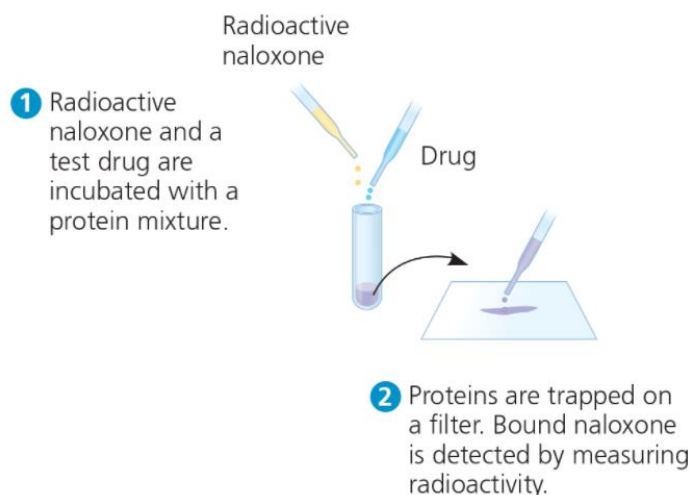


Specific Opiate Receptors in the Brain



Researchers were looking for opiate receptors in the mammalian brain. Knowing that the drug naloxone blocks the analgesic effect of opiates, they hypothesized that naloxone acts by binding tightly to brain opiate receptors without activating them. To test their hypothesis, the researchers added radioactive naloxone to a protein mixture prepared from rodent brains. If the mixture contained opiate receptors or other proteins that could bind naloxone, the radioactivity would stably associate with the mixture.

Drug	Opiate	Lowest Concentration That Blocked Naloxone Binding
Morphine	Yes	$6 \times 10^{-9} M$
Methadone	Yes	$2 \times 10^{-8} M$
Levorphanol	Yes	$2 \times 10^{-9} M$
Phenobarbital	No	No effect at $10^{-4} M$
Atropine	No	No effect at $10^{-4} M$
Serotonin	No	No effect at $10^{-4} M$

Data from C. B. Pert and S. H. Snyder, Opiate receptor: demonstration in nervous tissue, *Science* 179:1011–1014 (1973).

- [SP1, SP3] Propose a reason the researchers tested a variety of drugs, including both opiates and non-opiates.
- [SP5] The data above are expressed in scientific notation. Remember that a negative power of 10 means a number less than 1. For example, $10^{-1} M$ (molar) can also be written as 0.1 M. Write the concentrations in the table above for morphine and atropine in this alternative format.
- [SP4, SP5] Compare the concentrations listed in the table for methadone and phenobarbital. Identify the concentration that is higher. Calculate how much higher the concentration is.
- [SP1, SP4, SP6] Predict whether phenobarbital, atropine, or serotonin would have blocked naloxone binding at a concentration of $10^{-5} M$. Justify your response.
- [SP4, SP6] Identify the drugs that blocked naloxone binding in this experiment. Make a claim about the brain receptors for naloxone.
- [SP6] The researchers repeated the experiment using cells from intestinal muscles rather than brains and found no naloxone binding. Make a claim about opiate receptors in mammalian muscle.