

A close-up photograph of a red mushroom with white spots, likely an Amanita muscaria, growing in a field of dry grass. The mushroom has a bright red cap with numerous white, irregular spots. The stem is white and appears to be partially buried in the grass. The background is a dense field of dry, yellowish-brown grass.

Central Neurotransmission

definitions

- **neurotransmitter**
 - acts rapidly, briefly & at short range
- **neuromodulator**
 - act more slowly and further away
 - responsible for most synaptic plasticity
 - not always from neurones

A red mushroom with white spots on a bed of dry grass. The mushroom is the central focus, with its cap showing a vibrant red color and several small, white, irregular spots. The background is a dense layer of dry, brown grass, creating a textured, natural setting. The overall lighting is soft, highlighting the mushroom's texture and the surrounding grass.

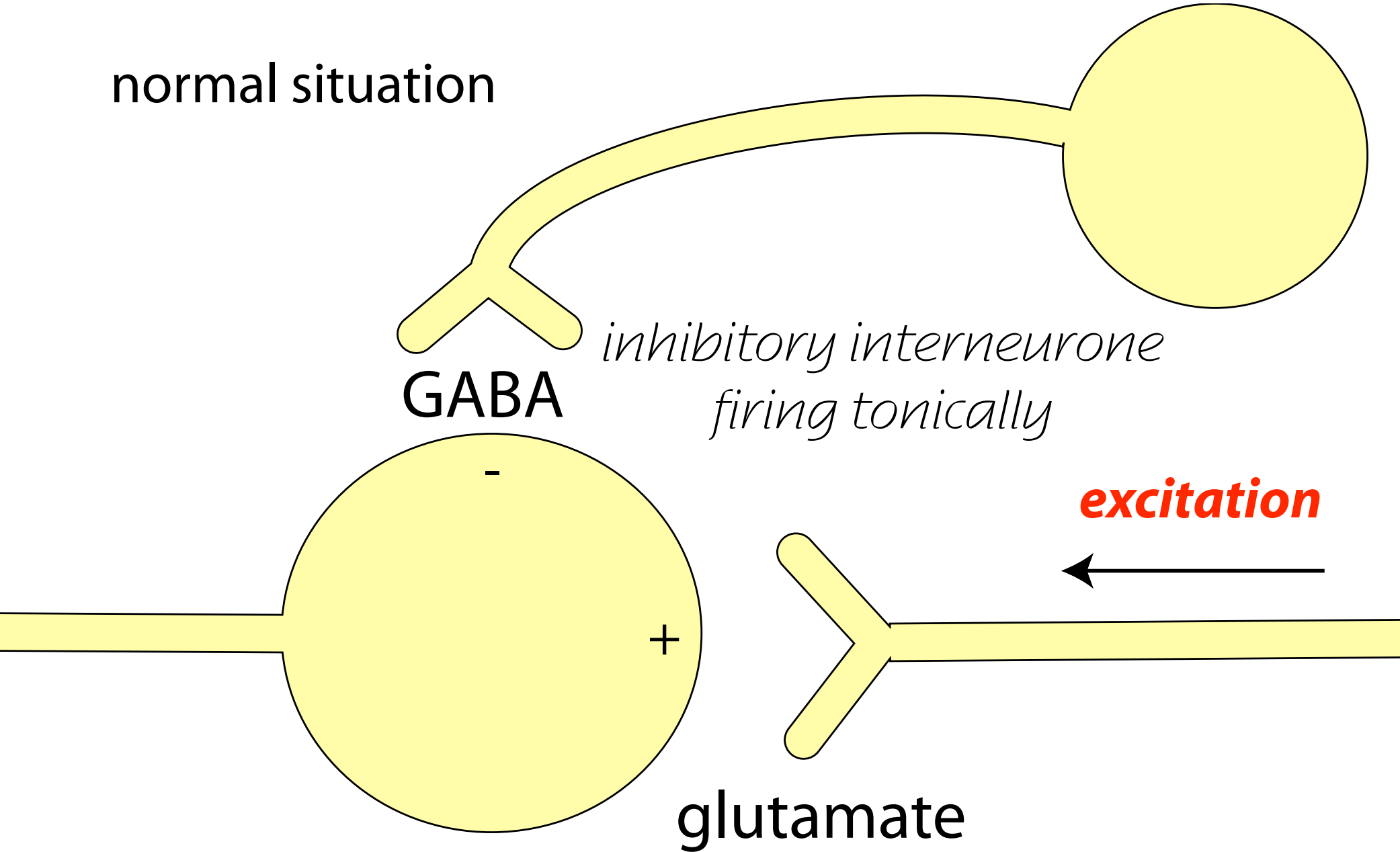
effects

- behavioural – ? – cellular
- depend on
 - wiring (NGF etc)
 - receptor subtypes , distribution & numbers
 - transduction mechanisms
 - neuromodulators
 - their transduction mechanisms
 - all these can change!

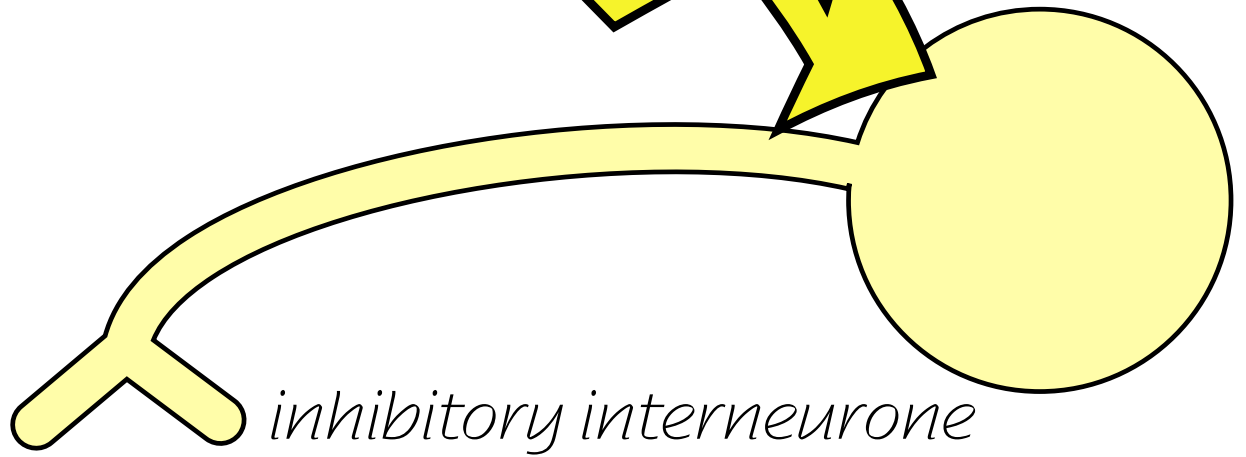
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disinhibition

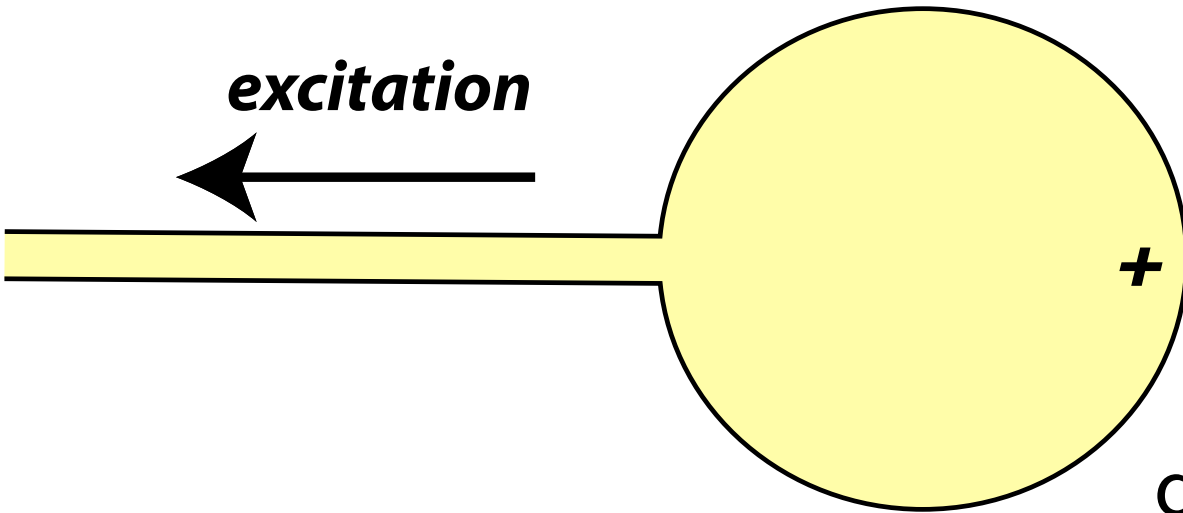
normal situation



INHIBITORY DRUG



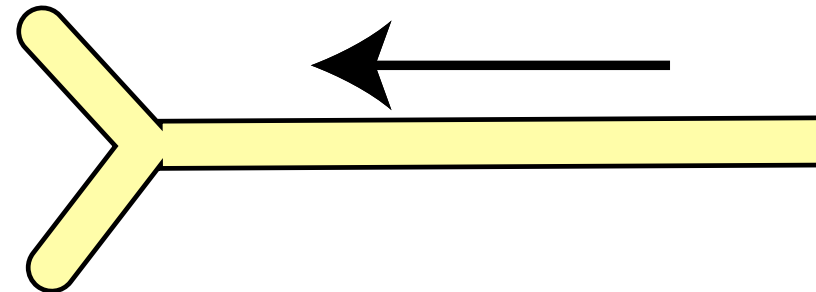
excitation



excitation



glutamate



time course

- **milliseconds**
 - fast transmitters
- **tens of ms**
 - NMDA receptors
- **seconds – minutes**
 - neuromodulators
- **minutes – days**
 - receptor up / down regulation
- **days – weeks (-never)**
 - neurone reconnections

neurotransmitters

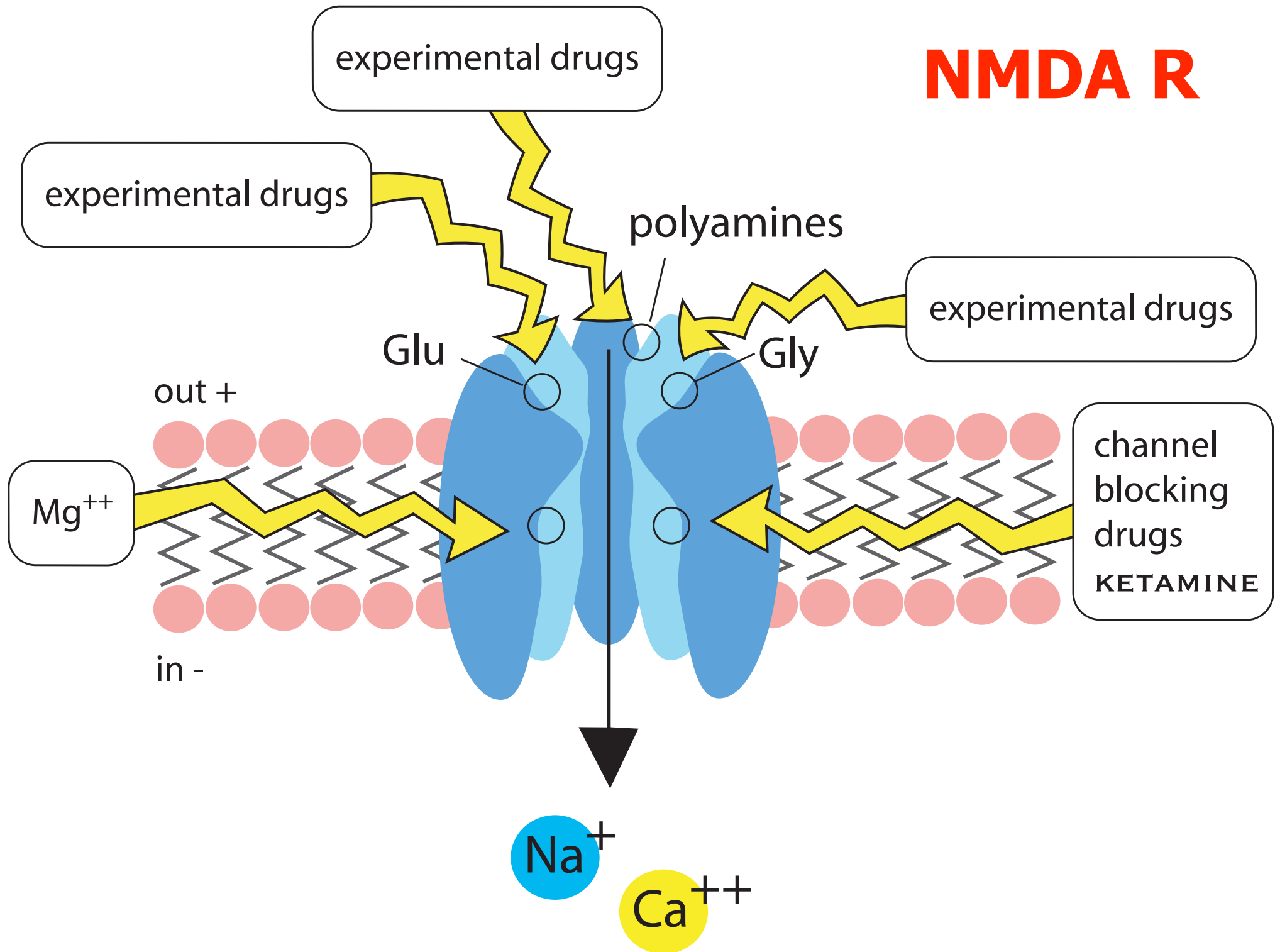
A large, red mushroom with white spots, resembling a fly agaric, is the central focus of the image. It is set against a background of dry, brown grass. The mushroom's cap is broad and slightly flattened, with numerous white, irregular spots scattered across its red surface. The stem is thick and white, with some darker, fibrous-looking areas at the base. The overall lighting is soft, highlighting the texture of the mushroom and the surrounding grass.

- **excitatory**
 - glutamate
- **inhibitory**
 - GABA
 - glycine
 - catecholamines
- **both / either**
 - 5HT
 - adenosine / ATP

glutamate receptors

- **AMPA fast**
 - normal transmission
- **NMDA medium**
 - wind up
 - pain
 - memory
- **metabotropic slow (9 subtypes)**
 - modulation?
- **kainate fast**
 - ?

NMDA R



RUN

Na^+

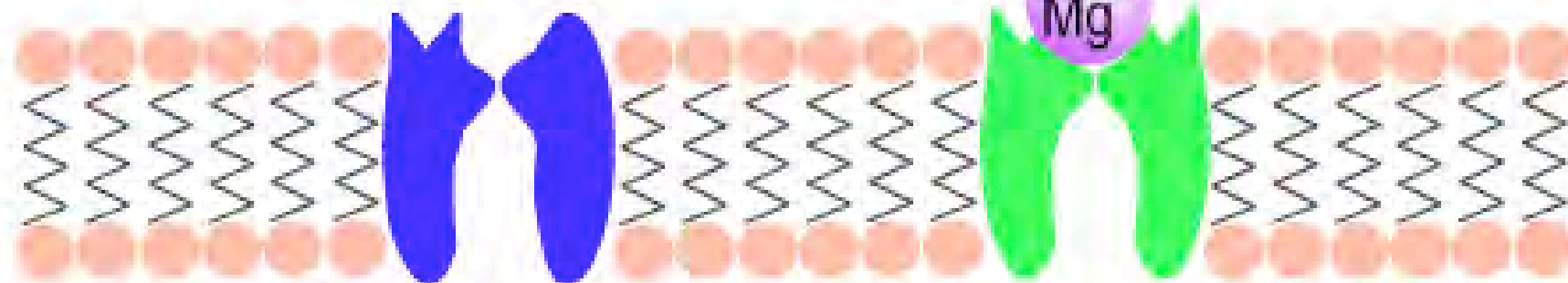
Na^+

Na^+

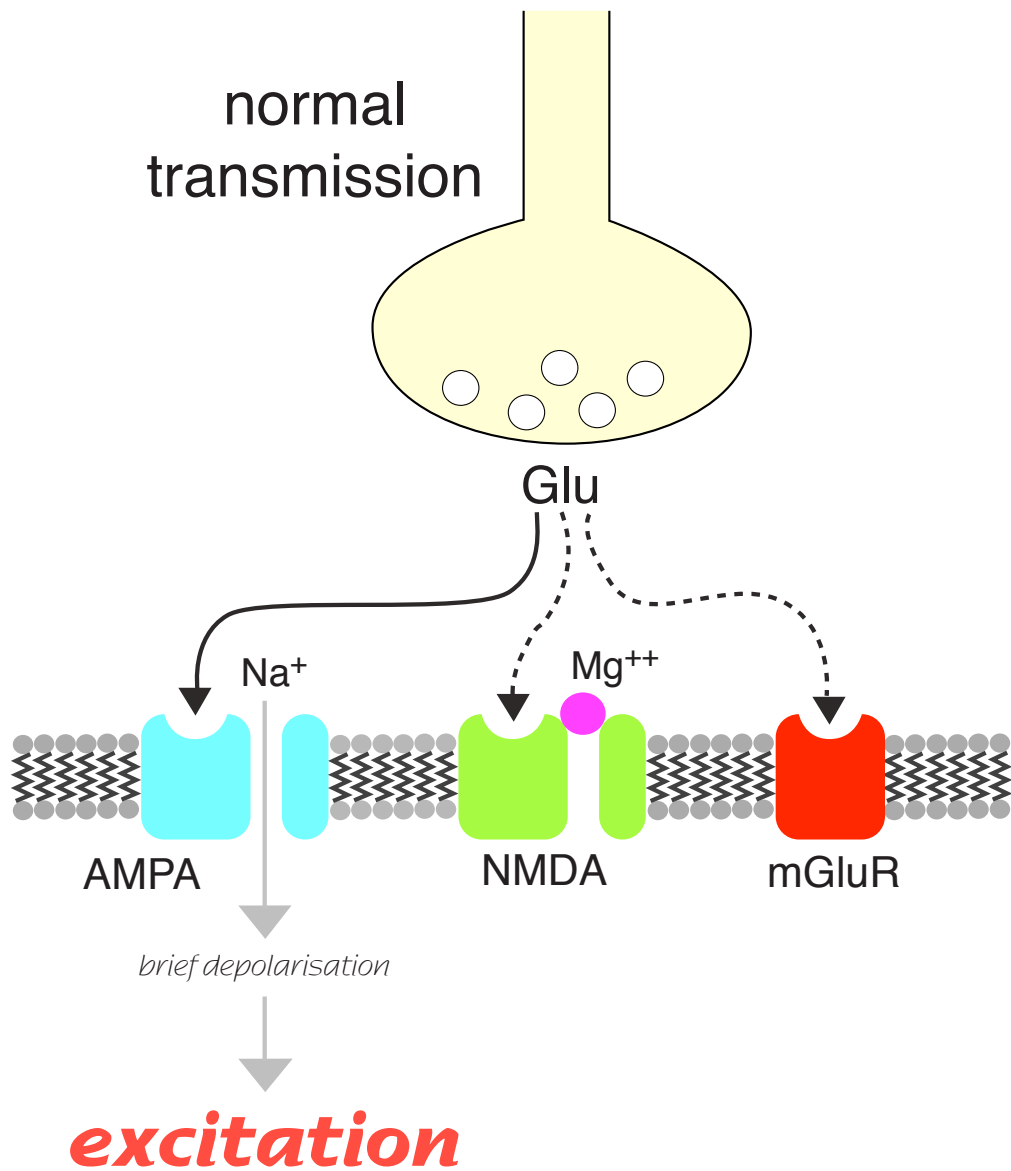
Mg^{++}

AMPA
receptor

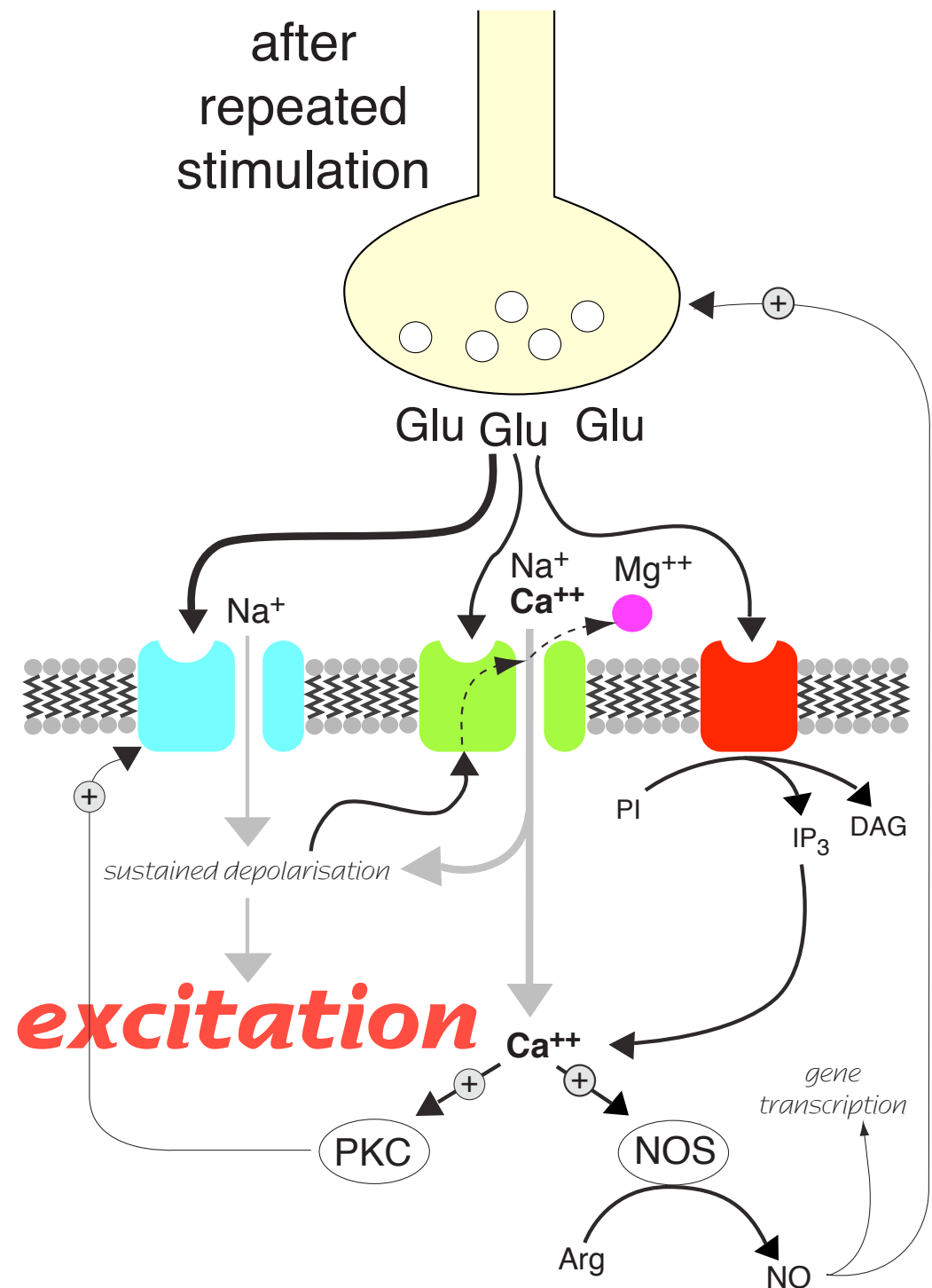
NMDA
receptor



normal
transmission



after
repeated
stimulation



glutamate

- energy metabolism
- excitotoxicity



neurotransmitters

A red mushroom with white spots, likely an Amanita muscaria, is the central visual element. It is positioned in the upper right quadrant of the frame, with its cap showing a vibrant red color and numerous white, irregular spots. The mushroom's stem is thick and white, partially visible below the cap. The background consists of a dense field of dry, yellowish-brown grass, which is slightly out of focus, creating a natural, outdoor setting. The overall lighting is soft, suggesting a natural environment.

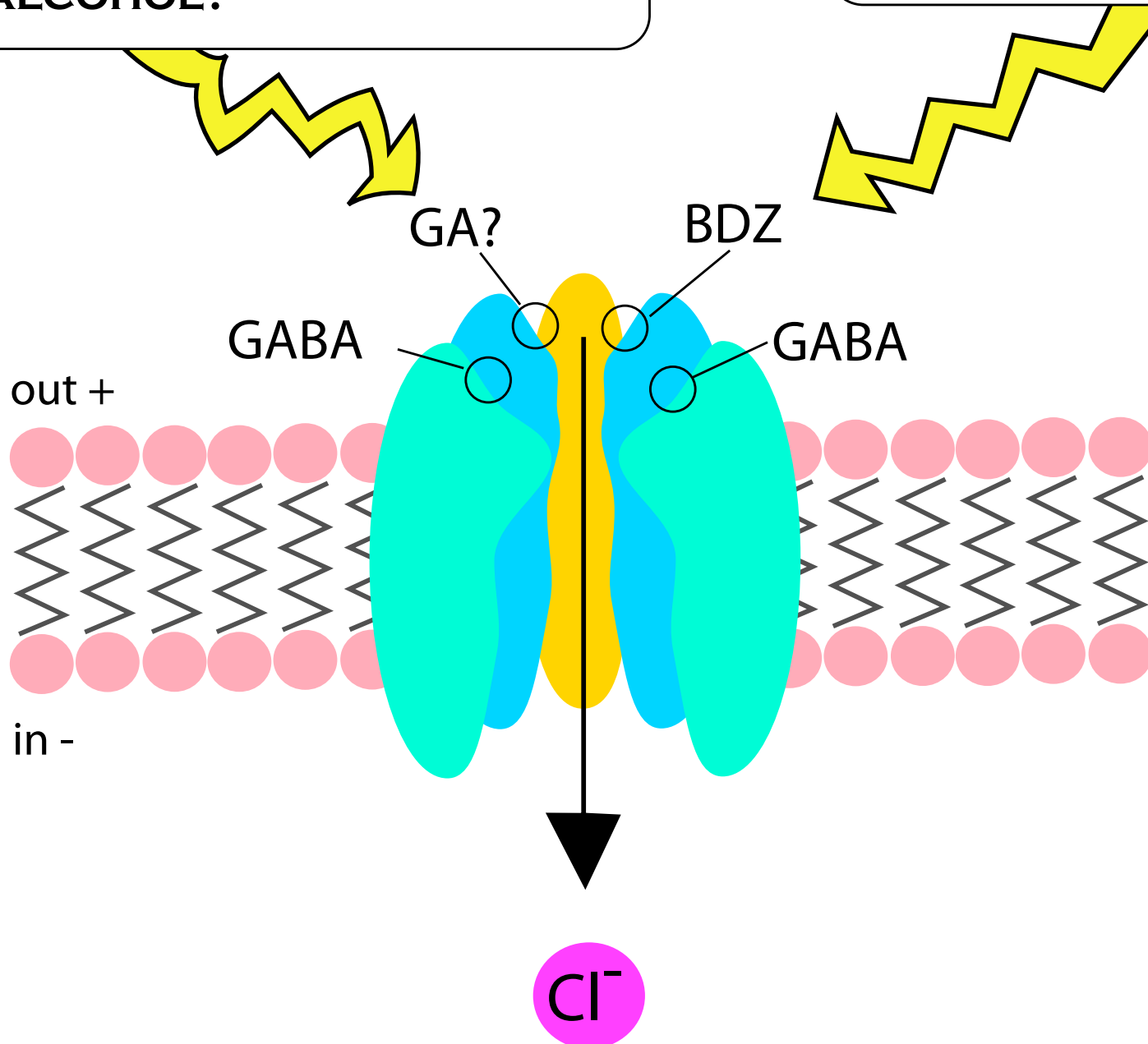
- **excitatory**
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 - GABA
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- **both / either**
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GABA / glycine receptors

- GABA_A
- glycine
 - postsynaptic chloride channels
- GABA_B
 - presynaptic, G protein coupled
- glycine / NMDA
 - on NMDA receptor
- glutamate (nematodes)

BARBITURATES
OTHER INJECTION ANAESTHETICS?
INHALATION ANAESTHETICS?
ALCOHOL?

agonist **DIAZEPAM**
antagonist **FLUMAZENIL**
inverse agonist **βCARBOLINE**



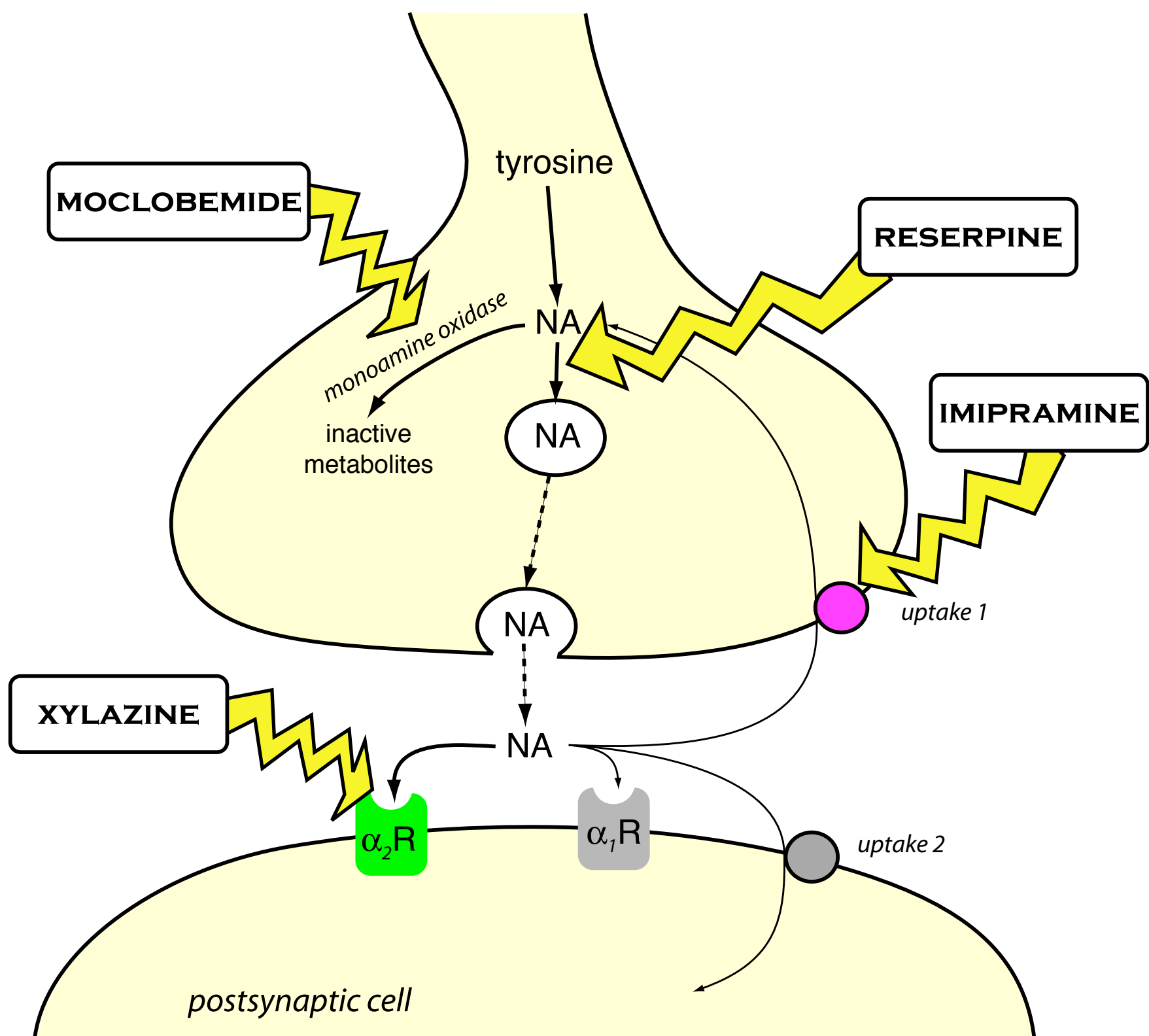
GABA / glycine receptors

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- glutamate (nematodes)

monoamine receptors

- noradrenaline
- dopamine
- 5HT
- octopamine





noradrenaline

- **mostly postsynaptic α_2**
- **mostly inhibitory**
- **alertness, pain, blood pressure**



imidazolines

A red mushroom with white spots, likely an Amanita muscaria, is the background image for the slide. The mushroom is positioned in the center-right, with its cap showing a vibrant red color and numerous white, irregular spots. The stem is white and slightly thick. The background consists of dry, brownish grass and some green blades, creating a natural, outdoor setting.

- I1
 - blood pressure
- I2
 - depression?? MAO
- I3
 - insulin release

A red mushroom with white spots on a bed of dry grass. The mushroom is the central focus, with its cap showing a vibrant red color and numerous small white spots. The background is a dense layer of dry, brown grass, creating a textured and natural setting. The overall lighting is soft, highlighting the mushroom's features against the muted tones of the grass.

dopamine

- **currently 5 receptors**
- **D2**
 - **reward pathway**
 - **pituitary hormone release**
 - **nigrostriatal pathway**
 - **vomiting**

5HT receptors in brain

- 5HT_{1A} – mood / emotion, pain?
- 5HT_{1C} – CSF secretion, motor function
- 5HT_{1D} – motor function
- 5HT₂ – stereotypy, mood / emotion, hallucinations
- 5HT₃ – anxiety, emesis, pain?
- + 9 other subtypes!

reuptake inhibitors

- human antidepressants
- used to alter animal behaviour



other fast transmitters

- **acetylcholine**
 - **nAChR, mAChR**
- **histamine**
 - **H1, H2, H3**
- **adenosine, ATP, AMP**

purinergic receptors

- **adenosine**
 - A1 and A2 R – G protein coupled
 - presynaptic inhibition
- **ATP**
 - P2x (ionotropic) P2y (metabotropic)
 - co-transmission in periphery, nociception

neuromodulators

- **excitatory**
 - substance P
 - neurokinins A & B
 - cholecystokinin
 - nitric oxide, carbon monoxide
 - arachidonic acid / prostaglandins
 - etc, etc

neuromodulators

- **inhibitory**
 - enkephalins, morphine – μ , δ R
 - some dynorphins – κ R
 - cannabinoids – CB1, CB2 R
 - magnesium?
 - zinc??

adaptive processes

- cfos, cjun
- growth factors



- blood sampled
2d ago
- now licking leg



central neurotransmitters

- glutamate is the main excitatory transmitter
- glutamate acts at AMPA (fast), NMDA (medium) and mglu (slow)
- GABA is the main inhibitory transmitter, acting at GABA_A receptors
- neuromodulators act slowly to amplify or reduce transmission
- noradrenaline, acting at α_2 receptors, causes CNS depression