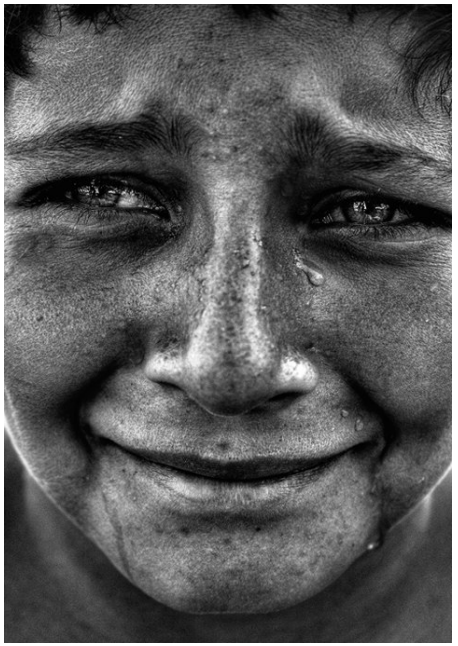
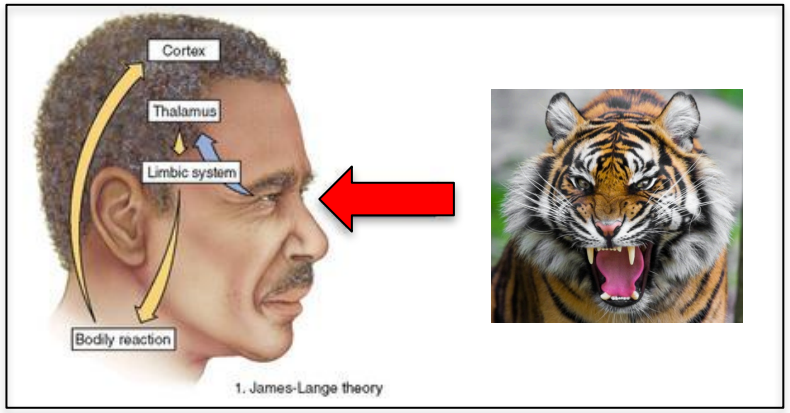
Lecture 10

# Emotion



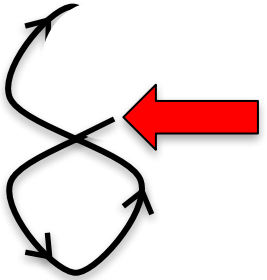
Cogs 17 * UCSD

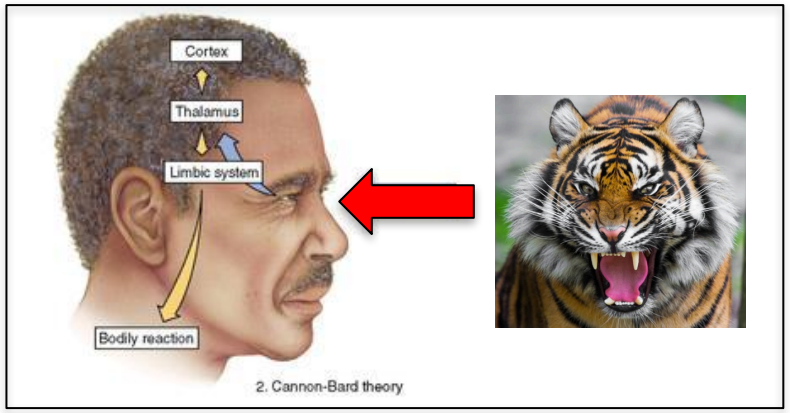
# Theories of Emotion




## James-Lange Theory (1880s)

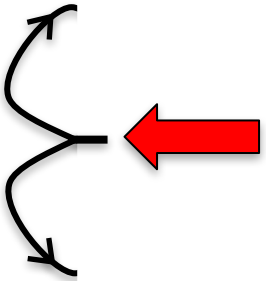
After-the-Fact Label

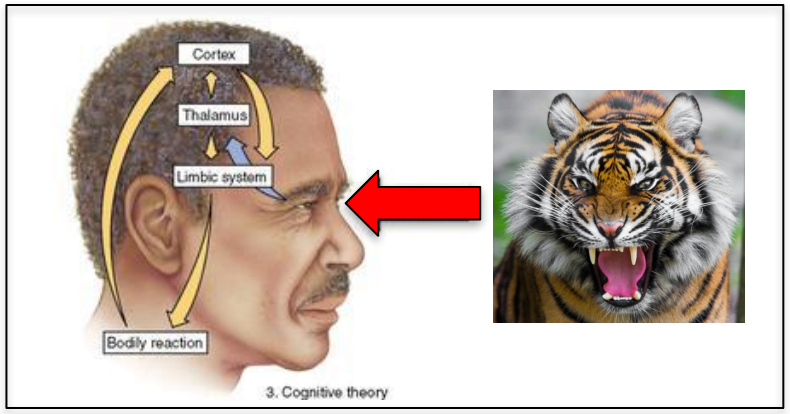





## Cannon-Bard Theory (1930s)

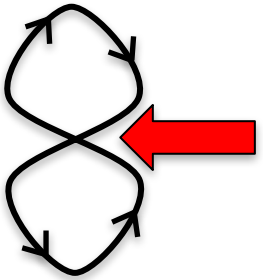
Simultaneous






## Schacter-Singer Theory (1980s)

Cognitive Appraisal



Combines both of above, *plus* top-down

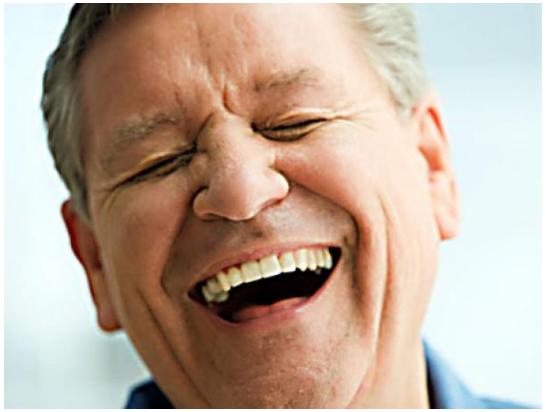
# Judgments of Emotional Stimuli

Inject some Subjects with Amphetamine, others with Placebo

Expose both groups to Emotional stimuli








Under chemical arousal, show <u>exaggerated emotional response</u>

Plus, report that stimuli are "**extremely**" sad, funny, scary, etc.

# Facial Feedback

Subjects were required to hold a pen in their mouths

Condition A
Hold pen in TEETH

Face muscles in a
smile-like configuration

Condition B
Hold pen in LIPS

Face muscles prevented from
a smile-like configuration

Subjects had to read the COMICS and then judge "how funny?"

Subjects in Condition A judged comics as FUNNIER than those in Condition B

So, facial muscles in smile-like configuration affected quality of emotion

# Facial Feedback

Subjects directed to alter particular muscle groups in particular ways

e.g. Raise brows,
pull them together,
raise upper eyelids,
tighten lower eyelids,
stretch lips horizontally...

Emotion terms never used in instructions

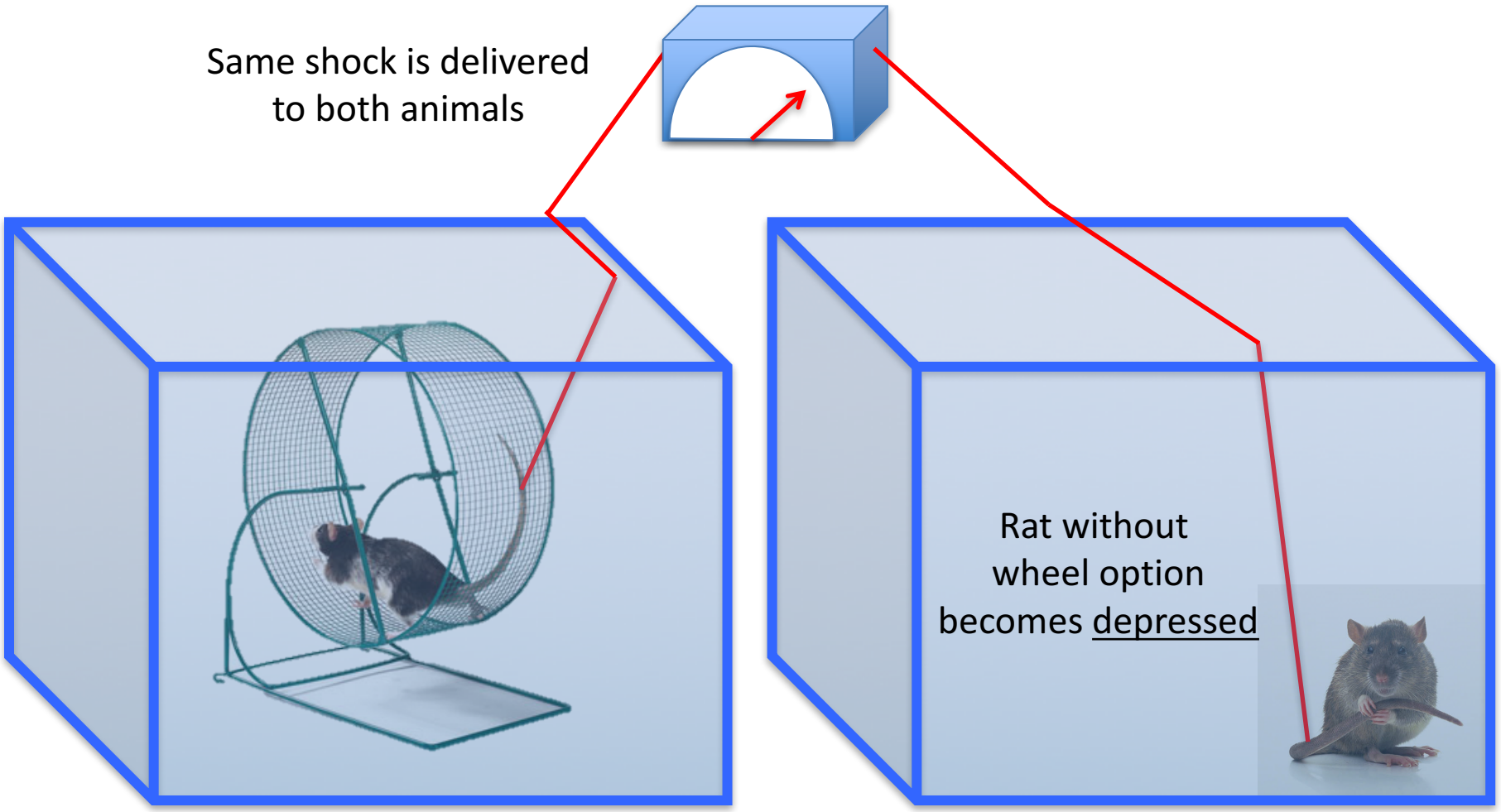
Subjects asked to report any "feelings" generated by this activity

Emotions reported corresponded to "universal" qualities of associated facial expression

Also produced corresponding body responses (change in heart rate, skin temp, etc)

# Learned Helplessness

Same shock is delivered
to both animals



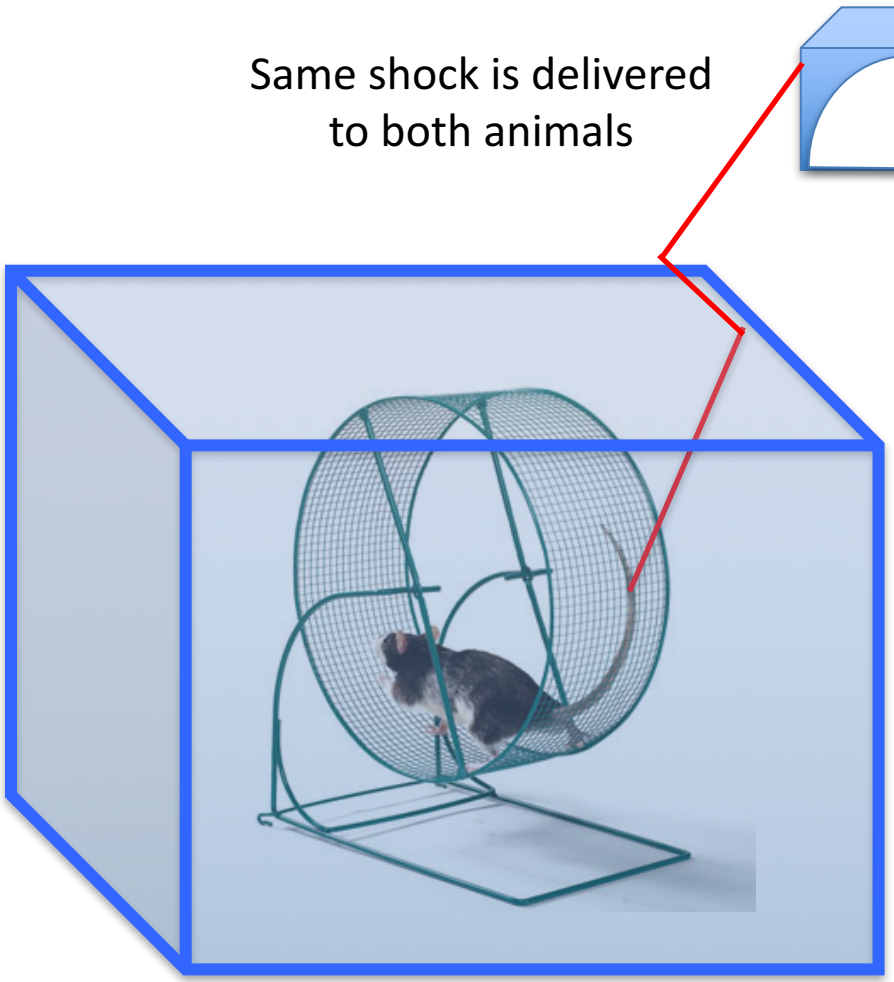

But rat with wheel soon learns
that it can stop shock
(to both rats)
by running in wheel

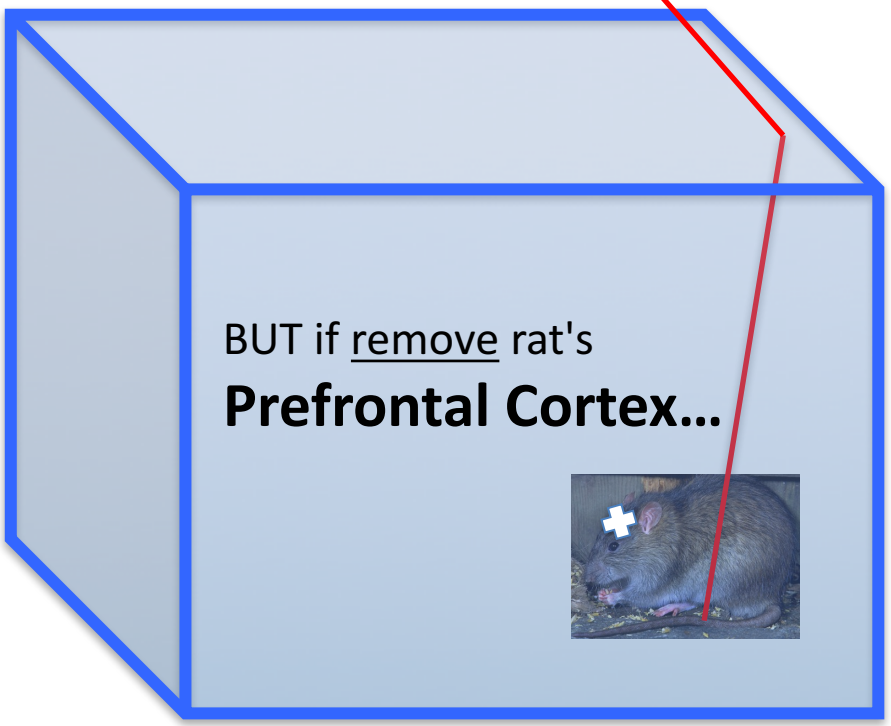
And only this rat develops ulcers
from stress of shocks.

= **"Learned Helplessness"**

# Learned Helplessness

Same shock is delivered to both animals






It's cognitive appraisal affects its autonomic response!

**…it will NOT develop ulcers!**

It will not become depressed, will not interpret situ as helpless

# Emotional Expression

## Universals

Anger | Fear | Disgust

Surprise | Joy | Sadness

BUT, there are also culture-specific "**Display Rules**" for when and to whom you may show what kinds, extents of emotion

# Neonatal Imitation


Fig. 1. Sample photographs from videotape recordings of 2- to 3-week-old infants imitating (a) tongue protrusion, (b) mouth opening, and (c) lip protrusion demonstrated by an adult experimenter.

We are pre-wired to practice manipulating the muscles emotional expressions based on the **behavior of others**!

# The LIMBIC SYSYEM

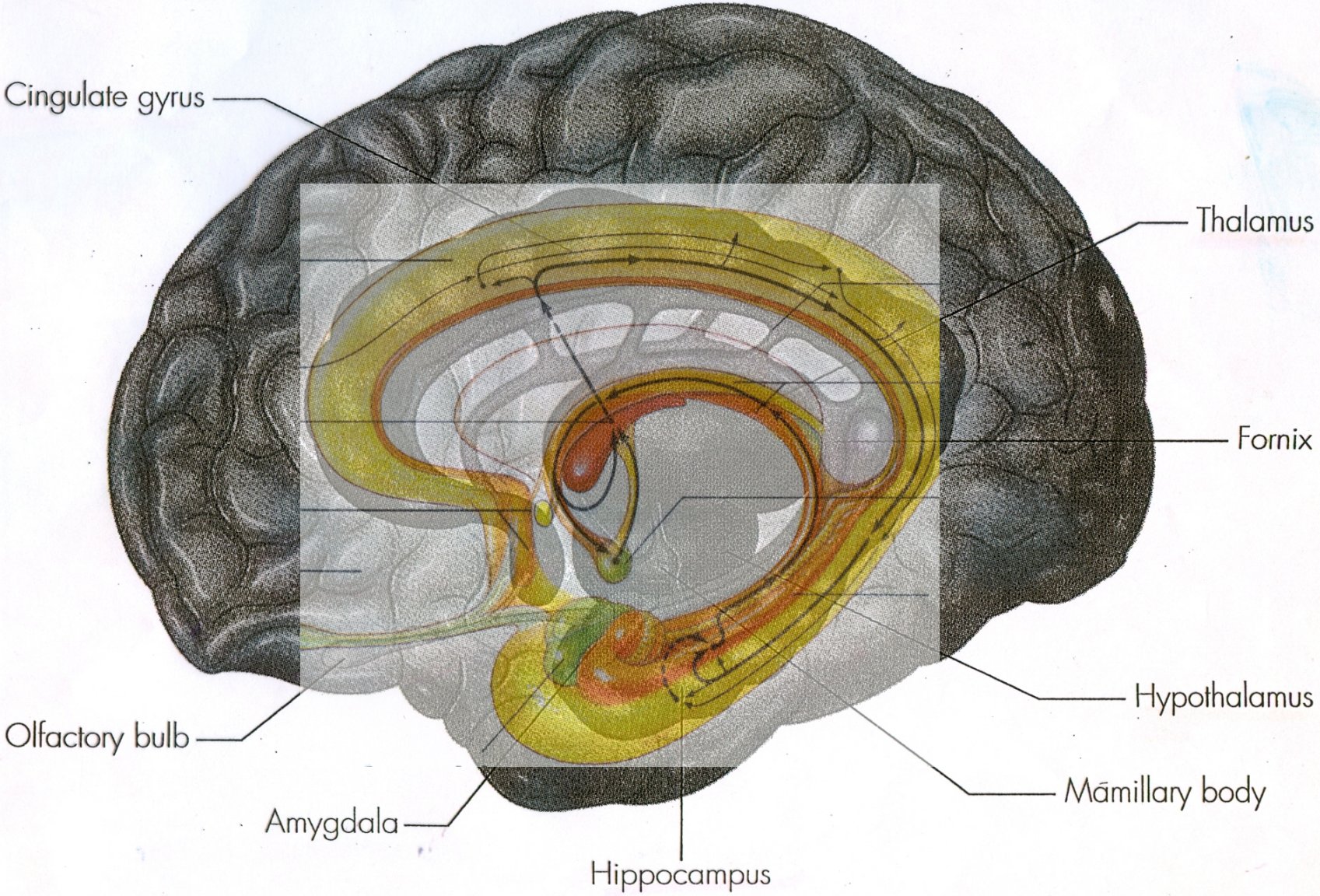
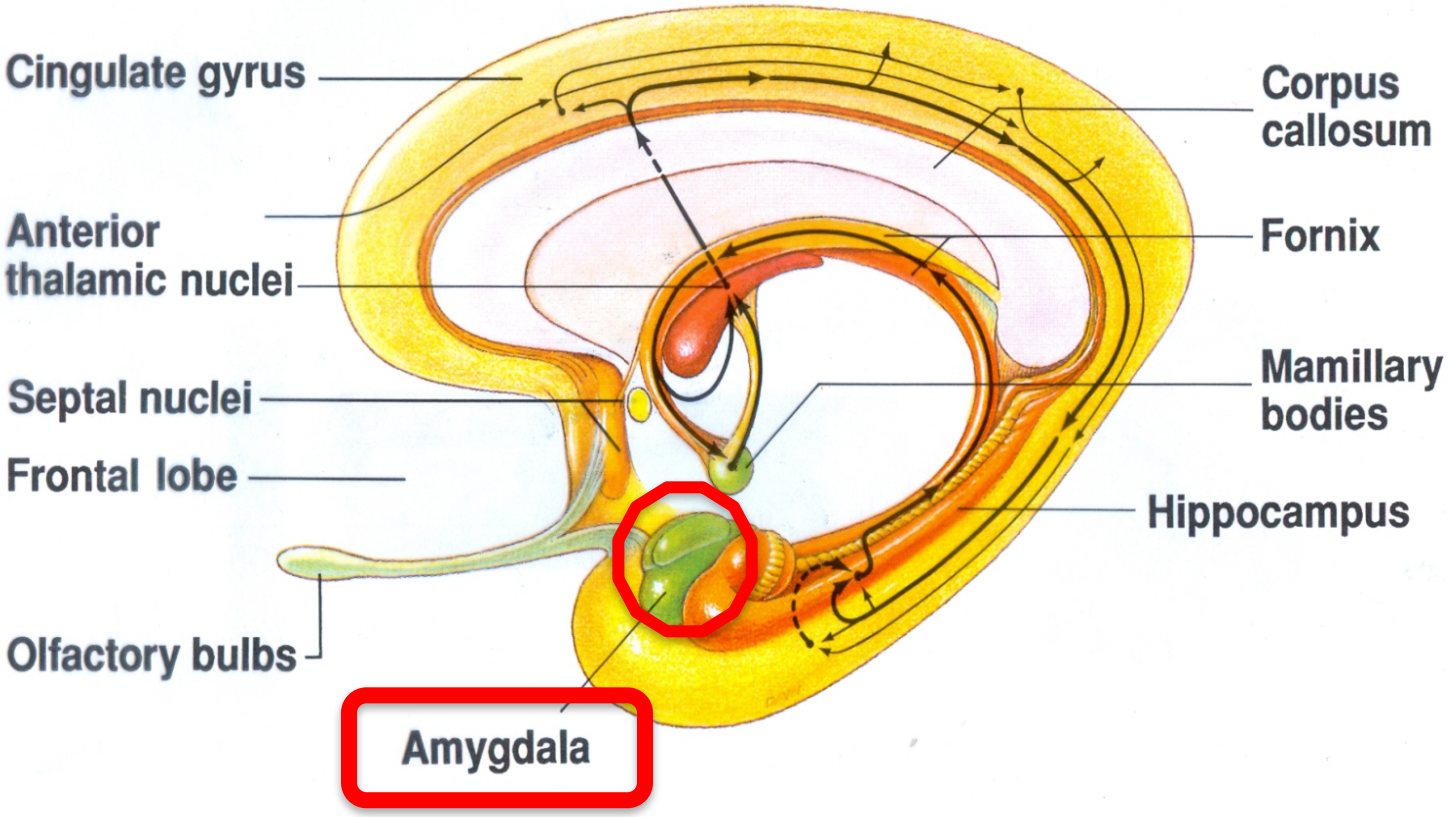



**Figure 4.10 The limbic system is a set of subcortical structures that form a border (or limbus) around the brain stem**

# The LIMBIC SYSYEM

## **The Amygdala**:

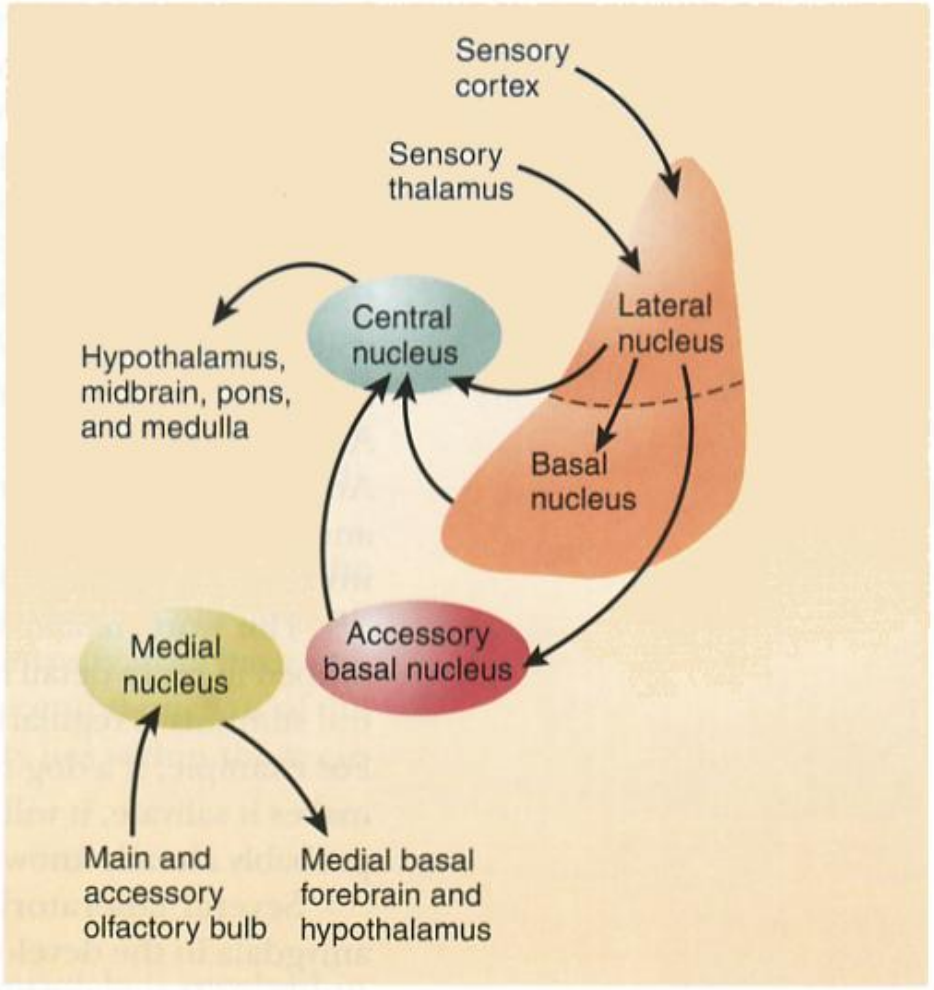
The "emotional center" of the brain




Plays a critical role in both **producing** and **interpreting** emotion

# Amygdala

A much-simplified diagram of the major divisions and connections of the amygdala that play a role in emotions.




Has multiple Nuclei with various functions and patterns of connection with other brain areas

We will examine a few in detail....

**Cortico-Medial** Amygdala

First area studied

Direct stimulation of this area >>

**RAGE!**

(Anger/Fear)

Most primal emotion (most critical to survival)

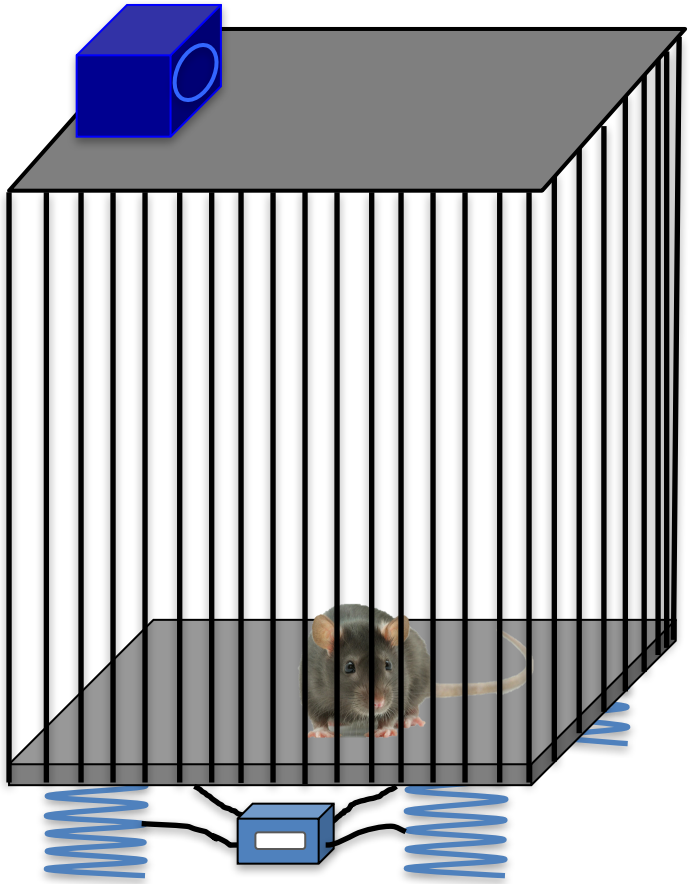
Virus that causes *Rabies* probably affects this area

But Amygdala does so much more...

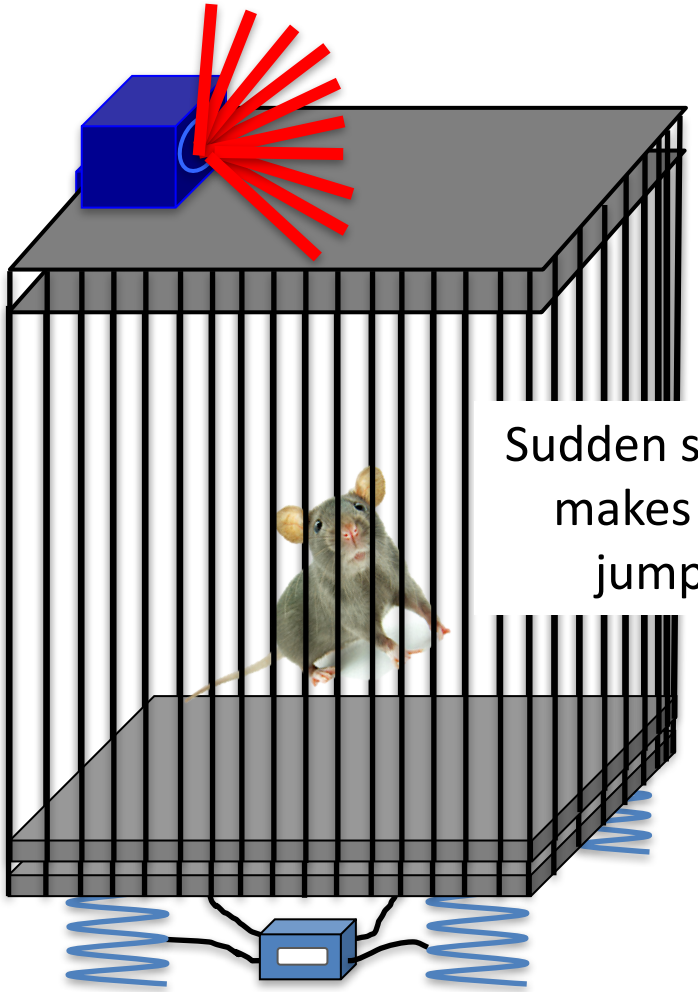
# Startle Reflex

## Lateral Amygdala

Speaker



Springs under cage record pressure rat exerts on floor of cage



Sudden sound makes rat jump!

Impact on springs when rat hits the floor = how high it jumped = measure of **Startle Reflex**

## Lateral Amygdala

- Output to **Central Gray Area** of Midbrain
  - Part of Tegmentum for motor control, esp of neck muscles
  - Clenching these muscles helps protect fragile cervical neurons near surface

- Output also to **Hypothalamus**, influences Autonomic NS response
  - e.g. Increase blood pressure, heartrate, etc

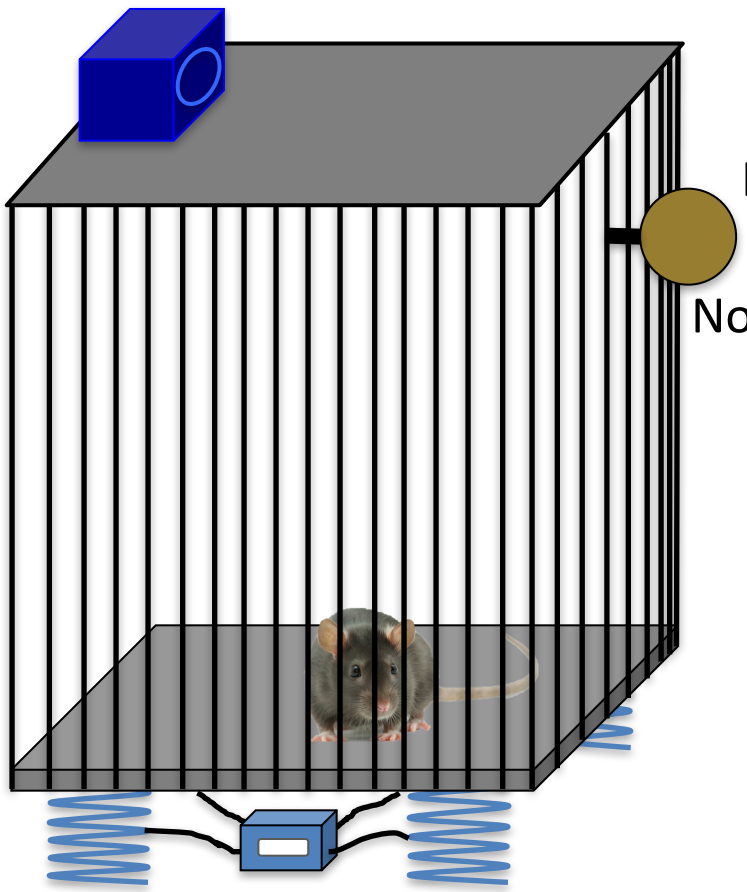
- Input from Pain fibers, and Visual and Auditory activity
  - To trigger startle reflex
  - ALSO to detect and learn emotional associations, in conjunction with...

## Central & Baso-Lateral Nuclei

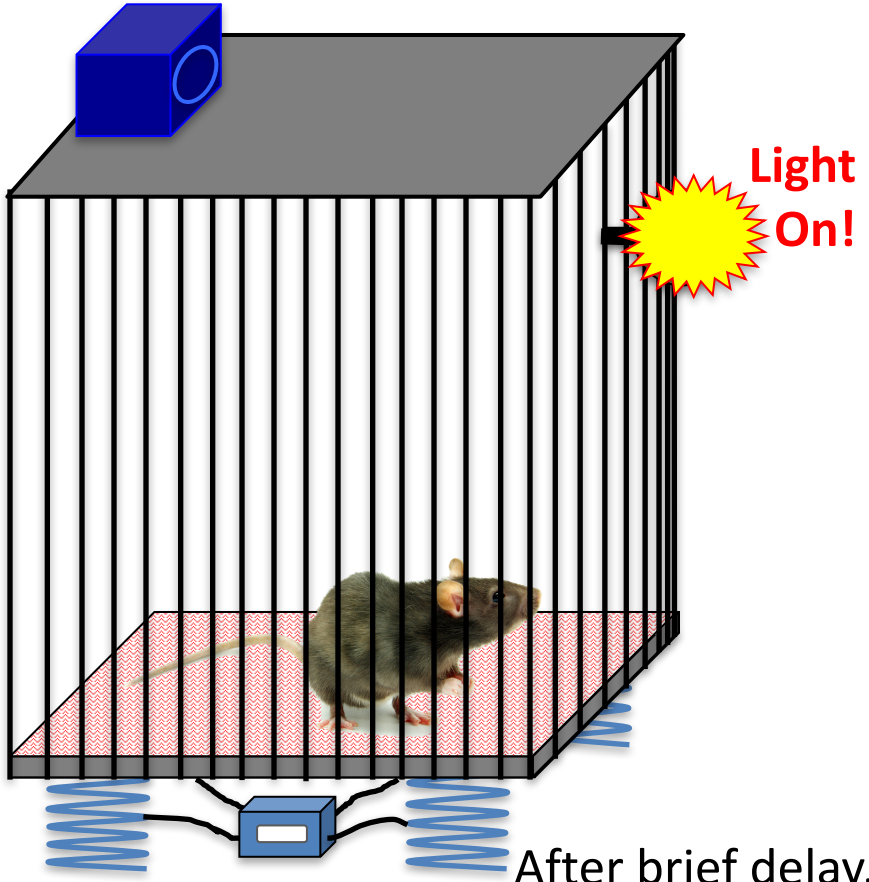
- For "Conditioned Fear"
  - Unlearned Startle Reflex becomes associated with other stimuli/contexts
  - Can either enhance or reduce Startle Reflex response

# Startle Reflex and Conditioned Fear

After establish baseline Startle Reflex,
train rat on association between Light and Shock



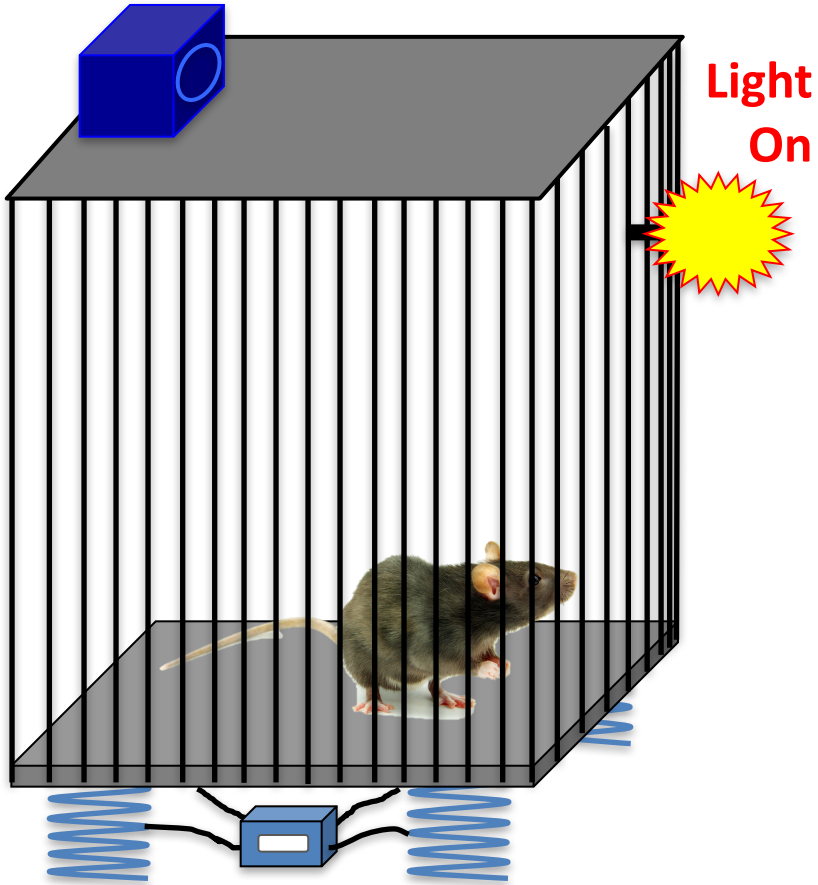
Light
Off,
No shock



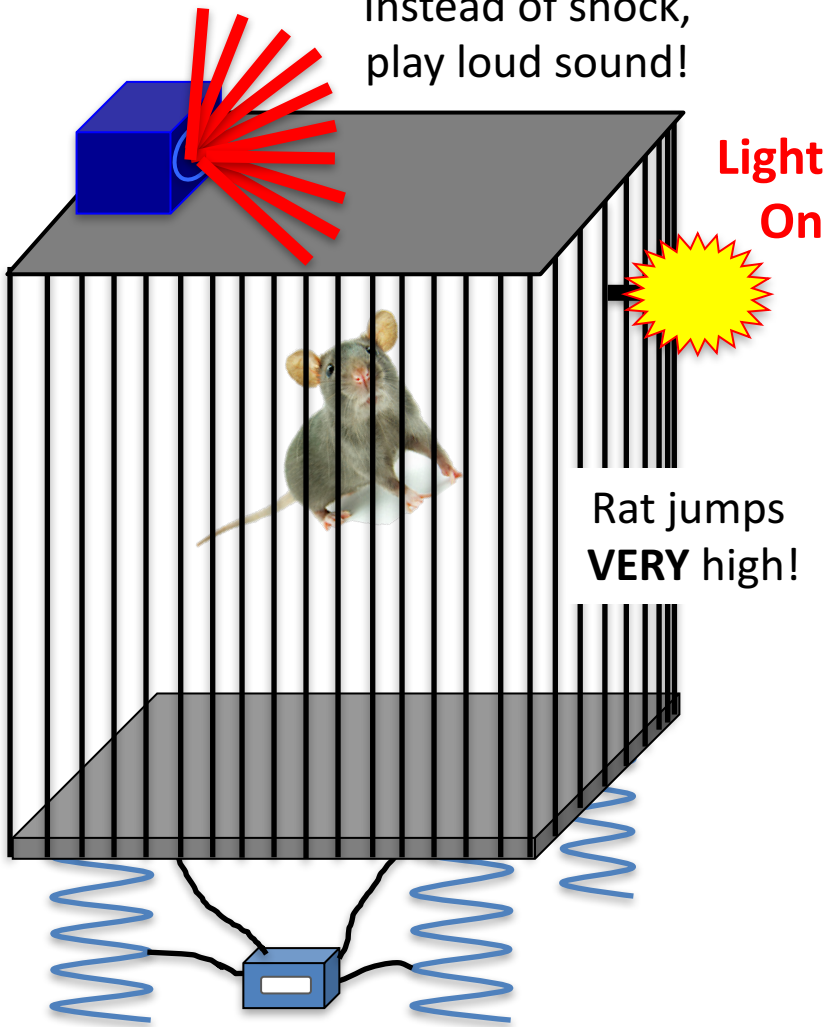

After brief delay,
receives mild, unpleasant ***shock*** to feet

Rat learns ☹ association – when light comes on, anxiously anticipates *shock*

# Startle Reflex and Conditioned Fear




Light comes on,
rat anxiously awaits shock




Rat shows an <u>enhanced</u>

**Startle Reflex**

# PTSD

Post-Traumatic Stress Disorder

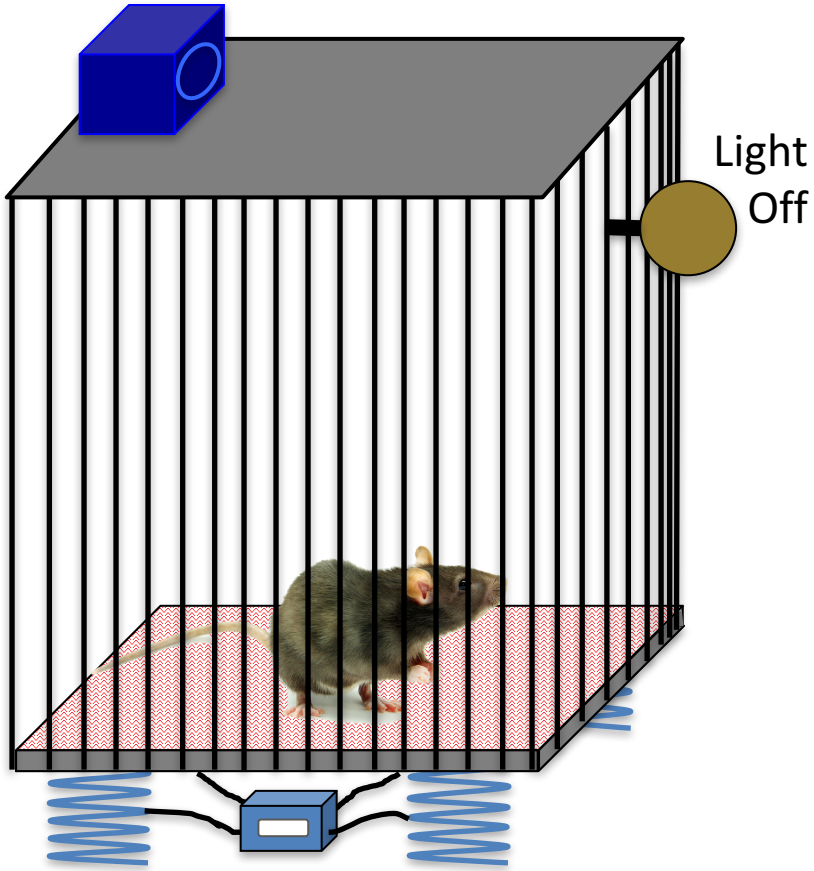
Includes
conditioned enhancement of
**Startle Reflex**

In Central & Basolateral Amygdala,
proportions of calming GABA
vs. stimulating CCK
have shifted

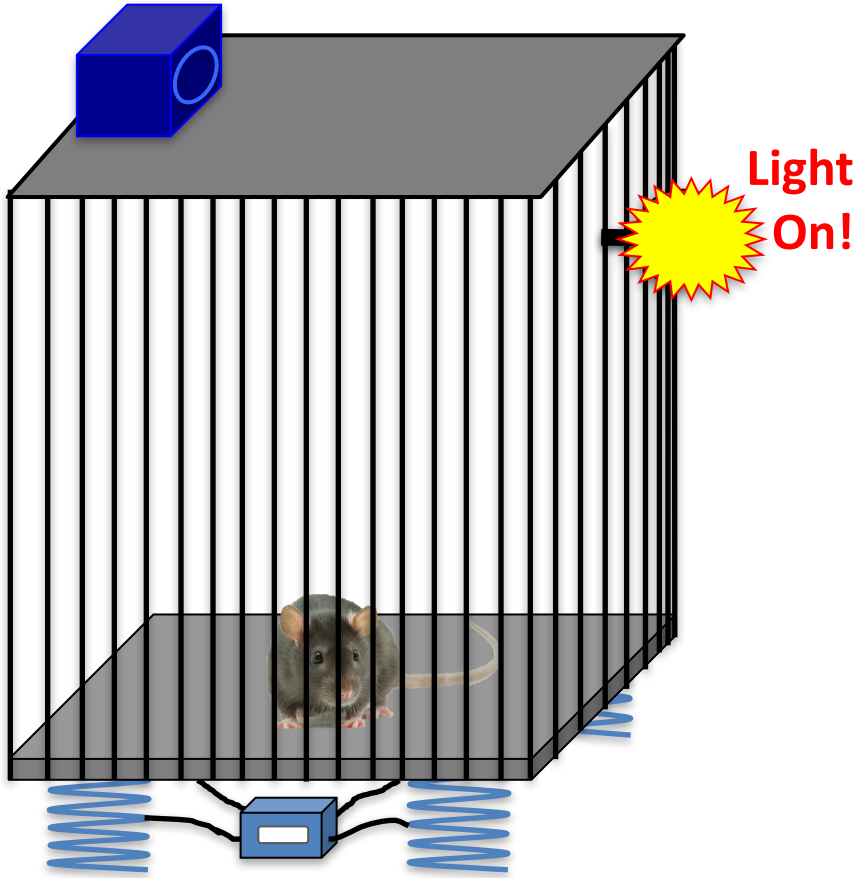
See below for difficulties in
treating this with NT
Agonists & Antagonists

# Can also Condition a reduced Startle Reflex!

Train opposite conditions from above…




If Light off, get mild *shock*

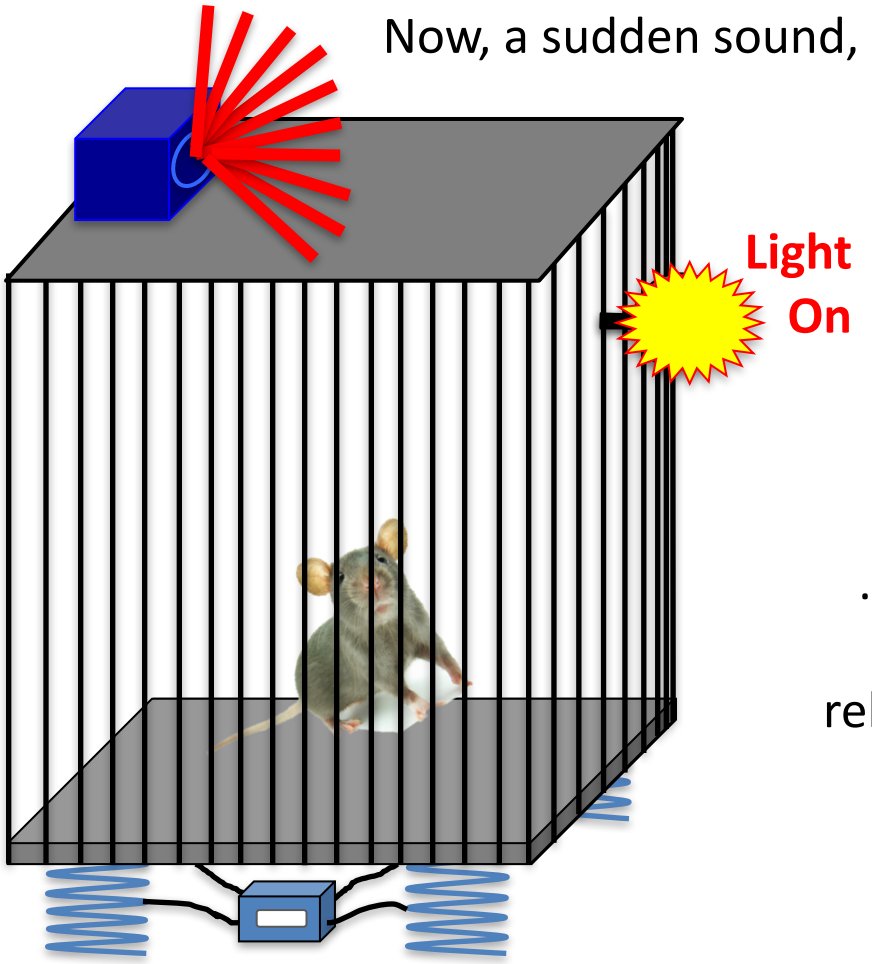



If Light on, shock turned off

Rat learns that Light predicts relief ☺

# Can also Condition a reduced Startle Reflex!

Now, a sudden sound, in presence of light….




…leads to a reduced
Startle Reflex,
relative to rat's baseline

# Urbach-Wiethe Disease

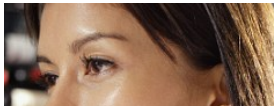
Amygdala active not just when feel/express but also when **observe** emotion in others

Urbach-Weithe disease involves calcification of Amygdala, which impairs function

Patients show a "flattening of affect" (less emotional expression), AND problems with interpreting emotions in others

e.g. Fail to judge which is more "approachable"

Although note, with eyes alone, do better

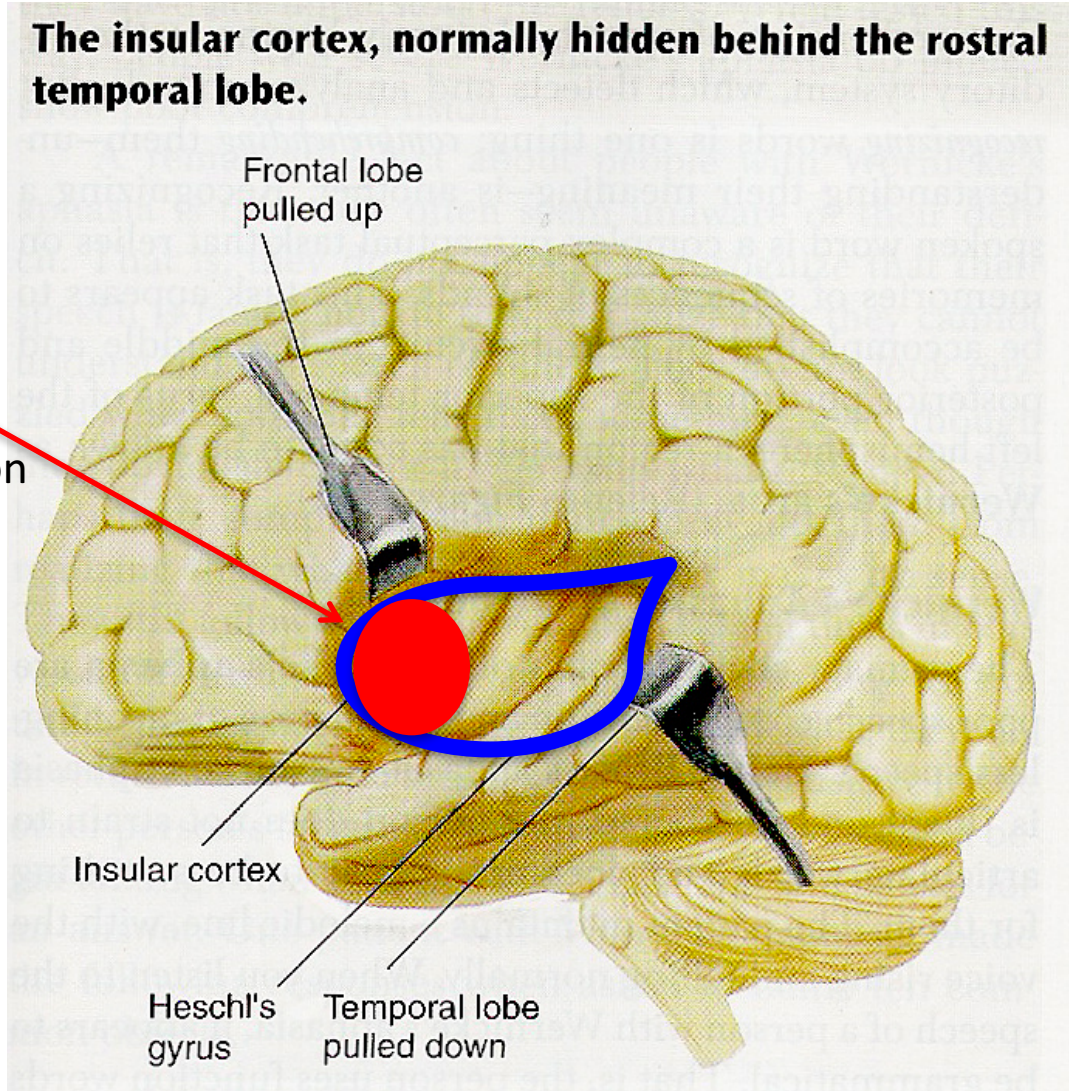


Possibly because eyes (so important!) are represented in many brain areas

# Insula

**Anterior Insula**

critical in emotional expression in social contexts



# Insula

**Anterior Insula**

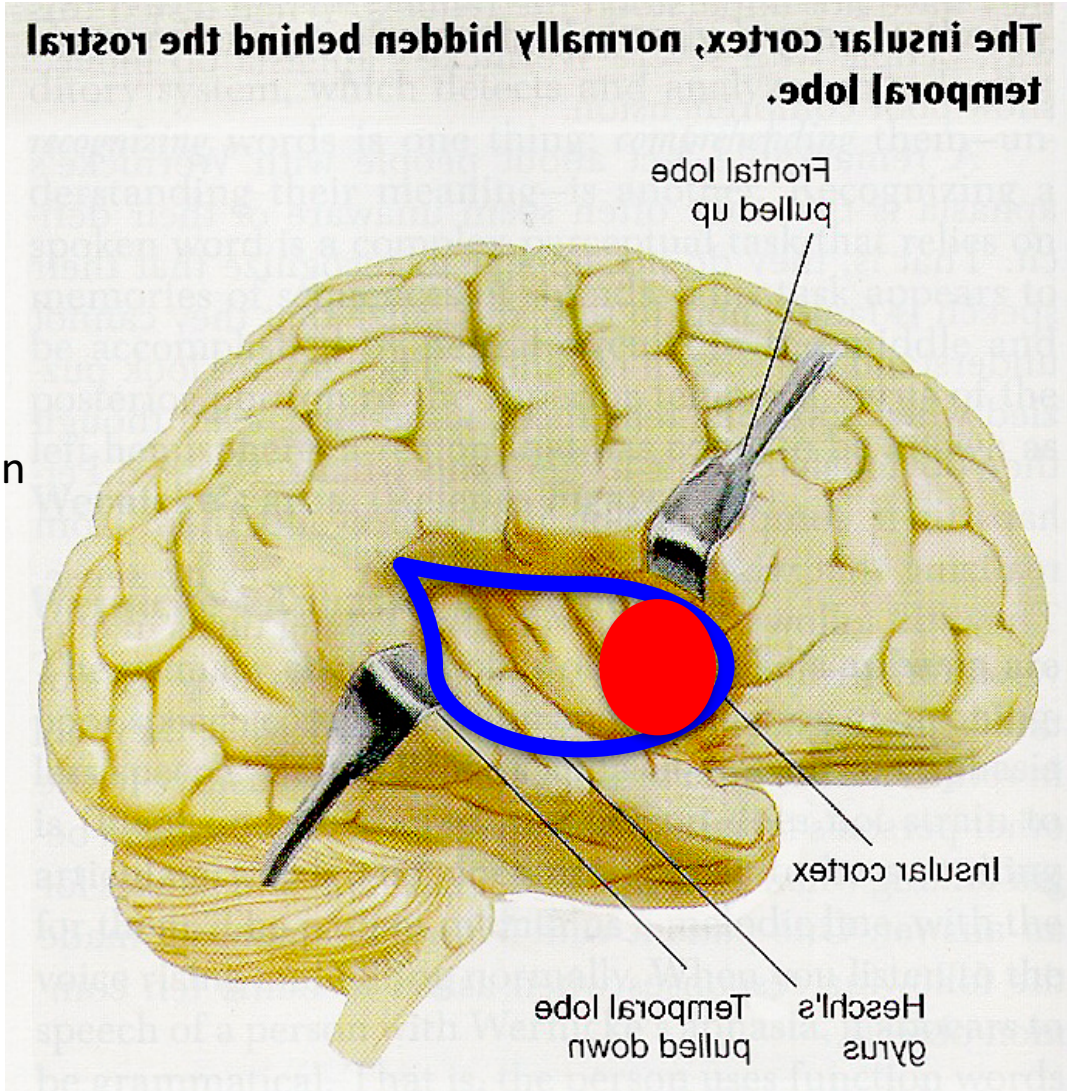
critical in emotional expression in <u>social</u> contexts

It is actually the

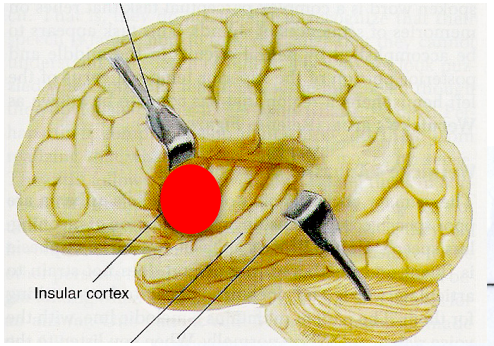
**RIGHT HEMISPHERE**

that is dominant for these functions!

(More on this to come)



# Anterior Insula




Connections between Amygdala & Orbito-Frontal Cortex pass through **Anterior Insula**

Orbito-Frontal Cortex

Amygdala

Thalamus

Fornix

Hypothalamus

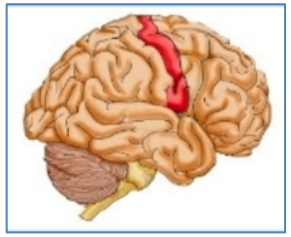
Mämillary body

Olfactory bulb

Amygdala

Hippocampus

## "Volitional Facial Paresis"



Damage to (right)

**Motor Cortex**

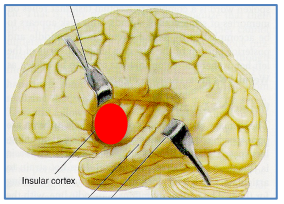
Cannot produce a full smile on command

But does spontaneously smile in a funny social situation

## "Emotional Facial Paresis"

Damage to (left)

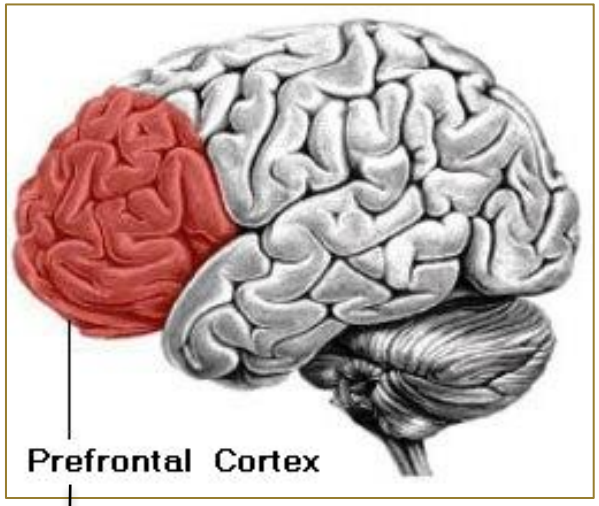
**Anterior Insula**

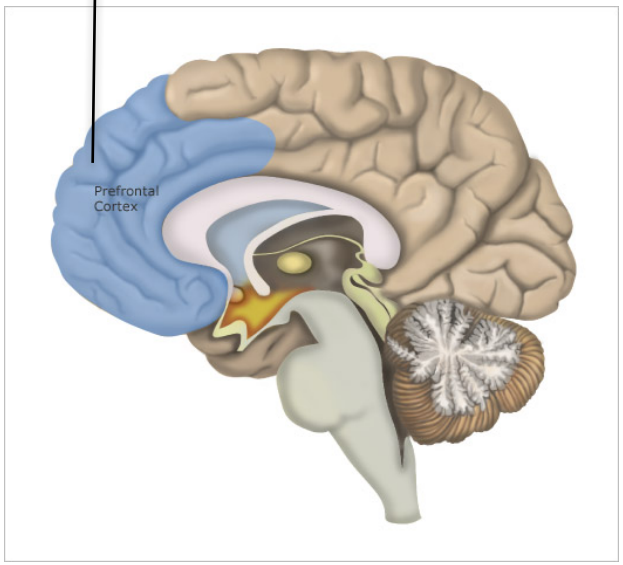


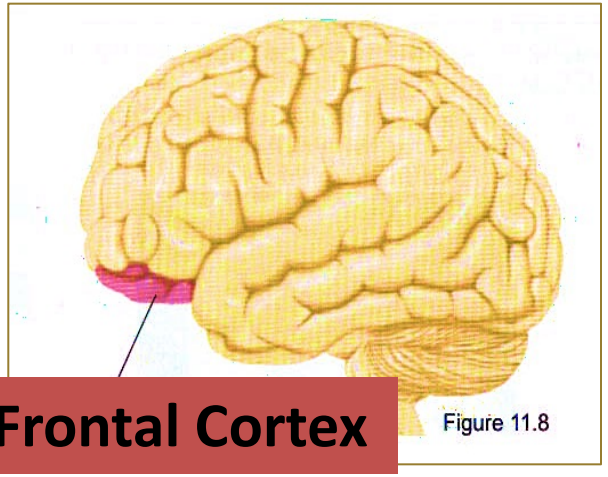

Can produce a full smile on command

But does not spontaneously smile in a funny social situation

# Prefrontal Cortex



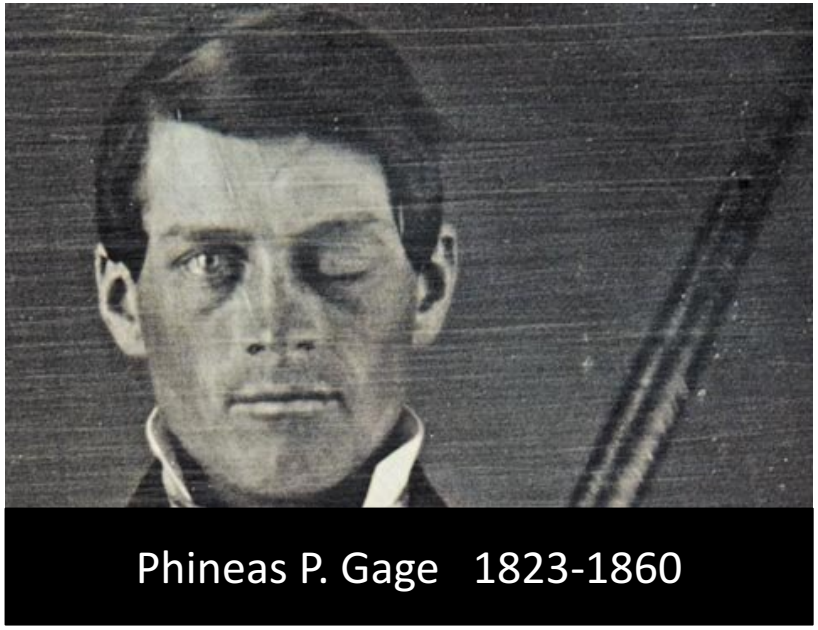




**Orbito-Frontal Cortex**

Area of prefrontal cortex of particular relevance to SOCIAL emotional behavior

# Phineas Gage

Accident obliterated much of his Orbito-Frontal Cortex



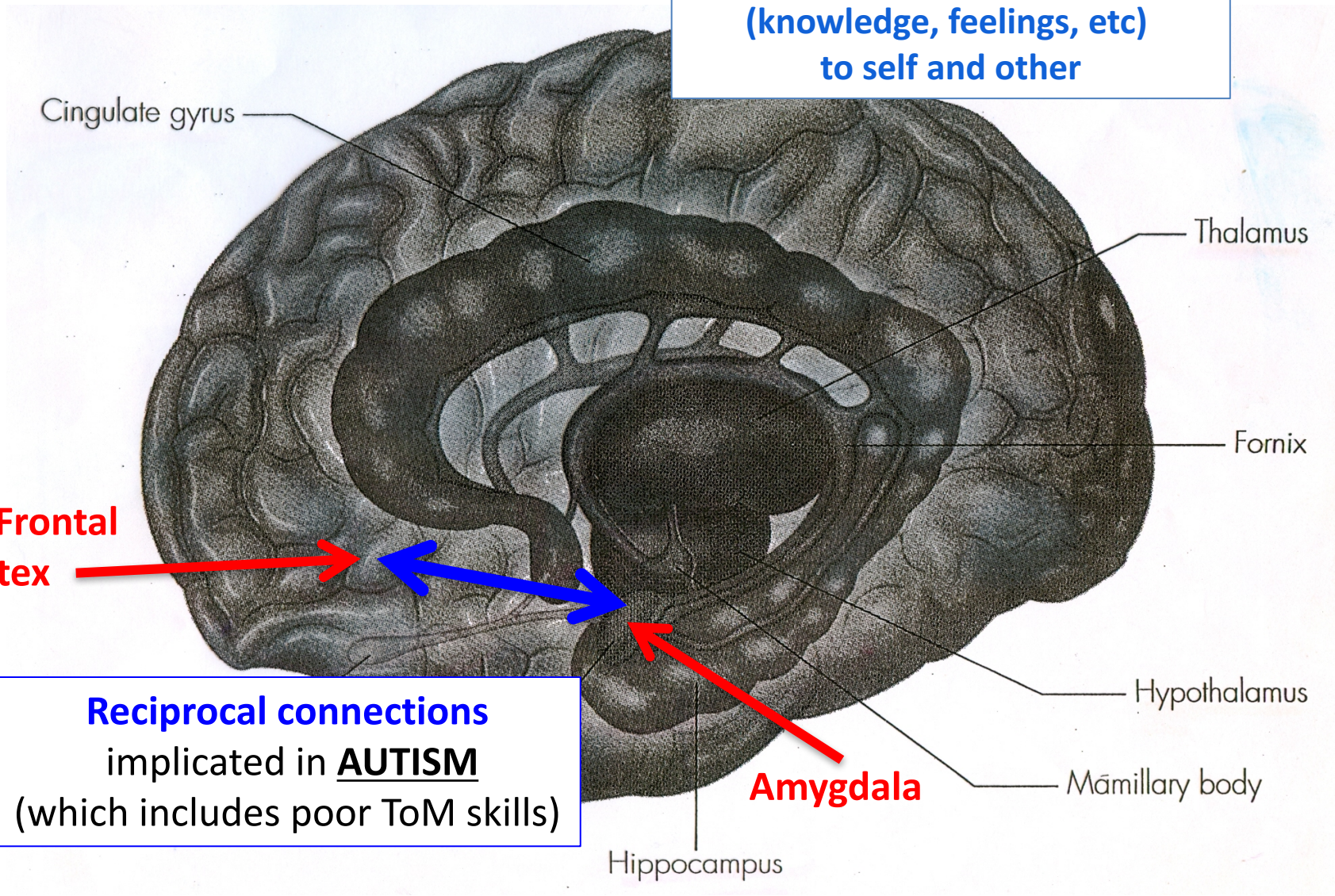
Phineas P. Gage 1823-1860

Changed personality, from upstanding, responsible to impulsive, violent, indifferent to consequences

i.e. Loss of Inhibition, of control by social-appropriateness

# "Theory of Mind"

**Ability to attribute mental states (knowledge, feelings, etc) to self and other**

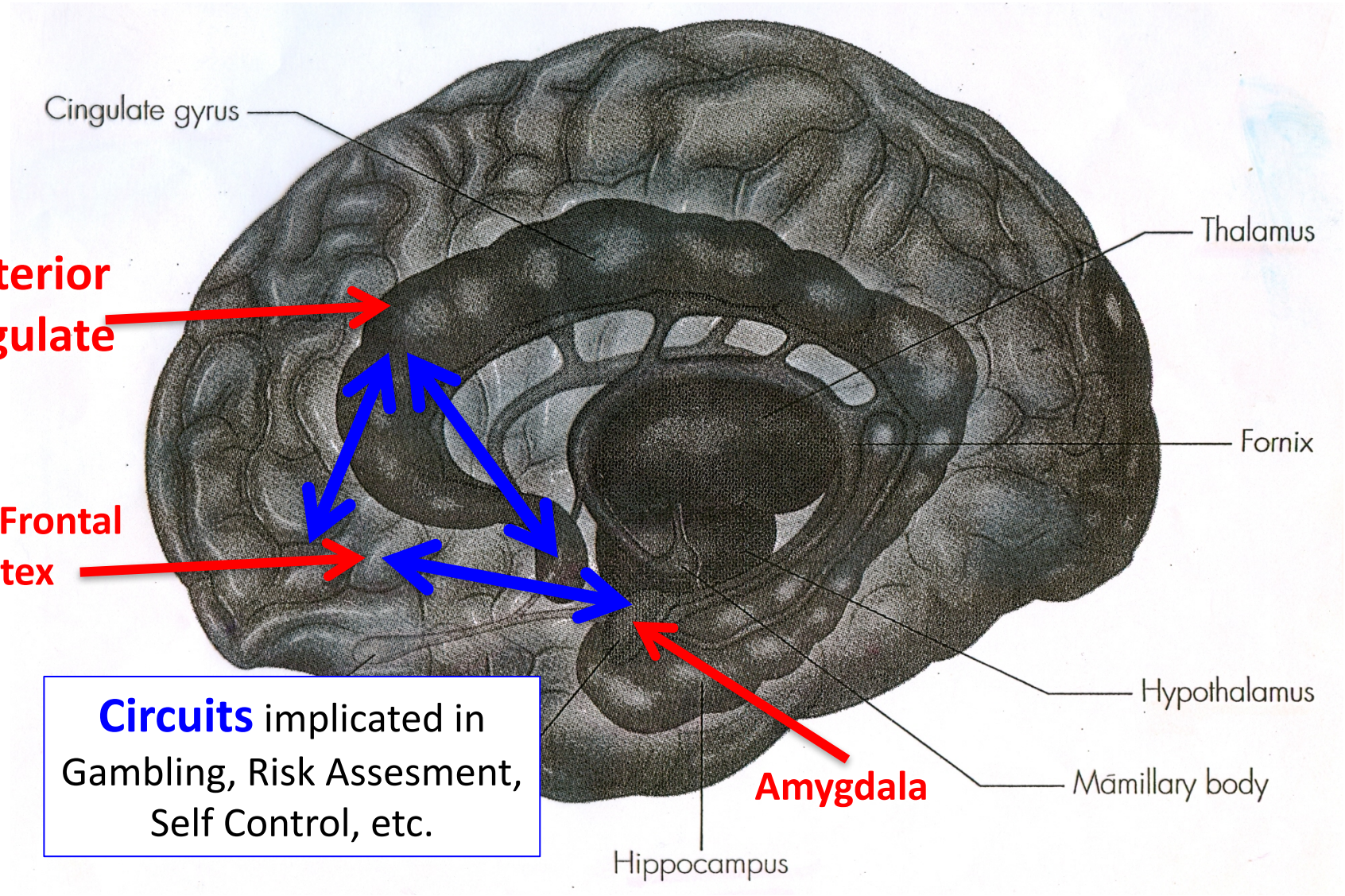



**Orbito-Frontal Cortex**

**Reciprocal connections**
implicated in **AUTISM**
(which includes poor ToM skills)

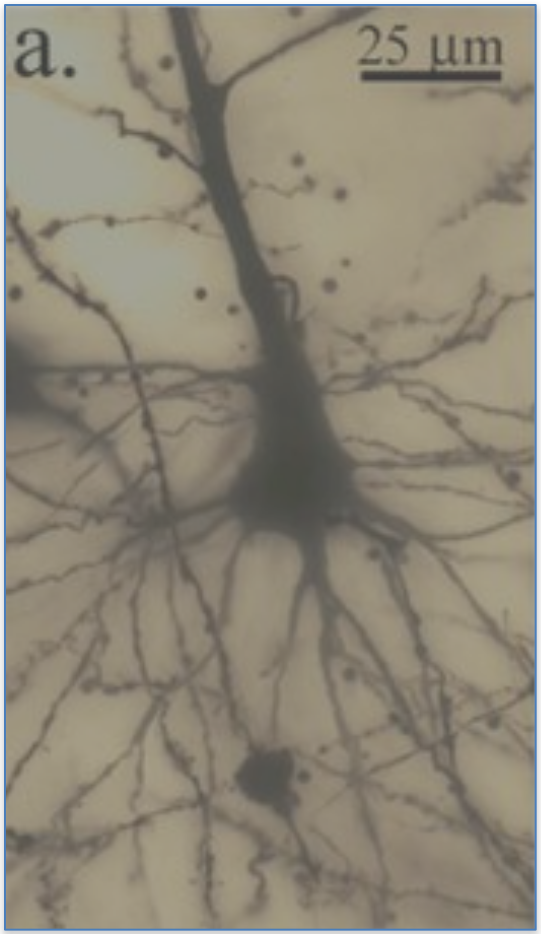
Possibly involve premature synaptogenesis in Orbito-Frontal, before connections with Amygdala develop?

# Cost/Benefit Evaluation




**Circuits** implicated in Gambling, Risk Assesment, Self Control, etc.

# Von Economo Cells




Typical Pyramidal Cell

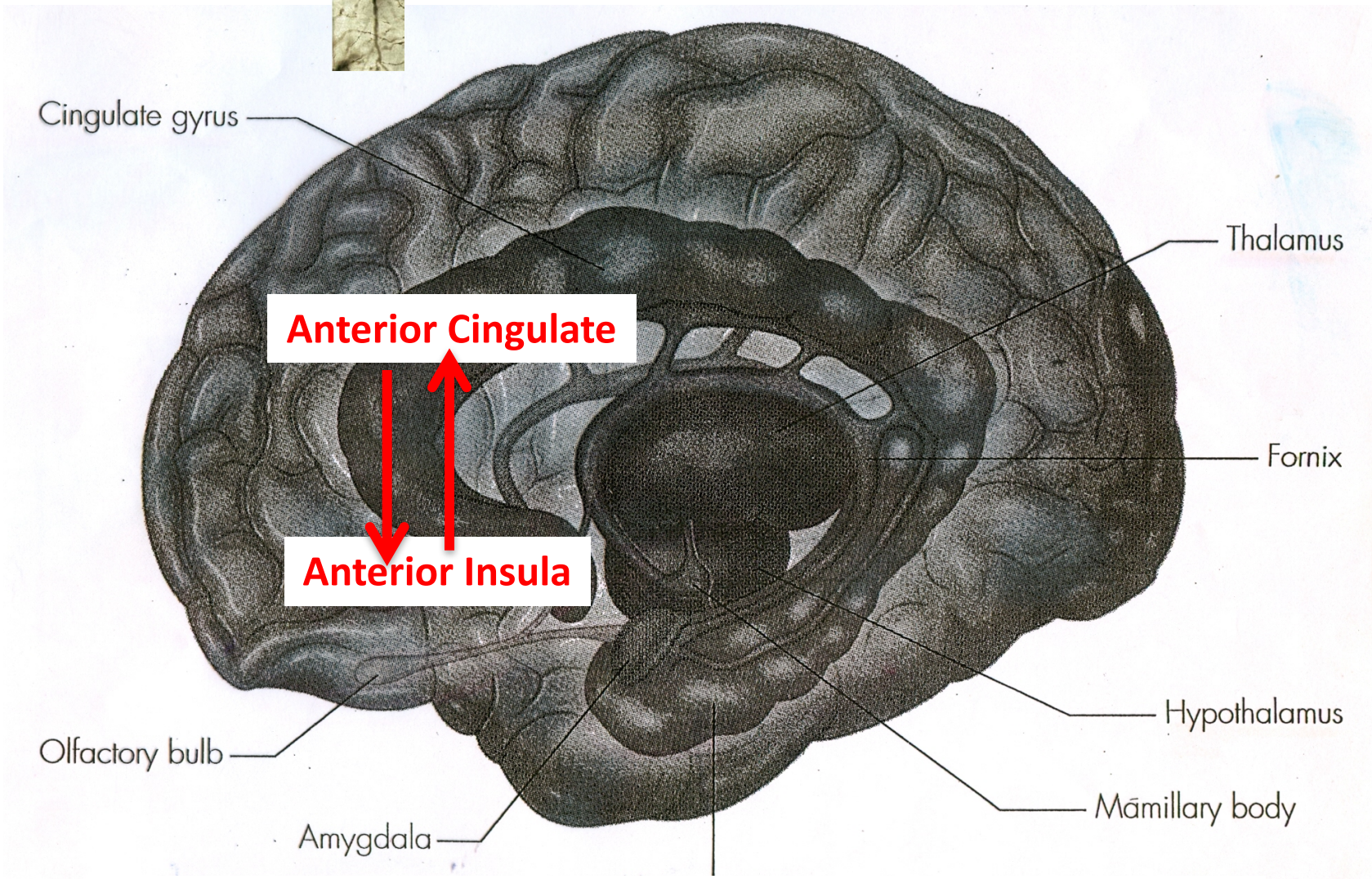

**Von Economo or "Spindle" Cell**

Long fibers, with few branches

Found only in large-brained animals (humans, elephants, whales)

Communicate between distant brain areas, with little intervening influence

## Von Economo Cells



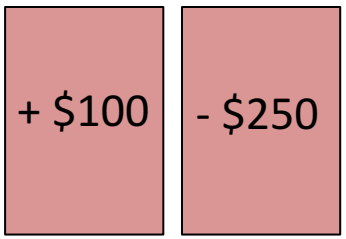

Connect **Anterior Insula** (social emotion) to

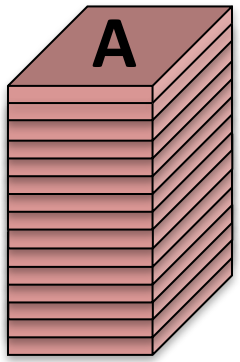
**Anterior Cingulate** (social risk, cost/benefit analysis)

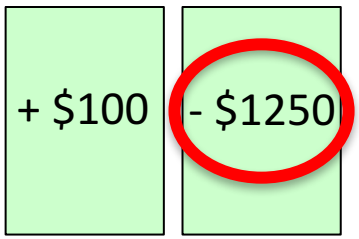
# Gambling Task

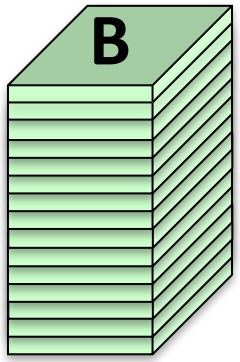
Subjects can freely select cards from any pile

They do not know payoff structure (+ and -) of each pile in advance

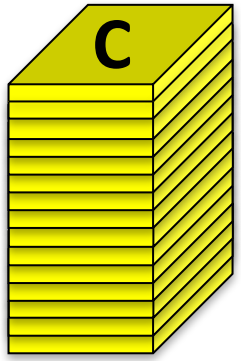


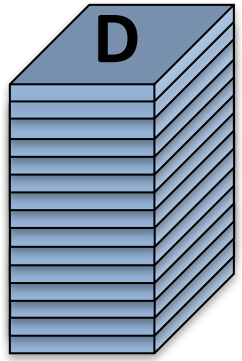









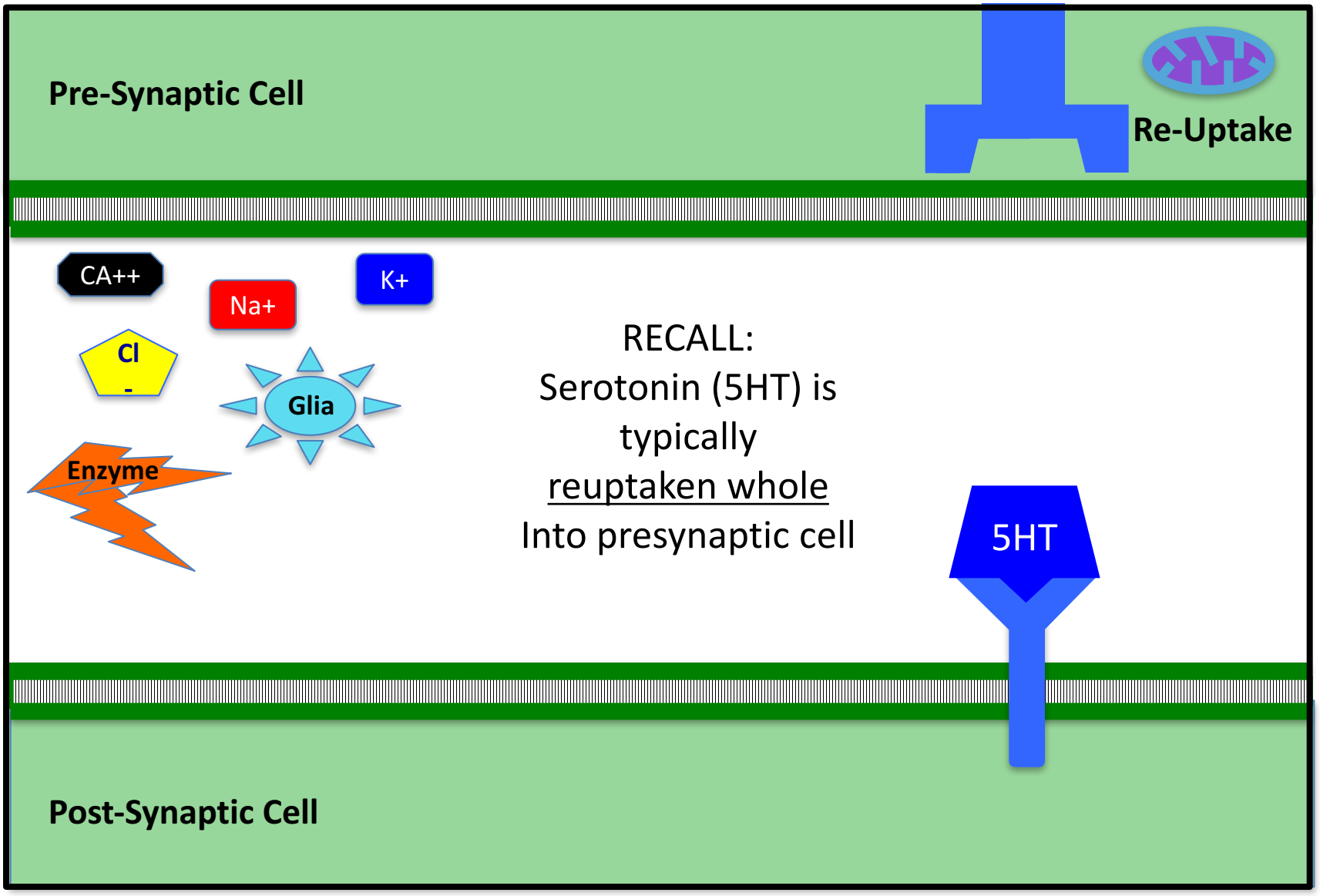



| | Feel Bad at Penalty | Show Anticipatory Anxiety | Shift from Worst (B) |
|---|---|---|---|
| Normal | + | + | + |
| Prefrontal Lesion | + | − | − |
| Amygdala Lesion | − | − | − |

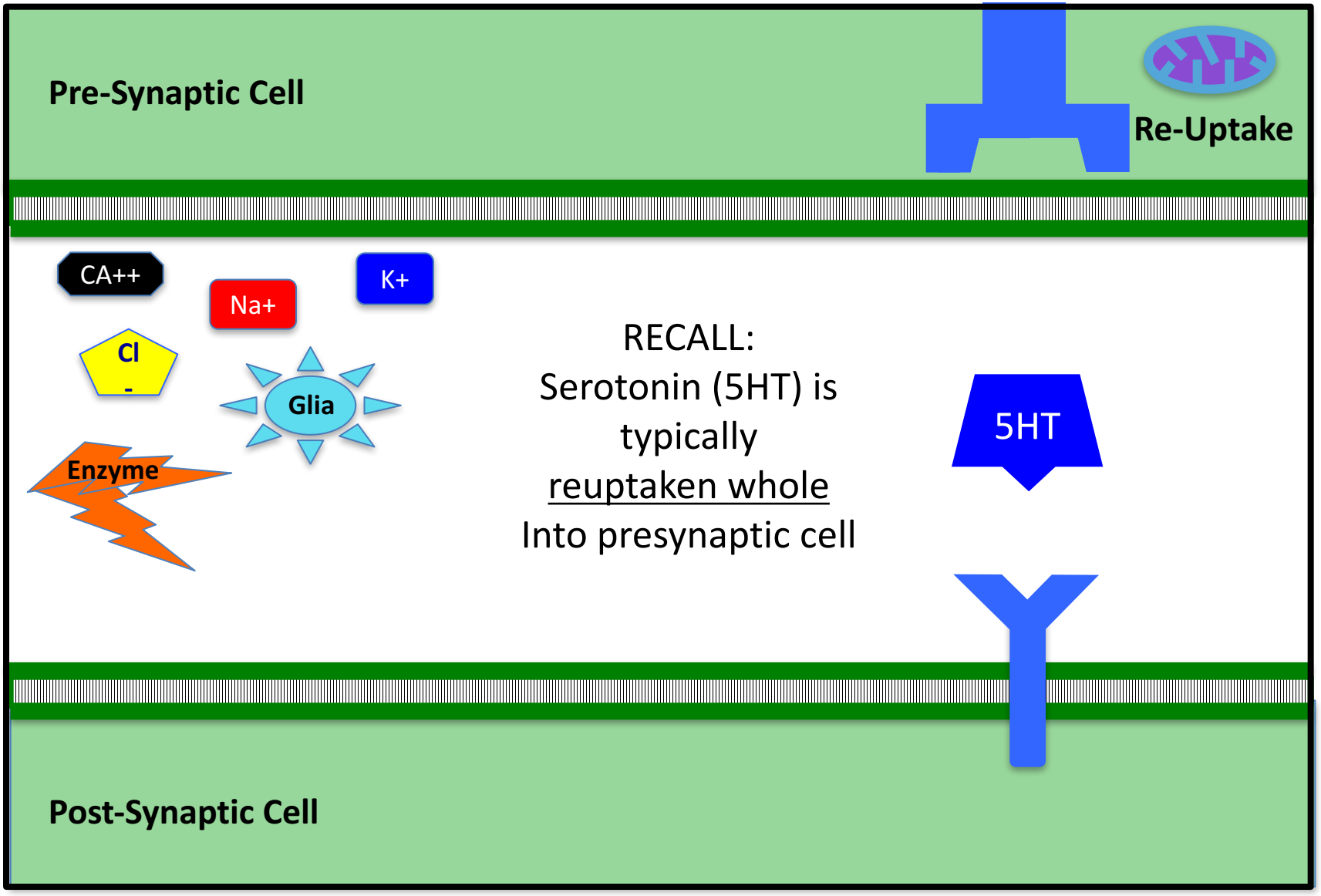
**Don't Learn!**

# Neurotransmitter Activity involved in EMOTION

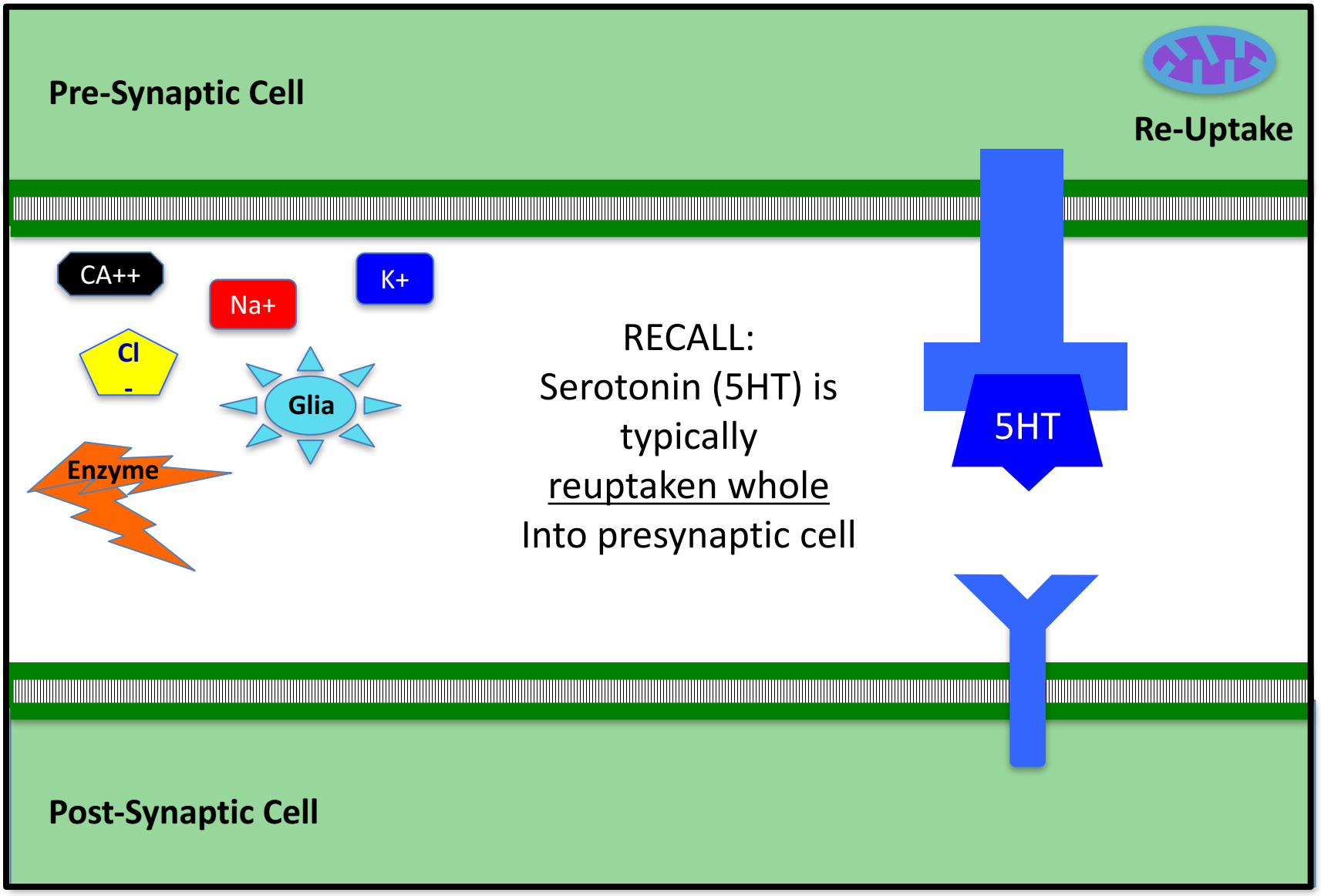
# Serotonin (5HT) in Amygdala



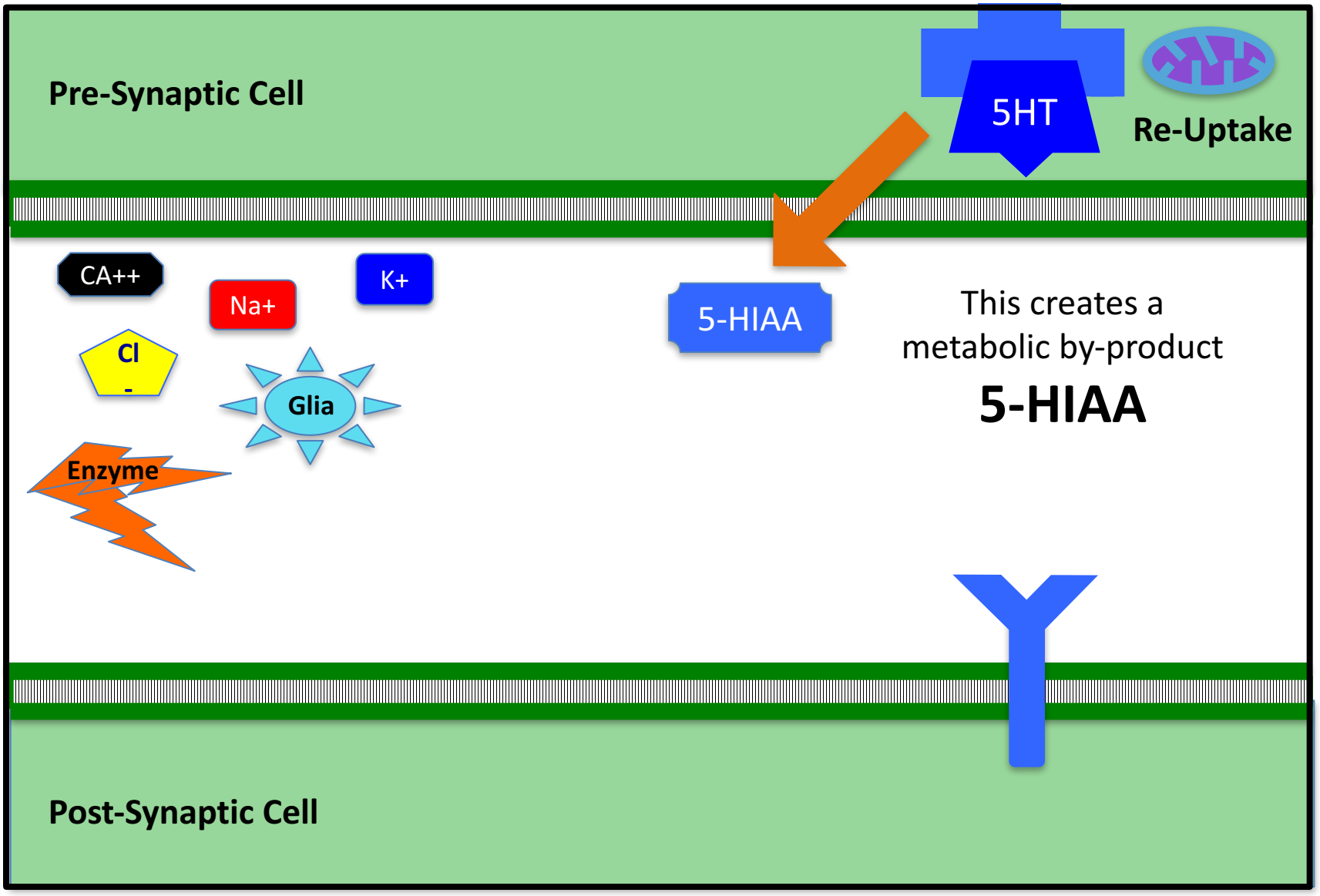
# Serotonin (5HT) in Amygdala



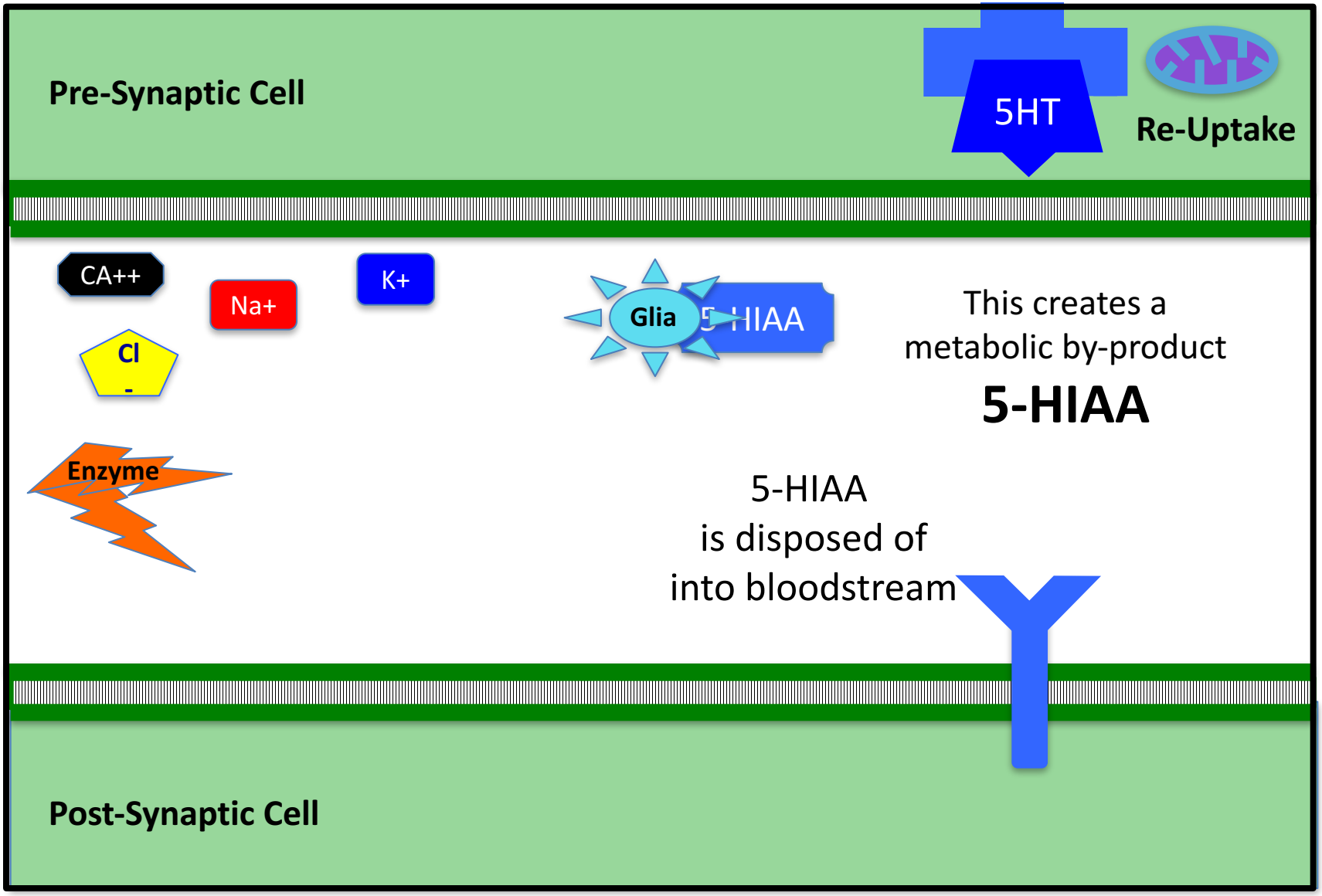
# Serotonin (5HT) in Amygdala



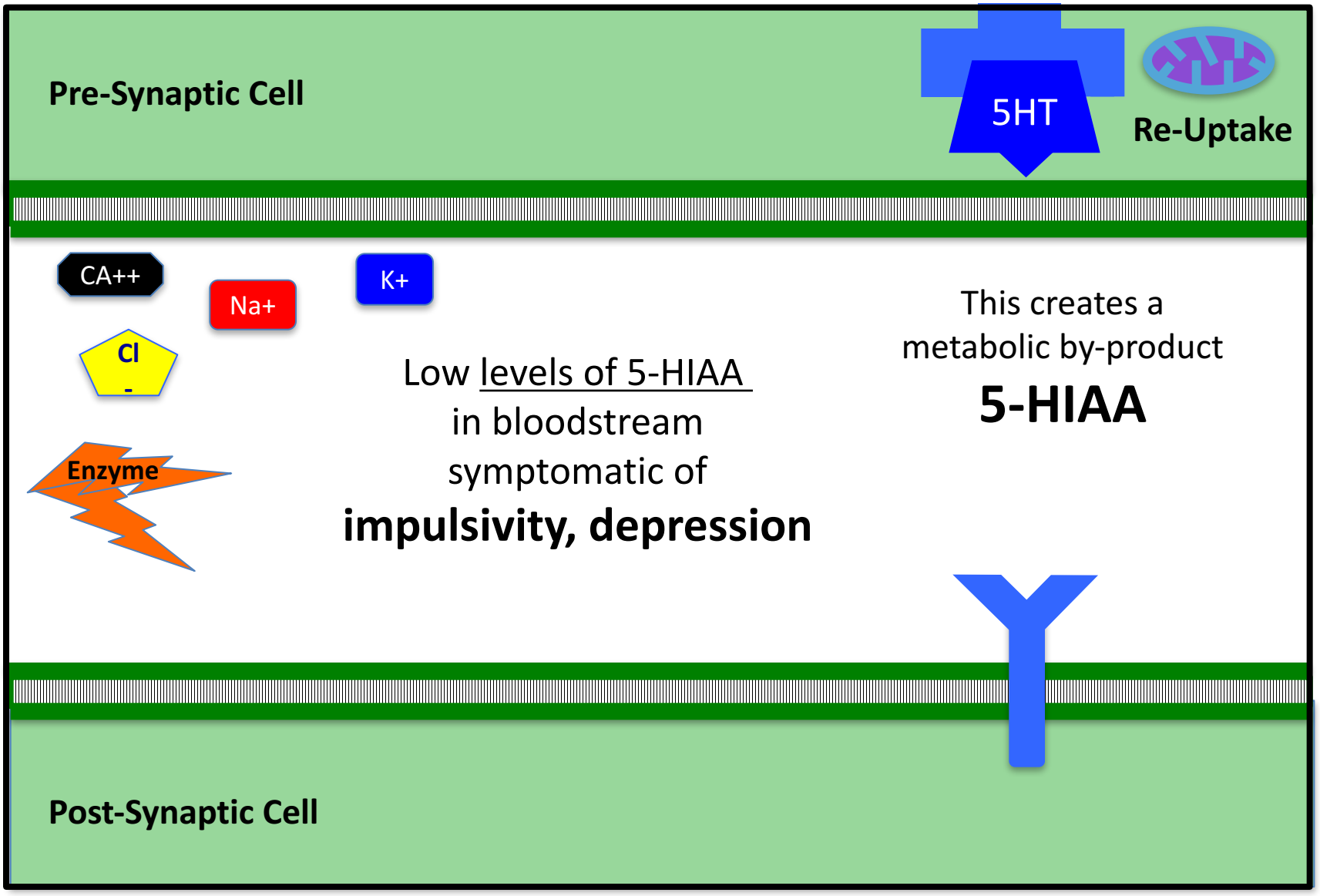
# Serotonin (5HT) in Amygdala



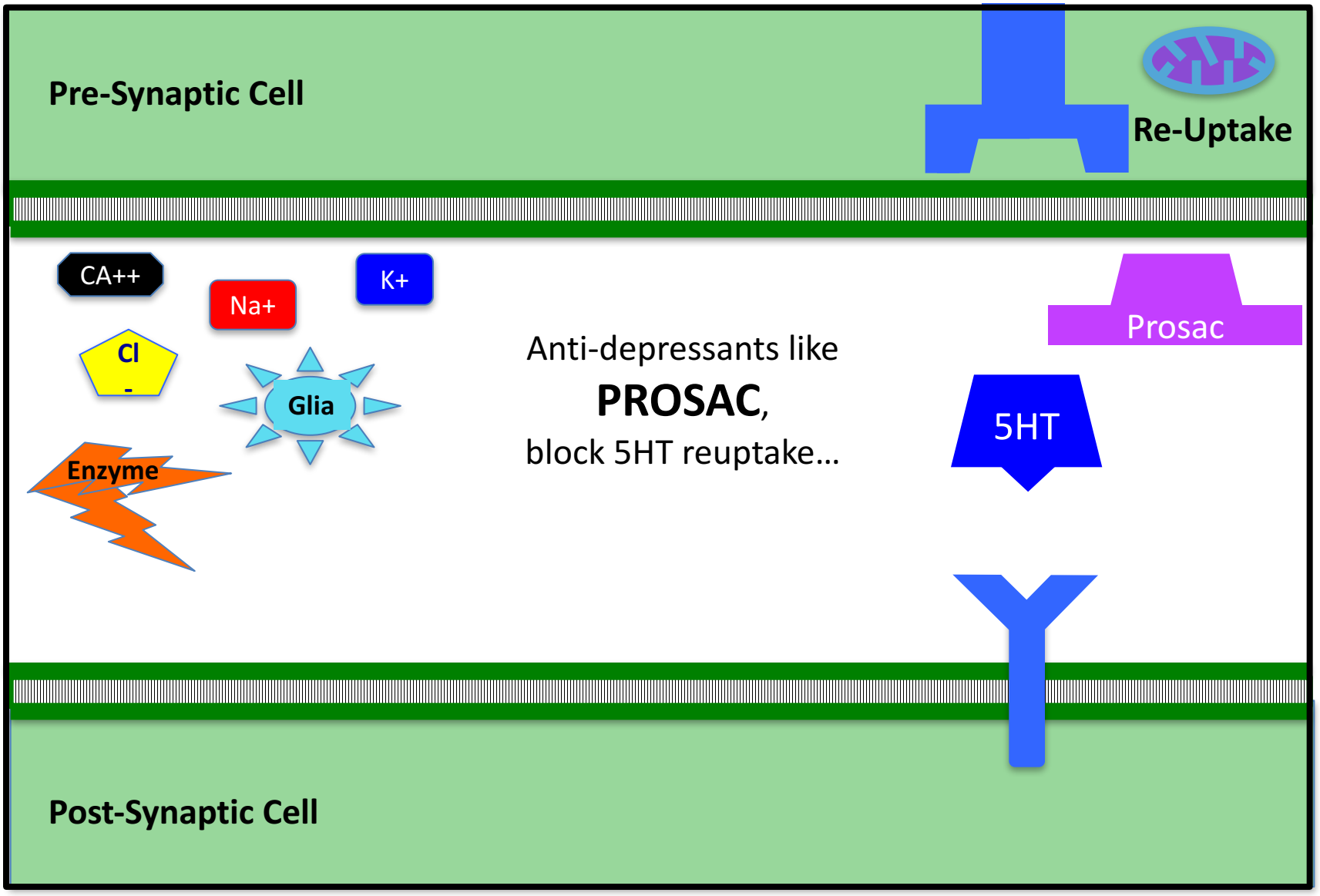
# Serotonin (5HT) in Amygdala



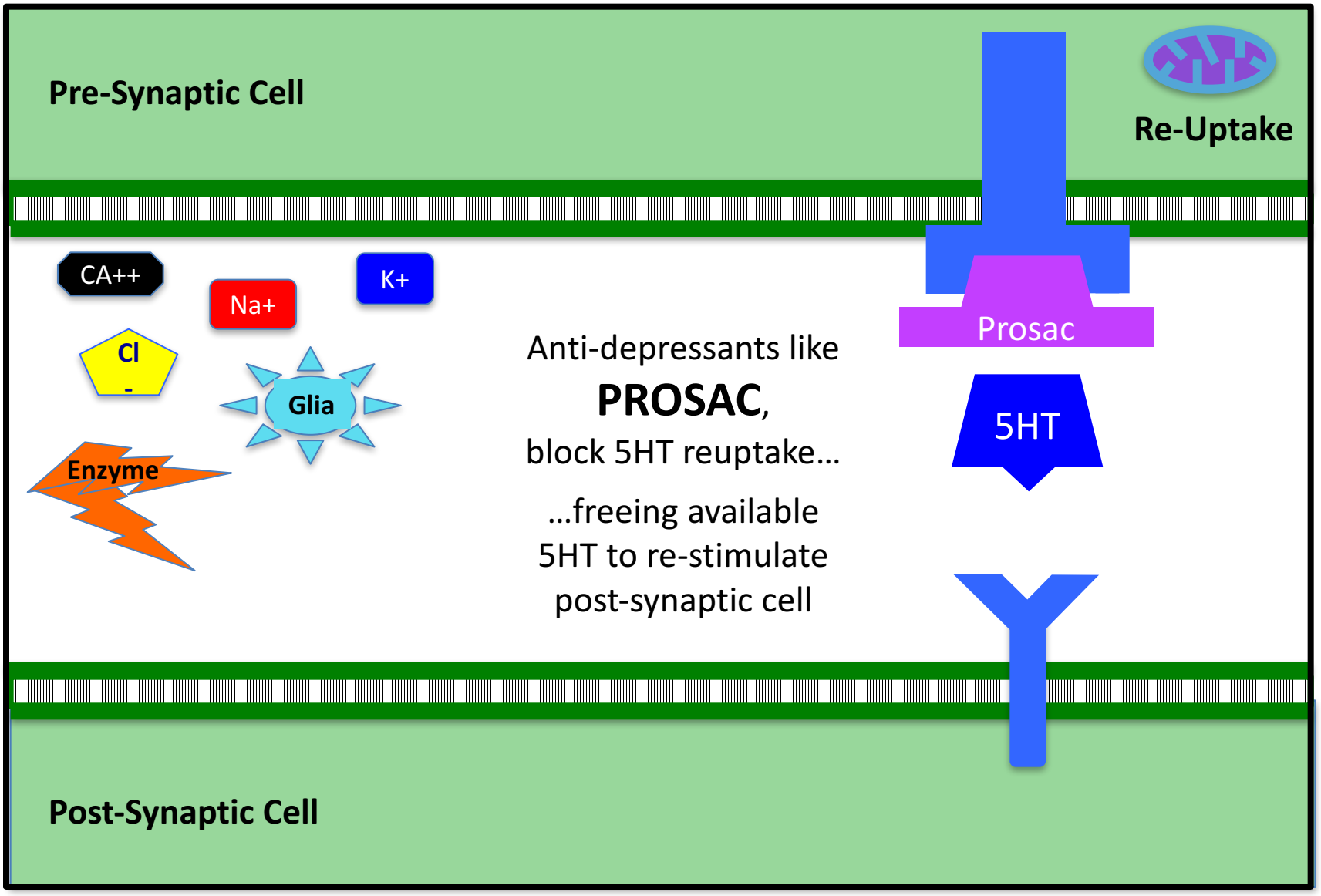
# Serotonin (5HT) in Amygdala



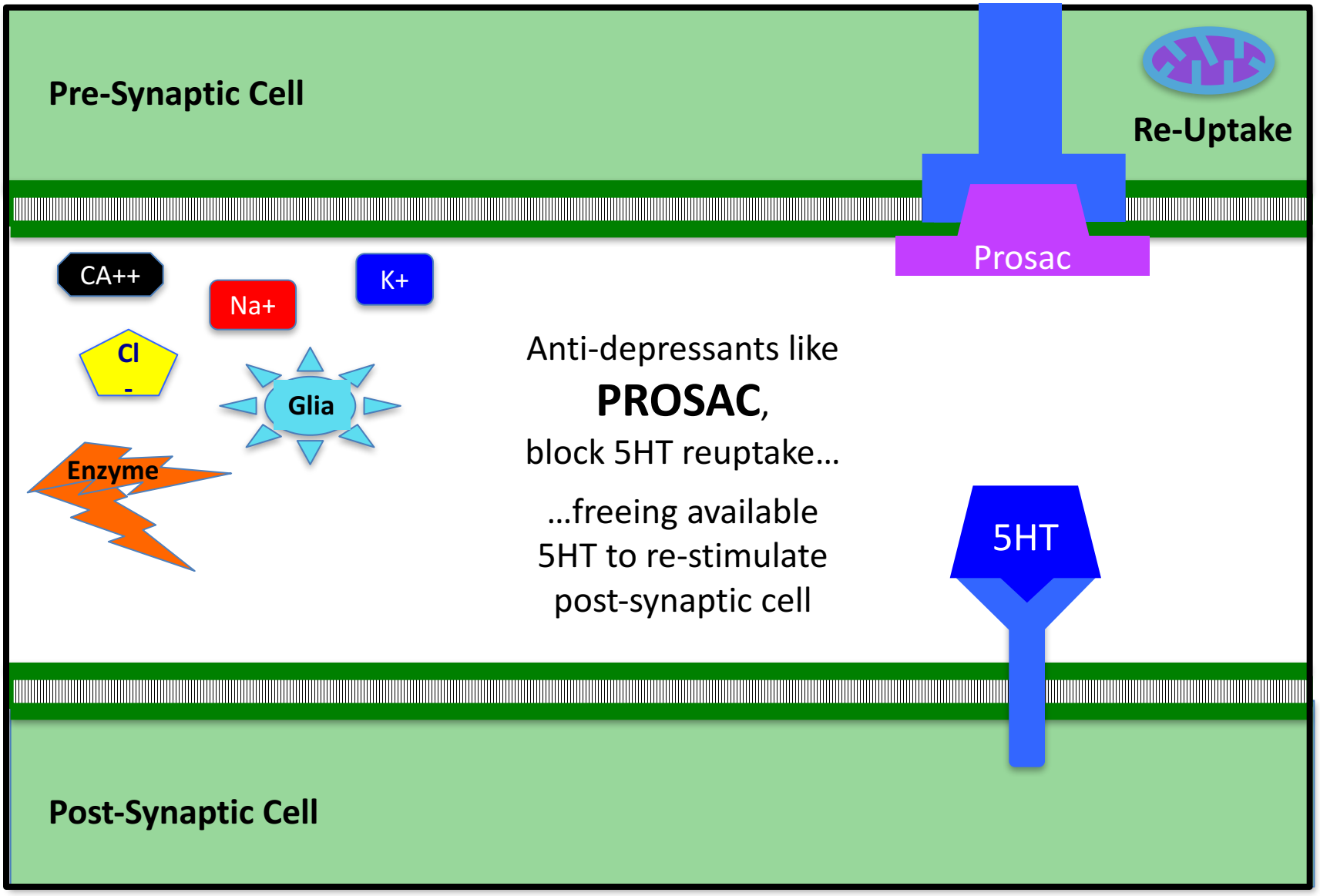
# Serotonin (5HT) in Amygdala



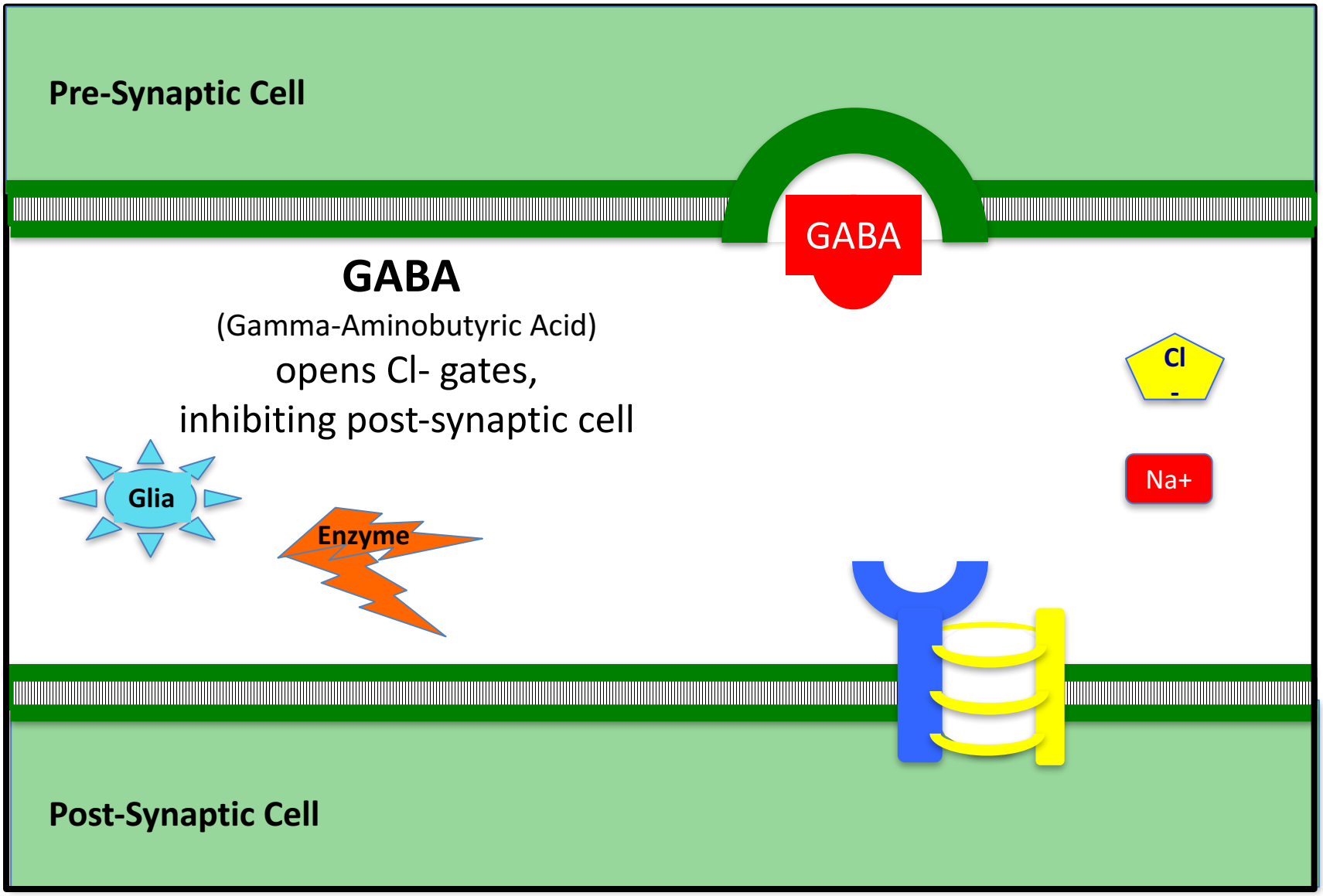
# Serotonin (5HT) in Amygdala



# Serotonin (5HT) in Amygdala



# GABA in Amygdala



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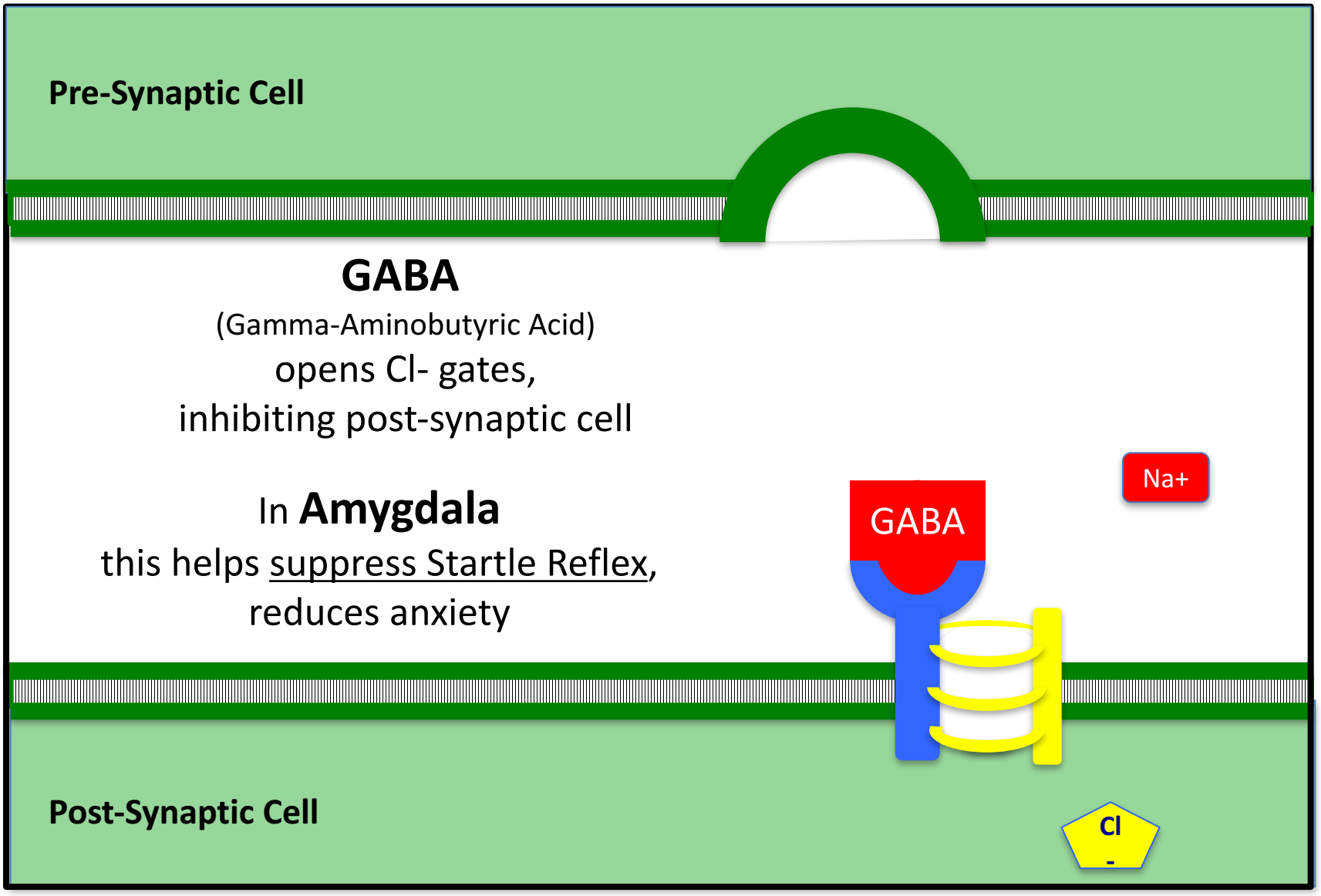

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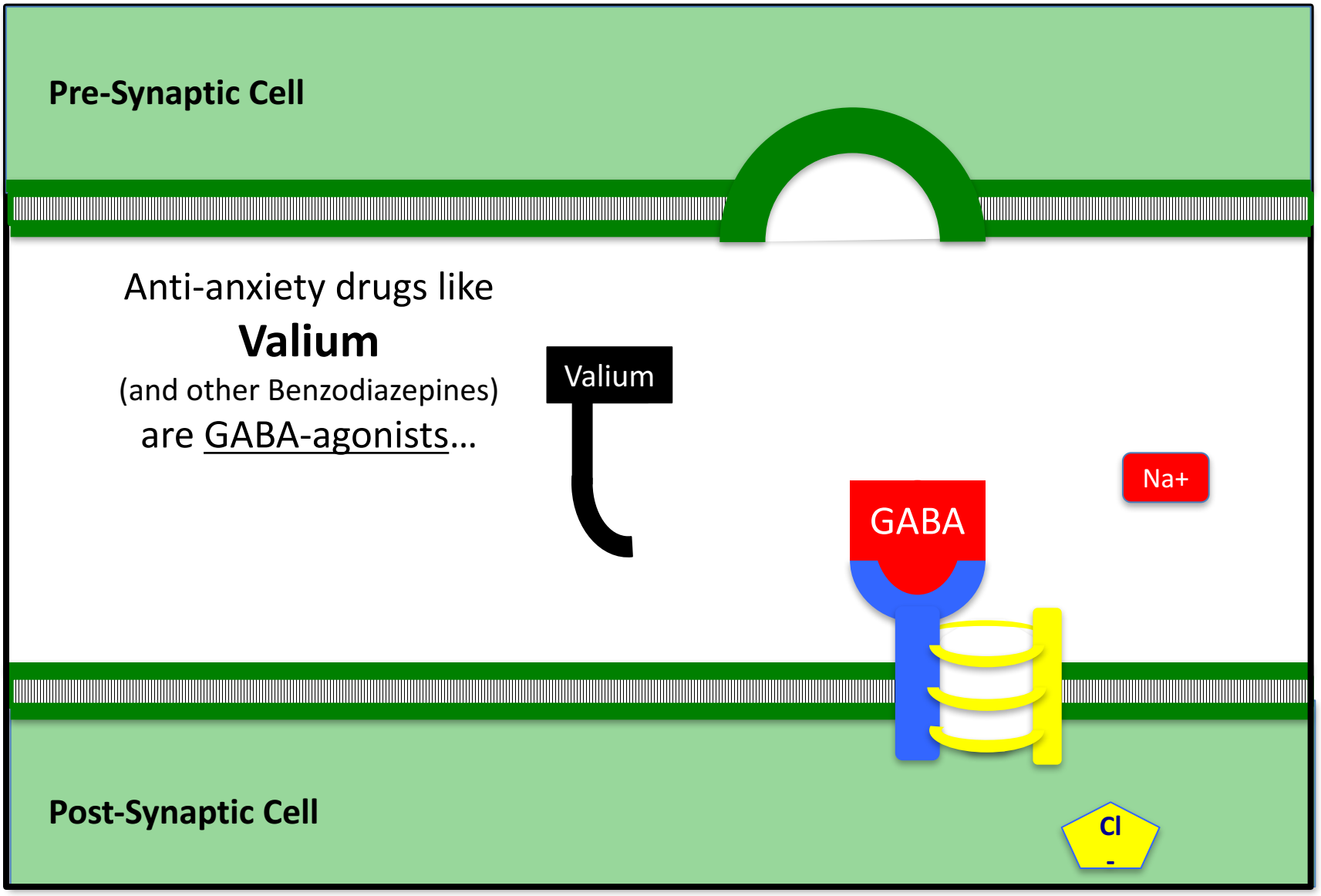
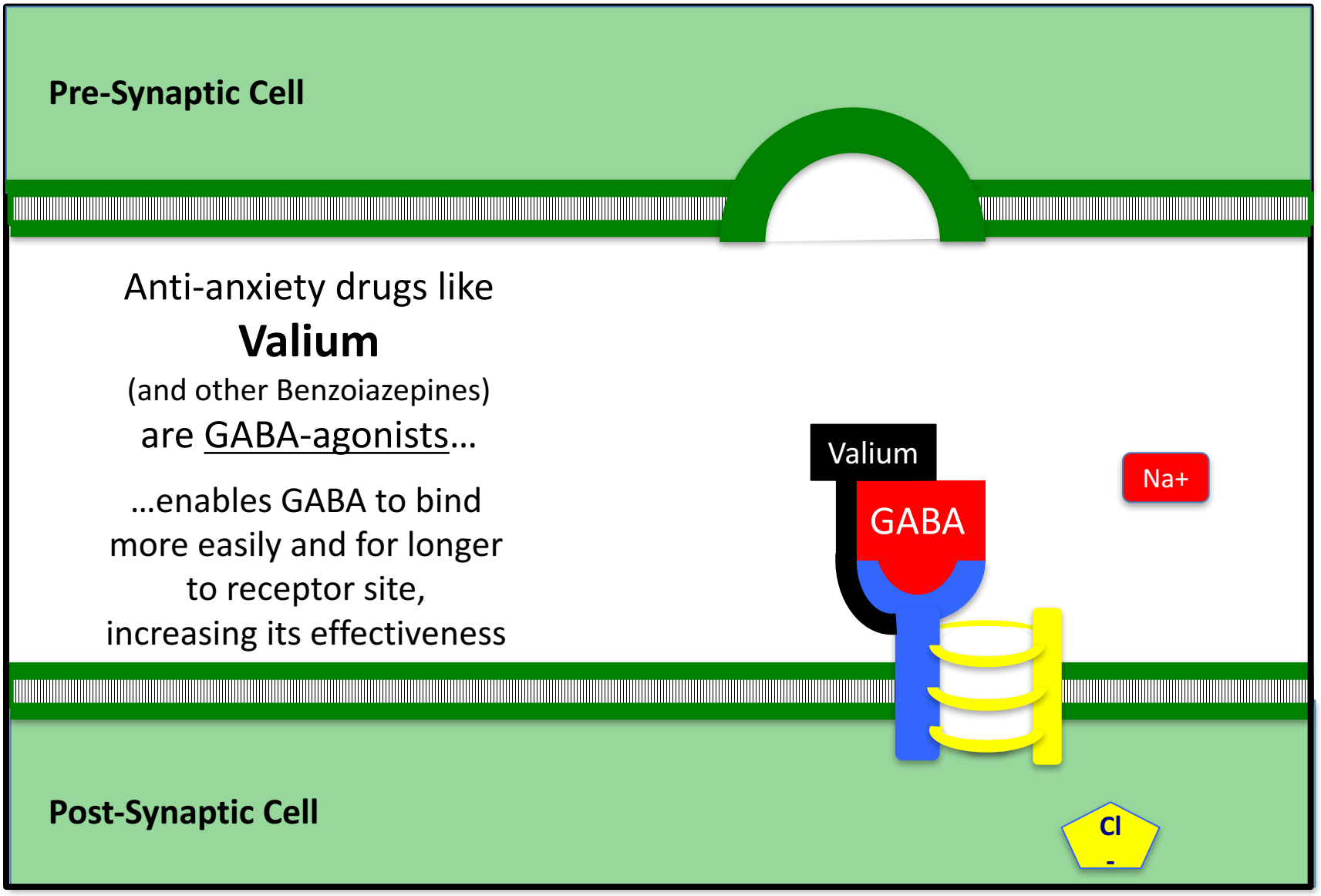
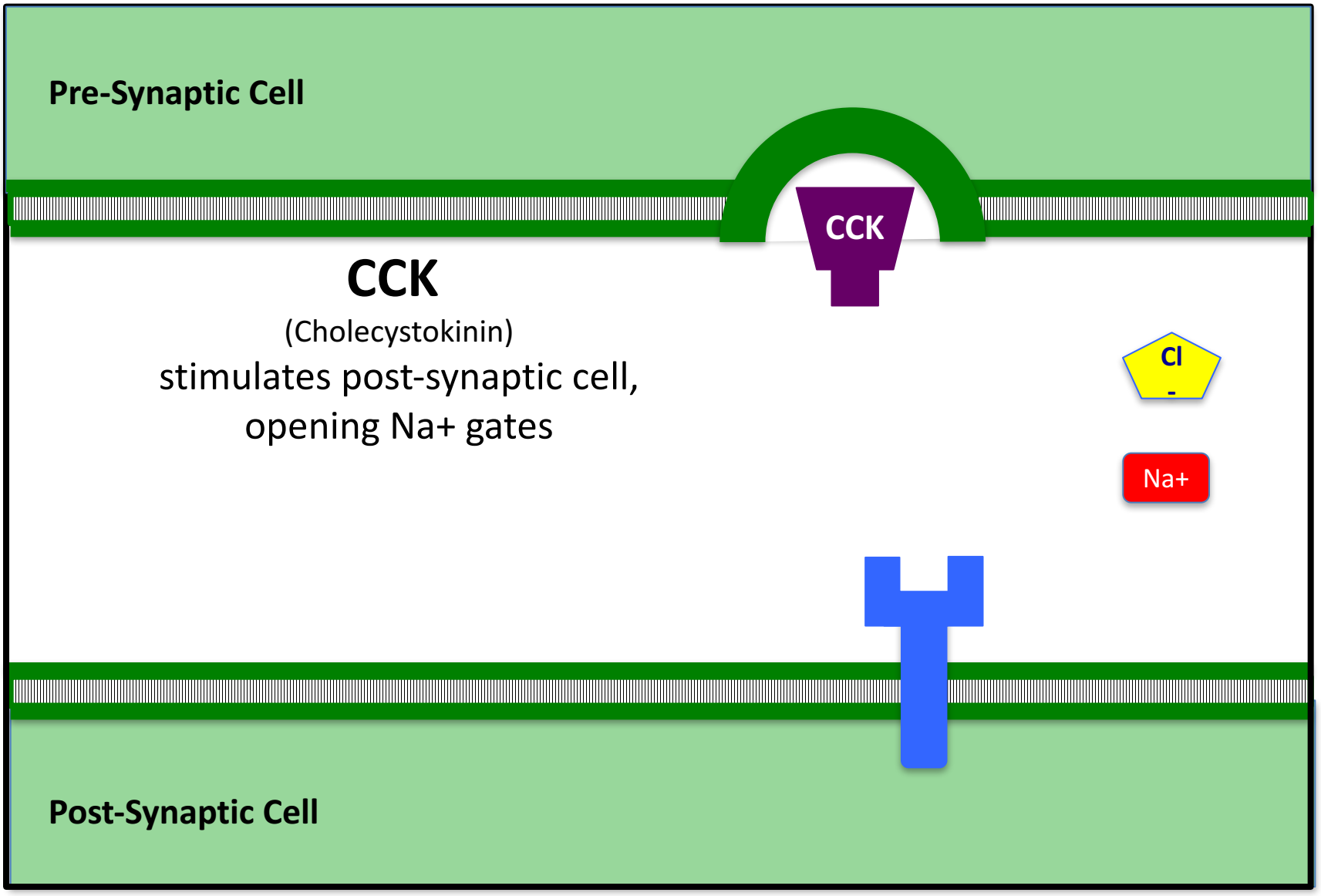


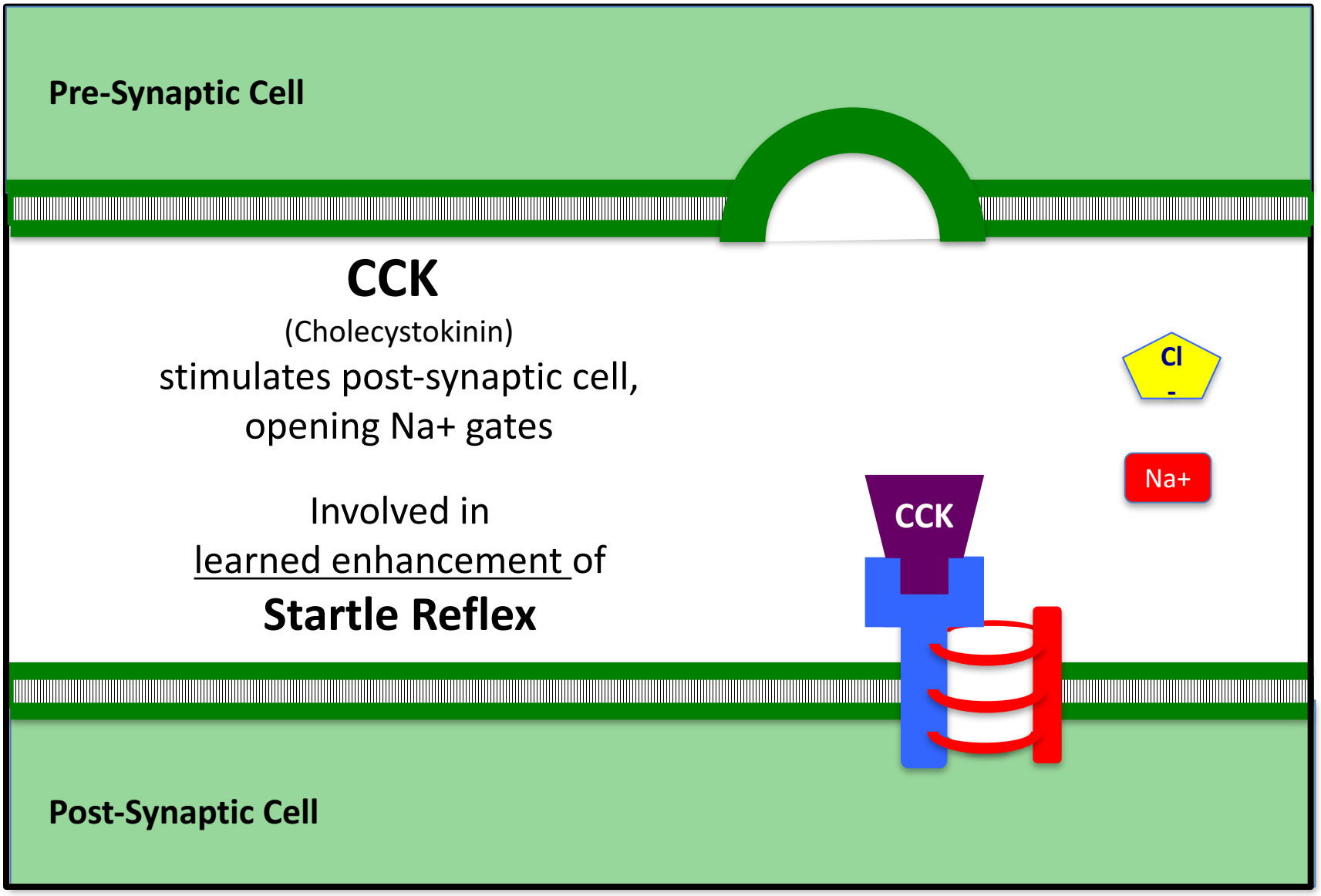
# GABA in Amygdala



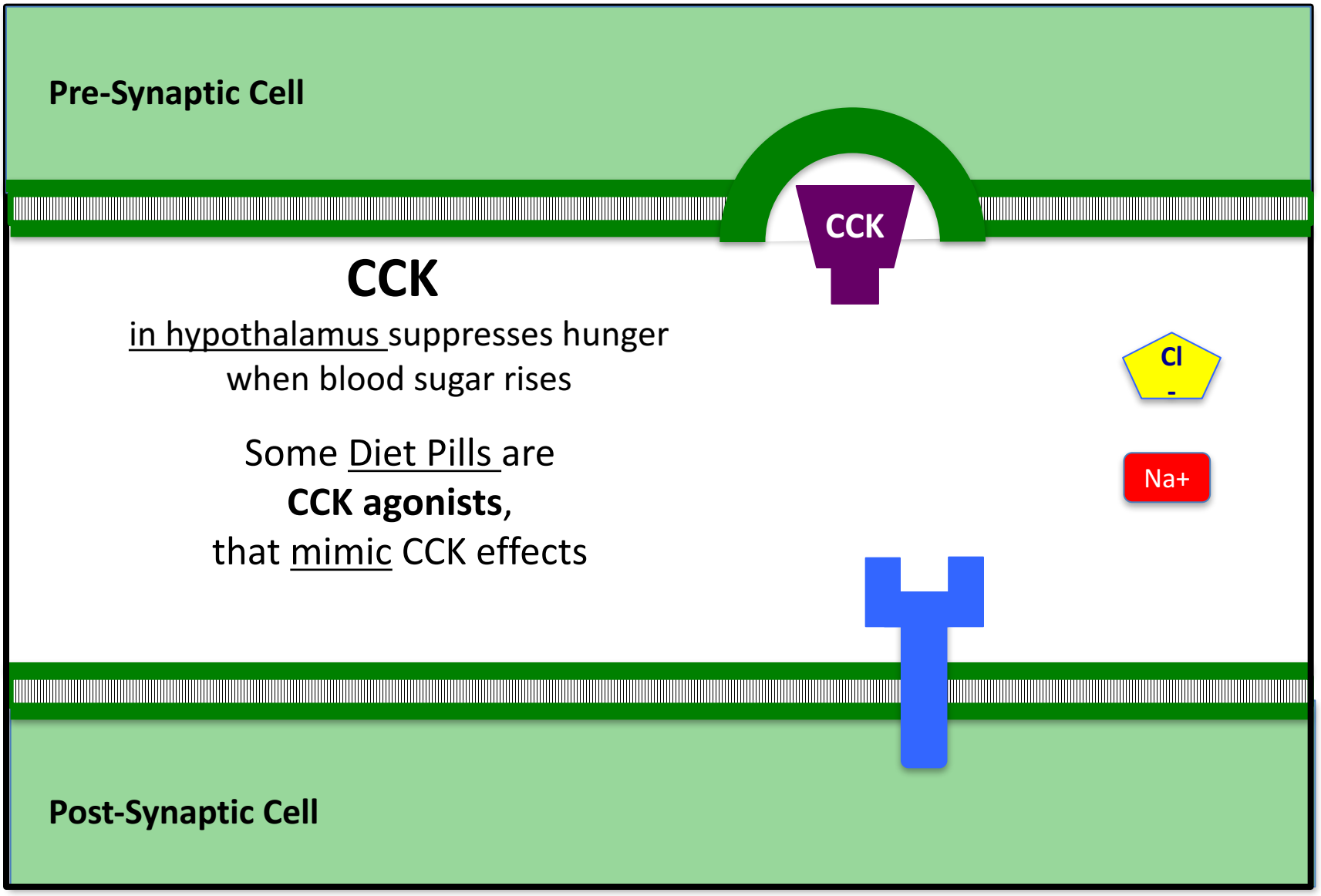
# CCK in Amygdala



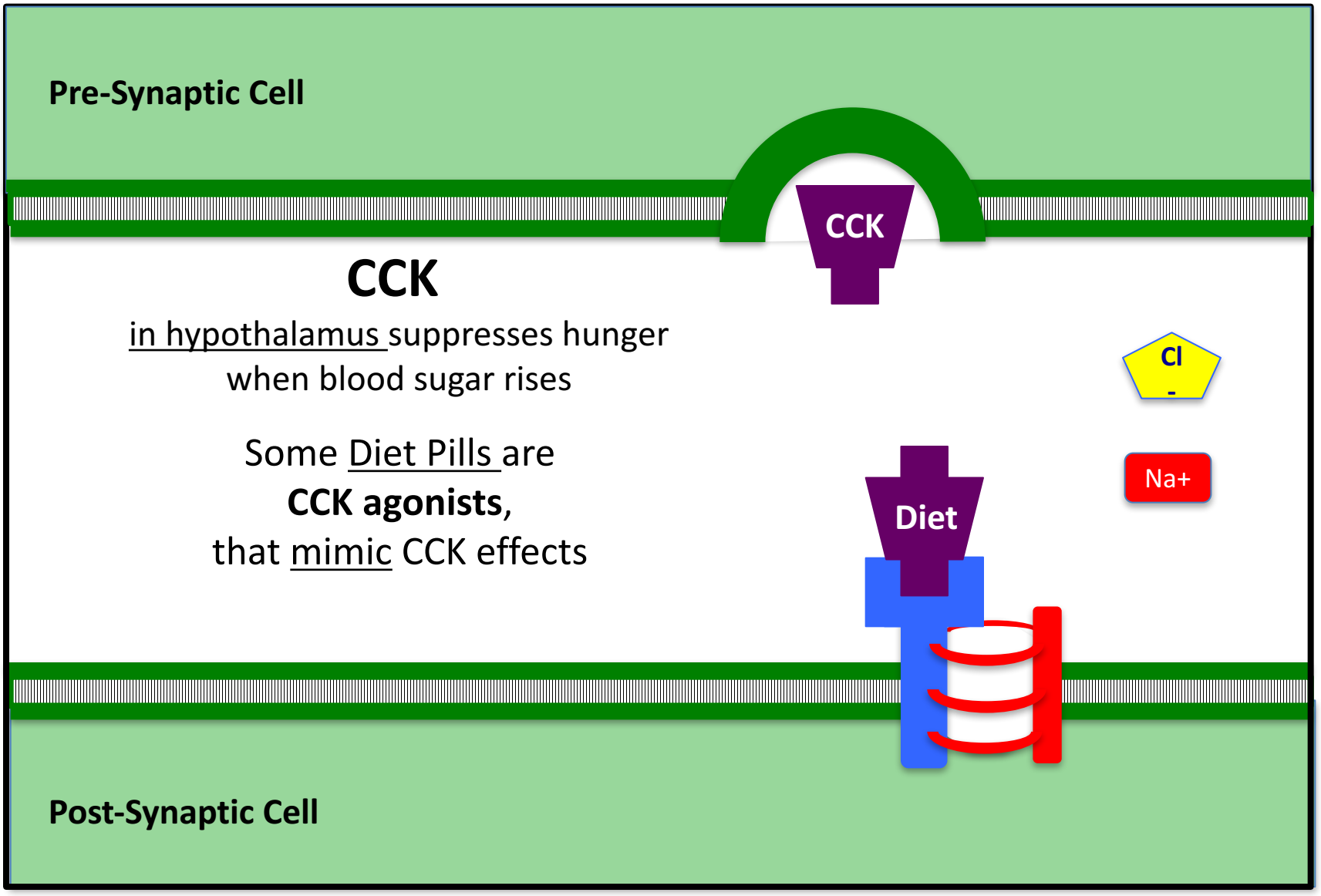
# CCK in Amygdala



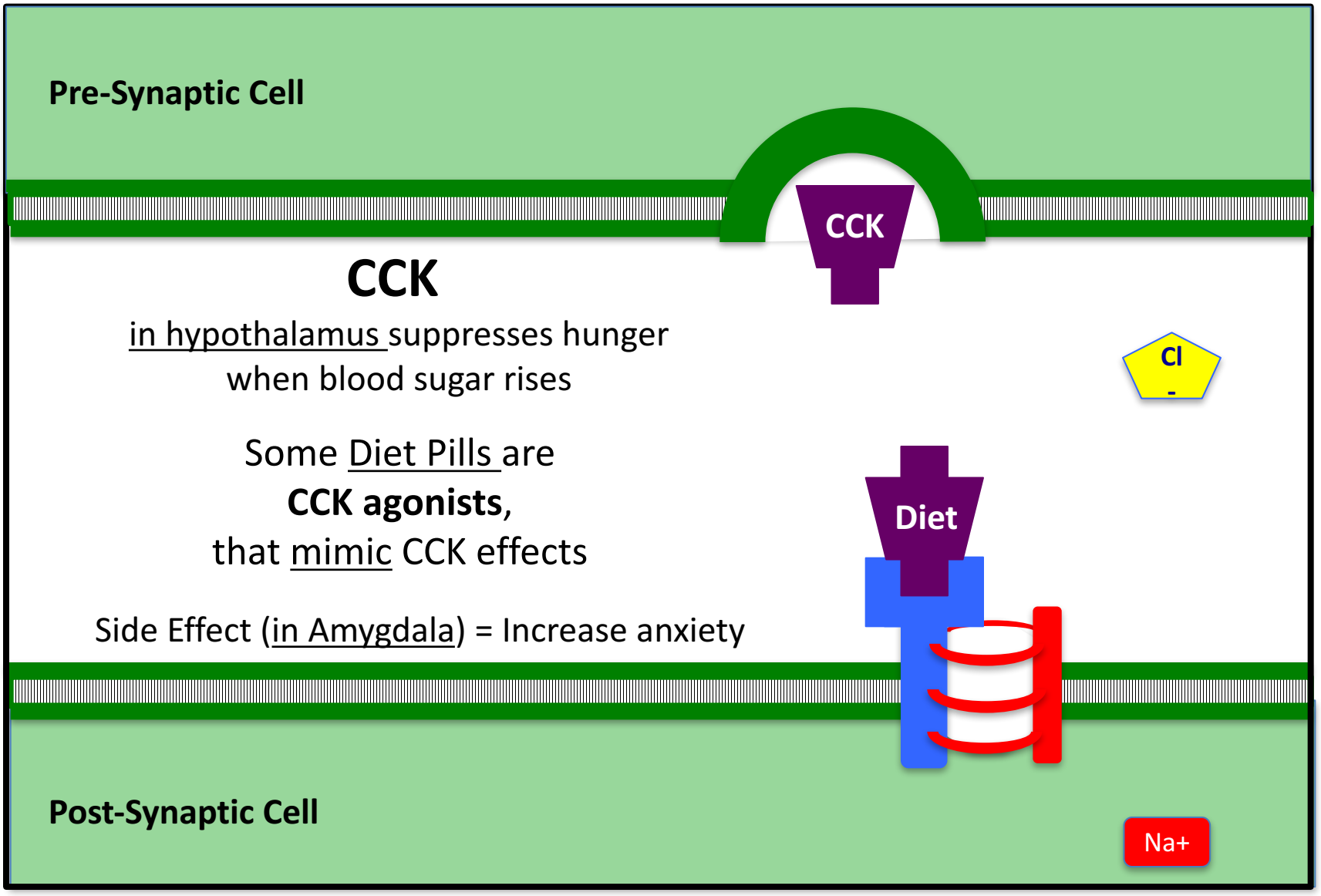
# CCK in Hypothalamus



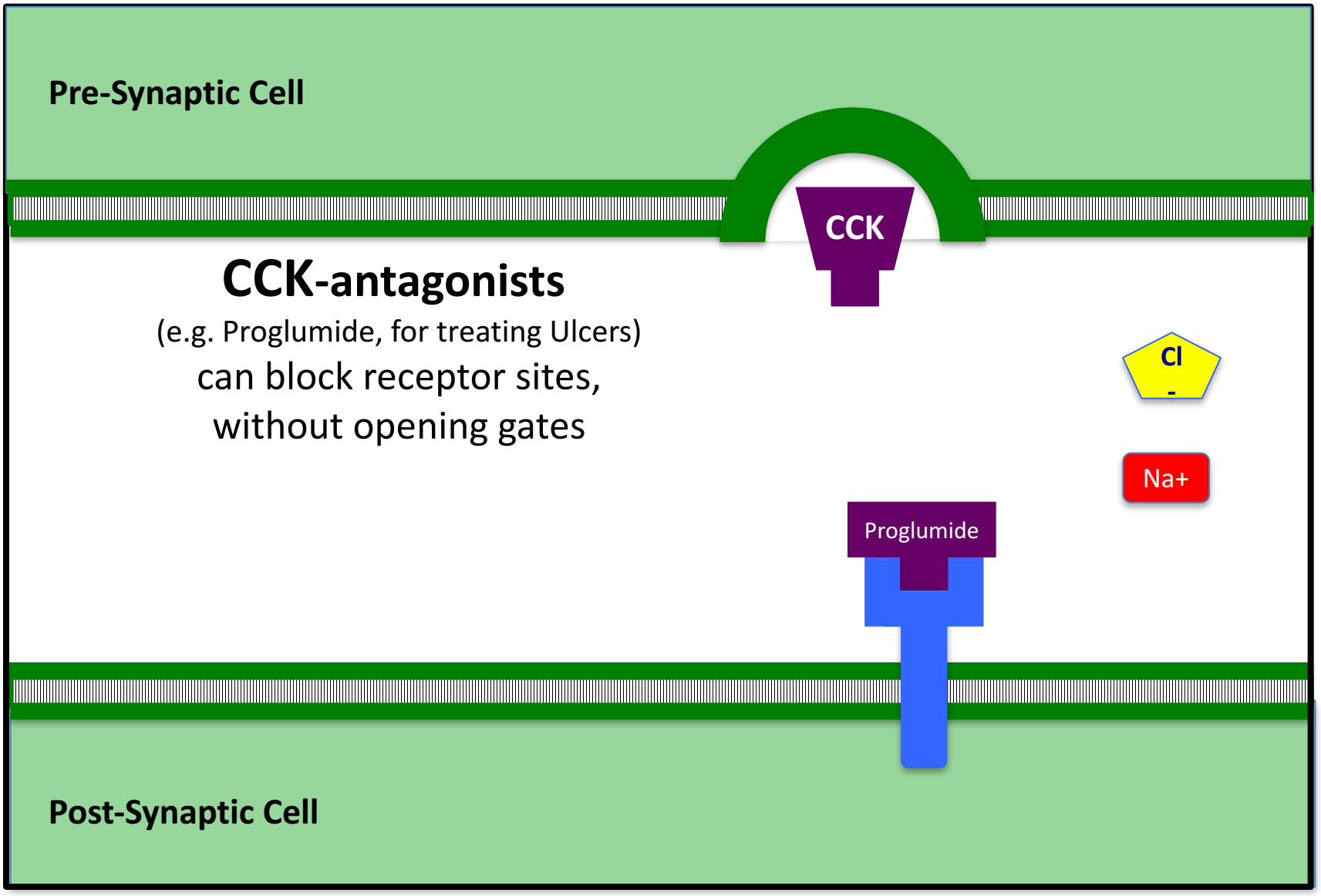
# CCK in Hypothalamus



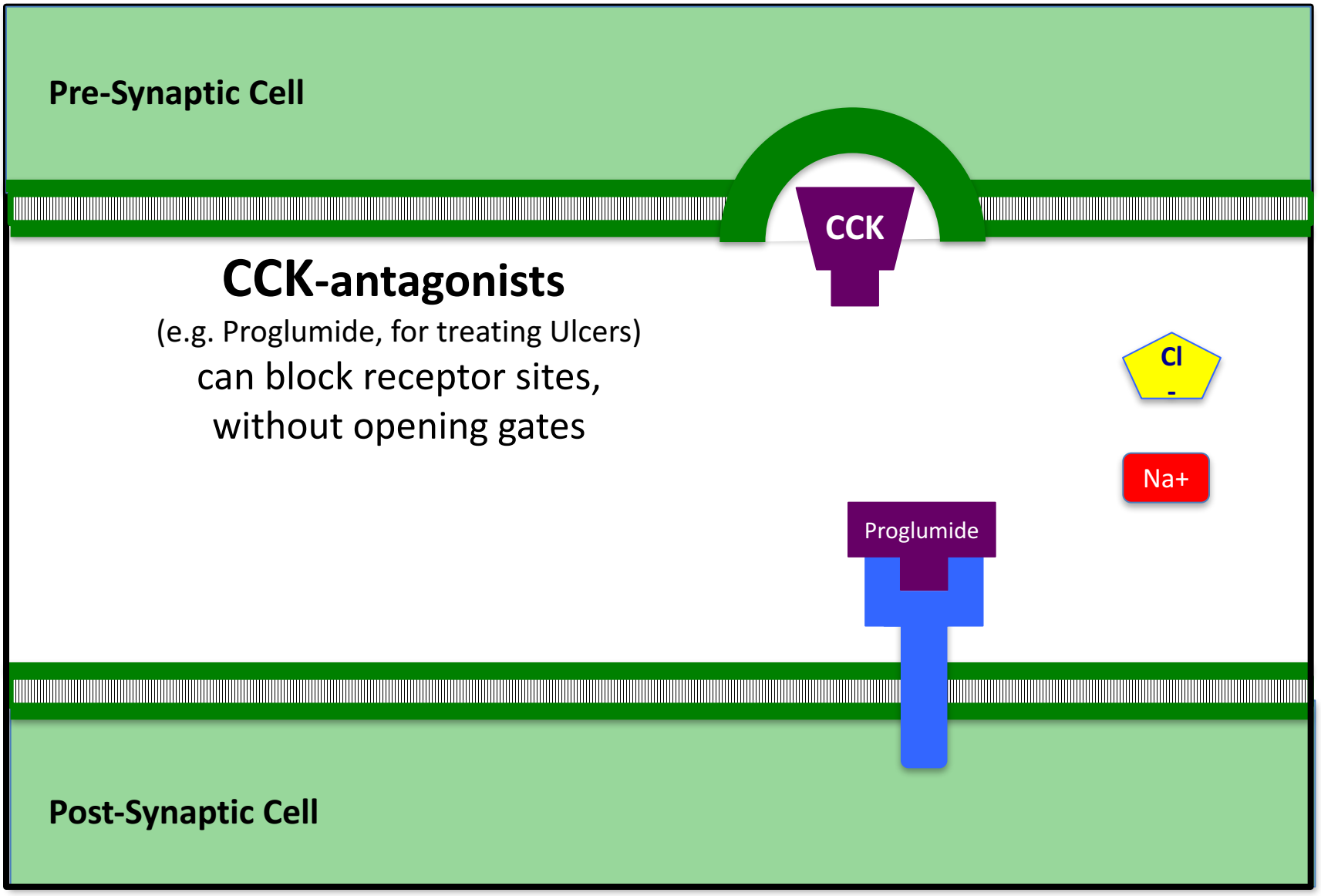
# CCK in Hypothalamus



# CCK in Hypothalamus



# CCK in Hypothalmus



# CCK in Amygdala