

METHODS OF MEMORY MANIPULATION

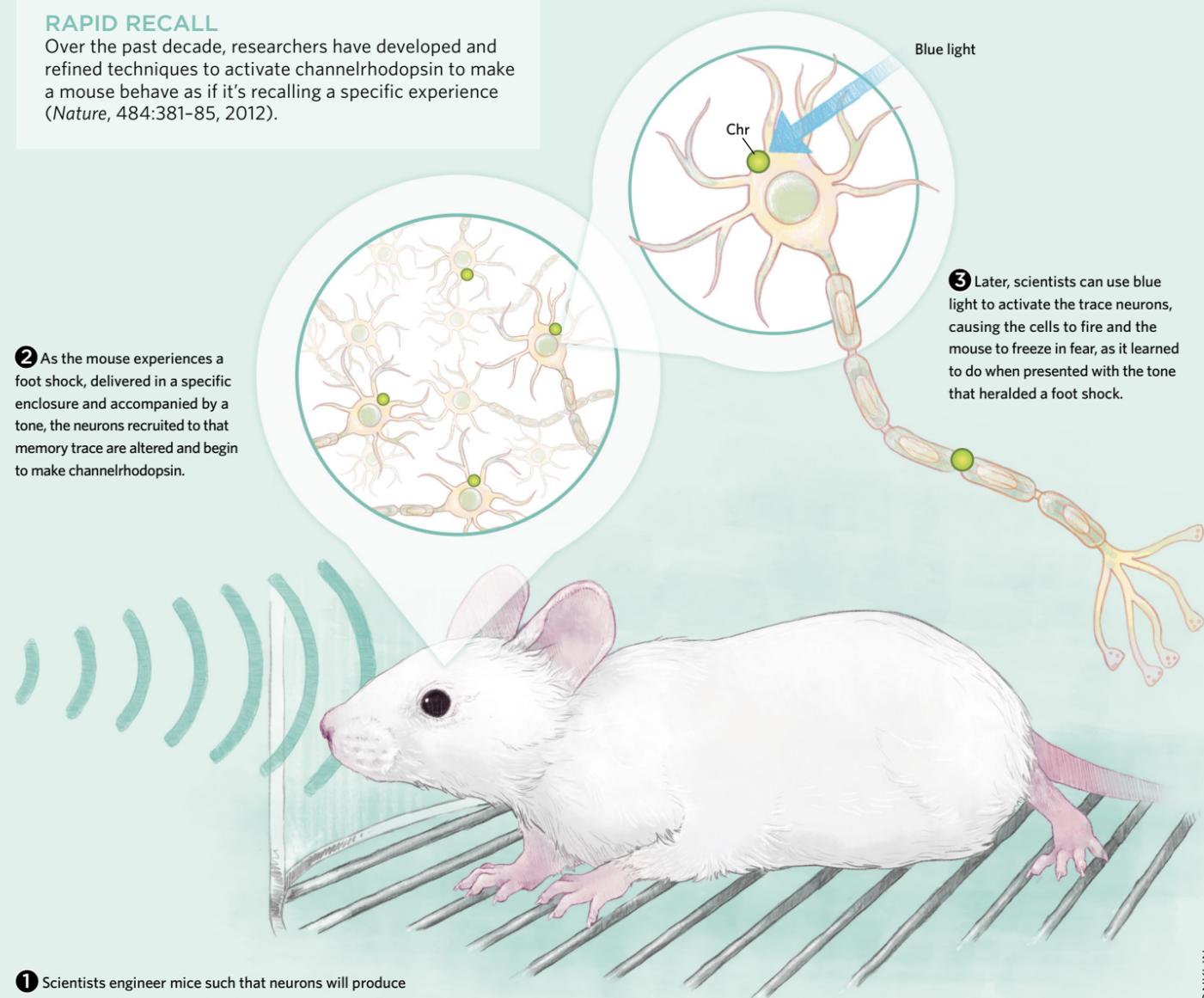
As a memory forms, certain neurons are incorporated into a memory trace, a neural network associated with a particular experience that is active when the memory is recalled. By permanently altering those neurons in mice, researchers can control their activity. Neurons are engineered to produce channelrhodopsin (Chr), a light-sensitive ion channel, once they're recruited into a specific memory trace. From memory formation onward, blue light can activate them, triggering the animal to act as if it is recalling the previous experience.

RAPID RECALL

Over the past decade, researchers have developed and refined techniques to activate channelrhodopsin to make a mouse behave as if it's recalling a specific experience (*Nature*, 484:381-85, 2012).

2 As the mouse experiences a foot shock, delivered in a specific enclosure and accompanied by a tone, the neurons recruited to that memory trace are altered and begin to make channelrhodopsin.

1 Scientists engineer mice such that neurons will produce channelrhodopsin once recruited into a memory trace. The mouse's diet determines when the neurons are vulnerable to this effect.



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FALSE MEMORIES

Last year, researchers used channelrhodopsin to implant a completely false memory in a mouse's brain: the idea that it had experienced something negative associated with the orange-like smell of acetophenone (*Nat Neurosci*, 22:933-40, 2019).

1 Scientists engineer M72 olfactory receptor neurons, which sense orange-scented acetophenone, to respond to blue light.

2 They do the same with neurons that control aversion to unpleasant stimuli such as a foot shock.

3 Stimulation of both areas simultaneously results in the formation of a false memory, linking the acetophenone odor to unpleasantness.

4 A mouse that has never experienced the smell of acetophenone will avoid the orange-like odor.

