In small groups decide 10 things to take to desert island. Each group presented with a challenge then ask “Based on the items you have chosen how will you survive?”. Offer 5 mins to re-negotiate items. Possible challenge: Attacked by a group from another island; Wild animals take all the food you gathered; A large storm hits the island lasting several days<sup>11</sup>.

**Life Book** – need scrapbook (or do on computer), decorative craft supplies, glue. Use photos and drawings to represent a timeline of their life. Allow creativity and free expression. This project allows them to re-visit and evaluate the pathway of their lives. It can highlight strengths and triumphs over difficulties so far. It can also be added to to show growth and learning<sup>11</sup>.

## Activities to aid Brainstem Development<sup>11</sup>

These activities aid sensory integration

**Shoveling, Raking & Baking.** Shoveling and raking will allow the student to experience patterned repetitive movements along with sensory integration – and the experience will become relationally rich if paired with a present, attentive and responsive adult<sup>11</sup>.

Baking also provides the opportunity to use their senses to encourage regulation and relational development<sup>11</sup>.

**Yoga Poses** – Bridge, Candle pose<sup>11</sup>

**Drumming Coordination** – Need drum: Steady rhythm with non-dominant hand. At same time first draw squares in the air. One way – then back the other way. Keep the rhythm. Do for one minute – then change shape (circle, triangle etc)<sup>11</sup>.

**Shaving Cream Art** – sculpt into shapes<sup>11</sup>. Alternatives playdough, clay, finger painting

**Paper Mache** – make object out of paper mache and decorate<sup>11</sup>.

**Buried Treasure** – Need: Sand (or Kinetic Sand), container with lid, small objects, shells, animals, etc. complete list of what is buried. Student uses hands to dig through sand to find all objects<sup>11</sup>.

**Message Mania** – Students write letters or draw simple picture on others back and let them guess what it is. Alternative – tap a rhythm on their back and get them to repeat on their legs/knees<sup>11</sup>.

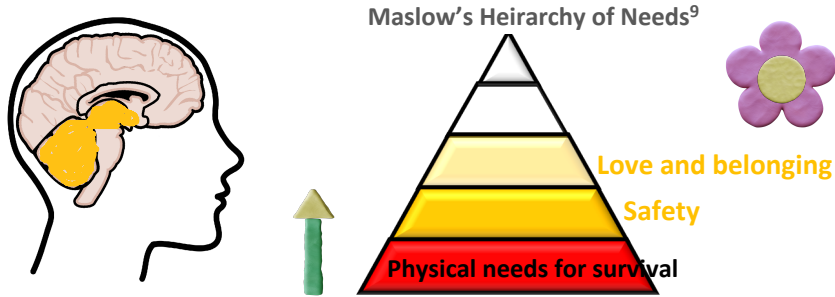
**Knee Touch/ Foot Touch** – like cross-crawl but additional movement. Left hand to right knee. Right hand to left knee. Left hand to right foot. Right hand to left foot. 10 repetitions<sup>11</sup>.

# Diencephalon and Cerebellum

Most Active Growth: 6 months–2 years<sup>1,4</sup>

The cerebellum is responsible for balance and coordination<sup>1</sup>. The diencephalon is important in relaying and processing sensory and motor information and has a role in managing emotions.<sup>1</sup>

*Promoting a feeling of safety and connection to a child and providing a range of experiences that use the five senses are important at this stage of brain development.<sup>1</sup> Physical activity is also important.<sup>1</sup>*



## Interventions that regulate or develop the diencephalon

Using Senses	Attunement	Rhythm
Sand, clay, playdough	Music	Swimming
Movement and music	Reading to child	Drumming
<b>Games:</b> Action Songs (e.g When all the cows were sleeping, Row, Row, Row your boat).		
<b>Therapies that target the Diencephalon:</b> Music and Movement; Reiki Touch, Therapeutic massage, Equine or canine interactions. <sup>1,4</sup>		



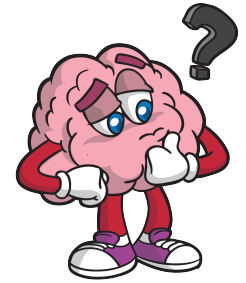
Reading & playing in the sand<sup>10</sup>



# Difficulties associated with Cortical Development<sup>2</sup>

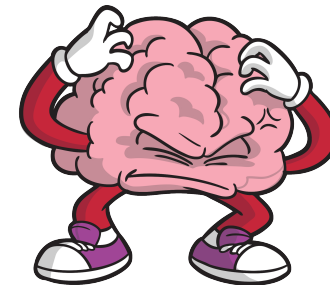
## Cognition<sup>2</sup>

- Difficulties with problem solving
- Struggles to complete a task
- Unable to process information quickly
- Cannot remember new information
- Poor ability to read social cues
- Cannot organize their belongings<sup>2</sup>



## Self Concept & Identity Development<sup>2</sup>

- Being knocked back easily
- Becoming upset at failure
- Self doubt and self criticism
- Not trying for fear of failure<sup>2</sup>



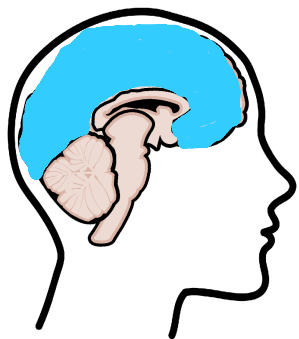


# Cortex

## Most Active Growth: 3–6 years<sup>1,4</sup>

The cortex is responsible for thinking, reasoning and creativity.<sup>1</sup> Important skills such as being able to pay attention, make decisions and do planning are part of the cortex's function.<sup>1</sup> The cortex is also where we process social and emotional information.<sup>1</sup> The cortex continues to develop into the mid 20's,<sup>6</sup> however it remains able to grow and change throughout life, enabling us to learn new skills and ways of thinking.<sup>1</sup>

*Heathy development of the cortex, and growing independence depends on the earlier needs being met and continuing to be met.*



Maslow's Heirarchy of Needs<sup>9</sup>



## Interventions to regulate or develop the cortex

Art, Music, Dance	Stories with that teach lessons
Physical Games and Sport	Riddles & Problem-solving games
<b>Therapies that target the Cortex:</b> CBT, Drama, Story Telling,	
<b>Activities:</b> Field trips and exposure to performing arts, museums etc. <sup>4</sup>	



Children playing soccer<sup>10</sup>



Puzzles<sup>10</sup>



Children dancing<sup>10</sup>

# Activities to aid Diencephalon Development<sup>11</sup>

These activities are self-regulation predominant

**Balancing** - Need: Small bean bag, sidewalk chalk. Try balancing a bean bag on various parts of your body (hand, elbow, knee, head, back, foot ankle). Walk around path made with sidewalk chalk<sup>11</sup>.

**Animal Walks** – Walking across the room like a crab, seal, Tasmanian , devil, rabbit, dog, kangaroo, duck, bear, commando crawl

**Clapping Games** – e.g .Gimme, gimme this this (any hand clapping game, body percussion or drumming activity).

Chant: Gimme, gimme, this, this

Gimme, gimme, that, that

gimme this, gimme that – gimme, gimme, this , that

Hand motions: Gimme, Gimme – hands clap together

This – palms clap partners hands

That – back of hand to clap partners<sup>11</sup>

**Bounce on Dotted Squares** - Need: Ball each, squares with dice dots on them, music. Students move around the squares bouncing the ball on the square the appropriate number of times. (options: can do just for fun, add up dots, do in sequential order, do backwards order)<sup>11</sup>.

**Exercise Ball Fun** – Need: Exercise Ball. Walk on hands over gym ball until under your feet 10 times. Lay on your back, ball in hands on the ground above your head, pass ball to between your feet and use legs to put down to the ground – then lift and repeat<sup>11</sup>.

**Smiling Mind** - age-appropriate guide meditation<sup>11</sup>

**Pinwheel Breathing** - Need: Pinwheel. Take a deep breath in through your nose, slowly blow on pinwheel. Can you keep it moving with your breath<sup>11</sup>.

**Simon Says Spin** – Play the game of Simon Says but instruct the students to do spinning, jumping, leaping, twirling. Speed up and slow down<sup>11</sup>.

# The Limbic System

## Most Active Growth: 1-4 years<sup>1,4</sup>

The Limbic System is responsible for emotional and behavioural regulation, and connection to others - initially the primary care giver.<sup>1,6</sup> Also associated with the limbic system is social language development, empathy, tolerance and interpretation of non-verbal language<sup>1</sup>. From Maslow's Hierarchy of Needs, all needs up to and including love and a sense of belonging are important to the development of the limbic system.

*The limbic system is the emotional centre of the brain. Positive, safe experiences provide a foundation for future relationships<sup>1,6</sup>*



Maslow's Hierarchy of Needs<sup>9</sup>



## Interventions to regulate or develop limbic system

Arts and Craft
Sharing games
Win/lose games
Role Play
Pretend Play
Turn Taking
Creative Dance
Chores



Art and crafts and Pretend Play<sup>10</sup>

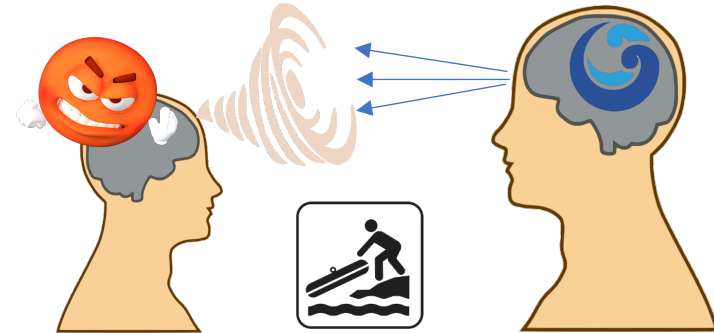
### Games

Hide & Seek; Candyland



**Therapies and activities that target the Limbic System:** Parallel play, Play Therapies, Performing Arts, Creative Arts.<sup>1,4</sup>

# Co-Regulation



## Share your calm – don't join their storm

Possible approach:

*I see you are angry and upset with my decision – do you need to go and get drink or do some colouring for 5 minutes before you start work”.*

- Name the emotion. Name it to tame it<sup>3</sup>.
- Give a choice – provide a life raft.
- Going for a walk and colouring can both lower cortisol (stress hormone) levels.
- Assisting to co-regulate by not getting swept away by their emotions. *Children need a lot of practice at co-regulation before they can self-regulate.*
- Modelling self-regulation while having empathy with their feelings. *I see/understand you are...*
- Modelling problem solving. Consider options. Ensure options are within boundaries.
- **Regulate – Repair Relationship – Reason<sup>11</sup>.** You cannot reason with a child when they are dysregulated as that part of the brain is not engaged. It is in fight/flight/freeze mode.

# Activities to aid Limbic Development<sup>11</sup>

These activities are relational predominant

**Copy Cat** – Mirroring partners movements etc

Try: Clapping, clicking tongue, tapping, snapping, stomping, twisting, silly faces, animal sounds<sup>11</sup>.

**Cotton Ball Soccer** : Need: cotton balls, masking tape, straws

Make field/goal area on floor with tape. Lying on floor, each uses straw to blow cotton ball and try to score goal<sup>11</sup>.

**Rock, Paper, Scissors Elimination**

Rock – crouch down on the ground

Paper – arms spread wide, legs shoulder width apart

Scissors – left arm and left leg forward- and right leg and right arm back (or vice versa)<sup>11</sup>.

**Ring on a string**. Need: textured rope, key ring

Make a loop out of rope with keyring on it.

Group makes a circle holding the rope with palms down

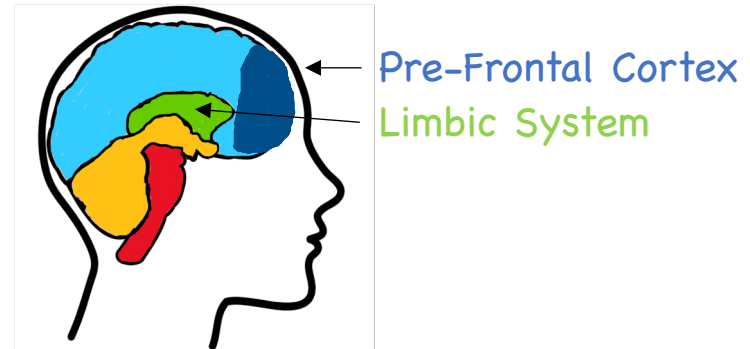
Select IT who stands in centre of circle, closes eyes, turns around 3 times slowly. While they are doing this, others start passing ring around circle and hide under someone's hand.

Person who is IT Opens eyes and tries to guess where ring is while others continue to pass/or pretend to pass ring around without taking hands off string. Whoever found with it is IT<sup>11</sup>.

**Robot Packs** – Needs small bean bag or weighted object for each player (Robot Pack). Game of tag with a twist. Need to balance robot pack on body part (head, arm, hand, foot). Instructor calls out body part, changing each minute or so. If tagged or drop their robot pack, they must freeze and say "help me" in best robot voice. Another player can replace their robot pack and they can go again<sup>11</sup>.

# Survival Mode: Fight, Flight and Freeze

When a child becomes overwhelmed, the **prefrontal cortex** goes offline. The **Limbic System** takes over. The response is fight, flight, freeze – or when extremely stressed, faint. Fawn is another recognized response.



# Regulate, Relate, Reason



*Heading straight for the “reasoning” part of the brain (**prefrontal cortex**) with the expectation of learning will not work so well if the child is dysregulated and disconnected from others<sup>10</sup>.*

## Difficulties associated with Limbic Development<sup>2</sup>

### Emotional Regulation<sup>2</sup>

- Outbursts of anger or distress at small events such as a change in activity
- Immaturity in friendships – jealousy, possessiveness, struggles to share
- Too emotional to take on new learning
- Tearfulness and anxiety at drop off
- Over dependence on adults
- Rule breaking
- Aggression, running and hiding<sup>2</sup>

### Behavioural Regulation<sup>2</sup>

- Lying, stealing, hoarding
- Disruptive in class
- Restless, fidgety, moves about the classroom lots
- Slowed down, unresponsive<sup>2</sup>



## Difficulties associated with Limbic Development<sup>2</sup>

### Attachment<sup>2</sup>

- Difficulty processing new information
- Underperformance or over dependence on academic excellence
- Difficulties organizing and completing tasks
- Struggles with transitions, loss and change
- Big reactions or zoning out for reasons not obvious to others
- Difficulties in friendships
- Find it hard to ask for help OR the child is always needing help
- Over compliance OR disruptive behaviour in class<sup>2</sup>.

