

Basic Neurology of a Dog

A dog's brain is similar in structure and function to a human toddler's. The key regions involved in behavior and response include:

- **Amygdala** – processes emotions (fear, aggression, excitement).
- **Hippocampus** – handles learning and memory.
- **Prefrontal Cortex** – decision-making and impulse control (less developed than in humans).
- **Cerebellum** – movement and coordination.
- **Hypothalamus** – regulates hormones and stress responses.

Neurotransmitters and Receptors by Activity

Play

- **Dopamine:** Released during enjoyable experiences (like fetch or tug), enhancing **motivation and reward**.
- **Endorphins:** Provide a **natural high**, reduce pain, and promote bonding.
- **Oxytocin:** Associated with **social bonding**; spikes during mutual gaze or physical interaction with humans or familiar dogs.

Effect: Play is mentally enriching and helps dogs regulate stress through positive social experiences.

Growling (Defensive or Aggressive Response)

- **Adrenaline** (Epinephrine): Released during fight-or-flight situations.
- **Norepinephrine:** Increases alertness and focus.
- **Cortisol:** Stress hormone; rises with **prolonged arousal or threat**.
- **Amygdala activation:** The emotional processing center interprets threat and sends signals to the rest of the brain and body.

Effect: Growling is often a **warning** signal driven by stress, discomfort, or fear — not always aggression.

Problem Solving / Enrichment (like puzzles)

- **Dopamine:** Strongly involved in **reward-motivated learning**.
- **Acetylcholine:** Supports **attention and learning**.
- **Hippocampus:** Memory formation and spatial navigation.
- **Frontal regions:** Light up during **working memory and problem-solving** tasks.

Effect: Solving problems triggers a reward loop. It builds confidence and reduces boredom and anxiety.

Learning (Training, New Skills)

- **Dopamine:** Helps form positive associations through reinforcement.
- **Glutamate:** A major **excitatory neurotransmitter**; vital for forming new synaptic connections.
- **BDNF** (Brain-Derived Neurotrophic Factor): Supports **long-term memory and neural plasticity**.

Effect: Repetition and reward create **strong neural pathways**, making skills and commands stick.

Stress or Anxiety

- **Cortisol:** Main stress hormone; elevated in **prolonged stress or trauma**.
- **Adrenaline:** Triggers physical arousal (increased heart rate, respiration).
- **Reduced serotonin:** Linked with **anxiety or mood imbalance**.

Effect: **Chronic stress can weaken memory, increase reactivity, and even suppress immune function.**



Summary Table

Stimulus	Key Neurotransmitters	Brain Regions Engaged	Effect on Behavior
<u>Play</u>	Dopamine, Endorphins, Oxytocin	Amygdala, Hypothalamus	Joy, bonding, stress relief
<u>Growling</u>	Adrenaline, Cortisol, Norepinephrine	Amygdala, Hypothalamus	Defensive, alert, possibly fear
<u>Problem Solving</u>	Dopamine, Acetylcholine	Prefrontal Cortex, Hippocampus	Focused, confident, engaged
<u>Learning</u>	Dopamine, Glutamate, BDNF	Hippocampus, Cortex	Memory formation, behavior change
<u>Stress</u>	Cortisol, Adrenaline	Amygdala, Hypothalamus	Fear, anxiety, fight/flight

If you're training dogs or working behaviorally, understanding how these systems interact lets you better **time rewards**, identify **stress signals**, and support **healthy neural development** through enrichment and structure.

Puppies (8 weeks – 6 months)	<ul style="list-style-type: none"> • Gentle tug and fetch with soft toys • Scent work with treats hidden in cups • Puzzle feeders (low difficulty) • Controlled socialization with calm dogs and new people
Adolescents (6–18 months)	<ul style="list-style-type: none"> • Intermediate puzzle toys (Kong, snuffle mats) • Obedience challenges with duration (sit, stay, place) • Leash walks with varying environments • Confidence-building obstacles (e.g., low platforms, tunnels)
Adults (1.5–7 years)	<ul style="list-style-type: none"> • Advanced puzzle feeders and foraging games • Agility or trick training • Scent detection or hide-and-seek • Canine sports (dock diving, nose work, rally)
Seniors (7+ years)	<ul style="list-style-type: none"> • Gentle enrichment: licky mats, slow sniff walks • Familiarity-based puzzle games • Soft massage and calm handling exercises • Short training sessions to engage the mind

Enrichment Ideas by Temperament

By Temperament

- **High Drive / Energetic:** Agility, flirt pole play, fetch with recall
- **Shy / Fearful:** Nose work, confidence walks, low-pressure puzzle games
- **Easily Bored:** Daily rotation of toys, new tricks weekly, supervised exploration
- **Calm / Steady:** Long-lasting chew toys, slow-paced tracking, relaxed group classes