Signals: Key Models, Cells & Organisms

SIGNAL TRANSDUCTION

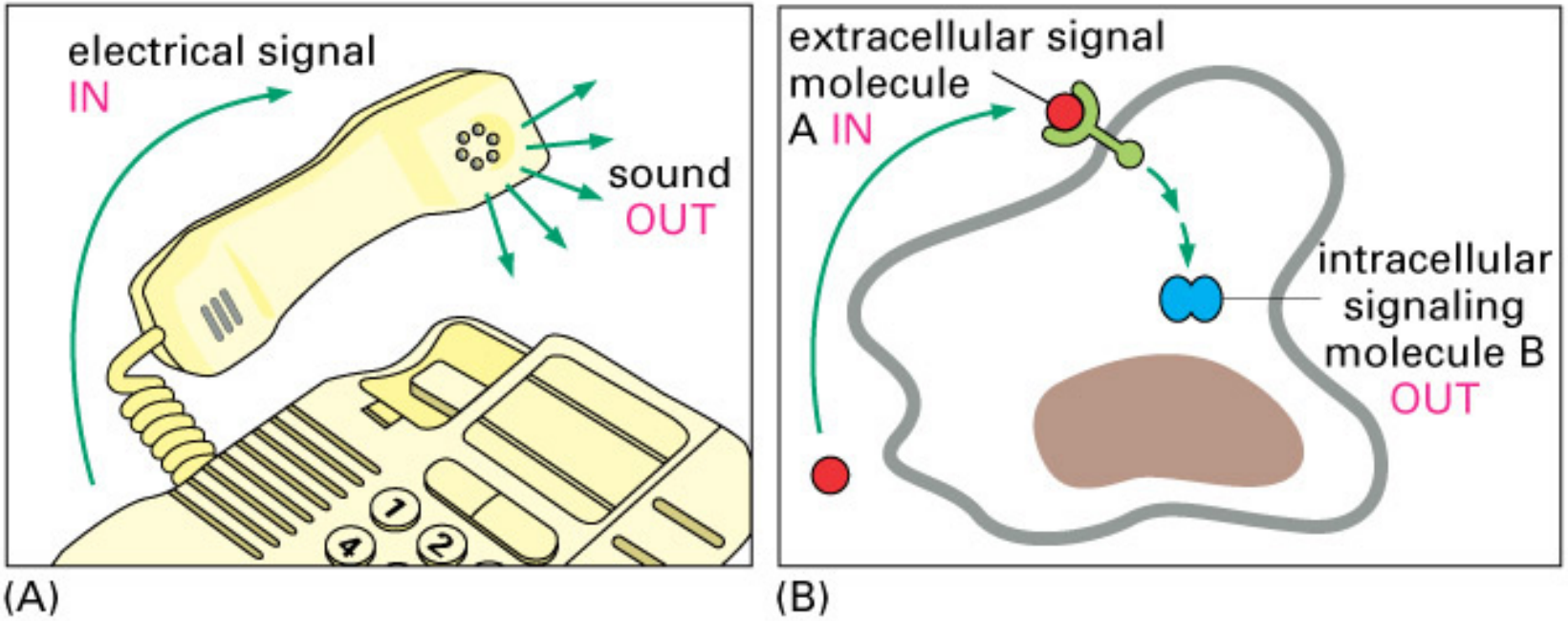
- Cells can exist as single celled organisms or be part of a multi-cellular organism
- How do they know what is happening around them?
- Cells do not have ‘eyes’, ‘noses’, or ‘ears’

SIGNAL TRANSDUCTION

Cells communicate with others and have mechanisms to sense their environments using a variety of methods as we will uncover - whichever method is used it involves a very important principle called

Signal Transduction

The conversion of a signal, of some type, from one physical form to another.



Electrical impulses are converted to sound waves that we hear

Signal molecules are received by target cells via receptors and converted to other intracellular forms

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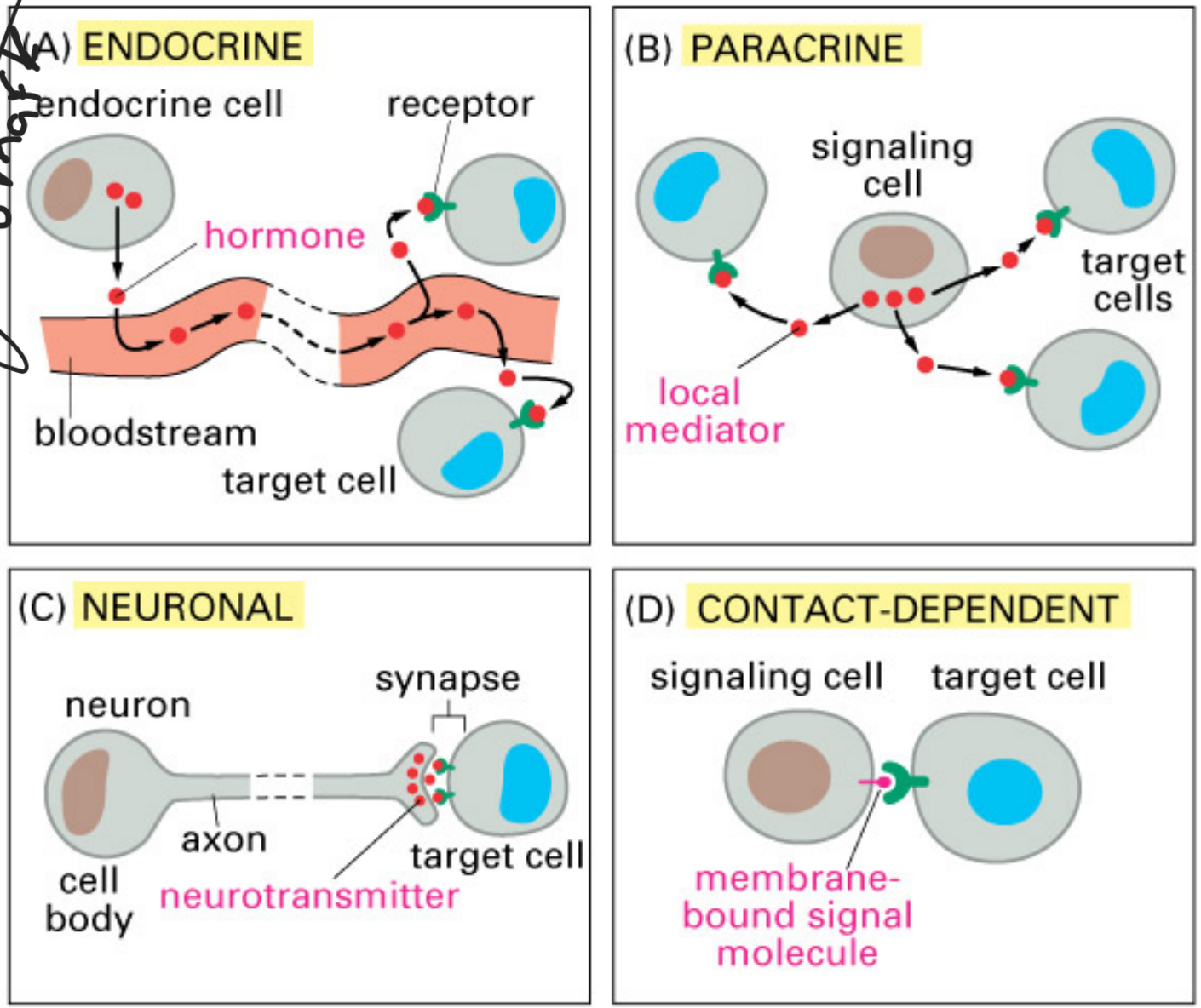
Definition & types imp

Cell Signaling types

- Endocrine - hormones, long distance
- Paracrine - local vicinity
- Neuronal - very short distances
- Contact-dependent - physical contact
- Autocrine - act on self

Important for Smarks



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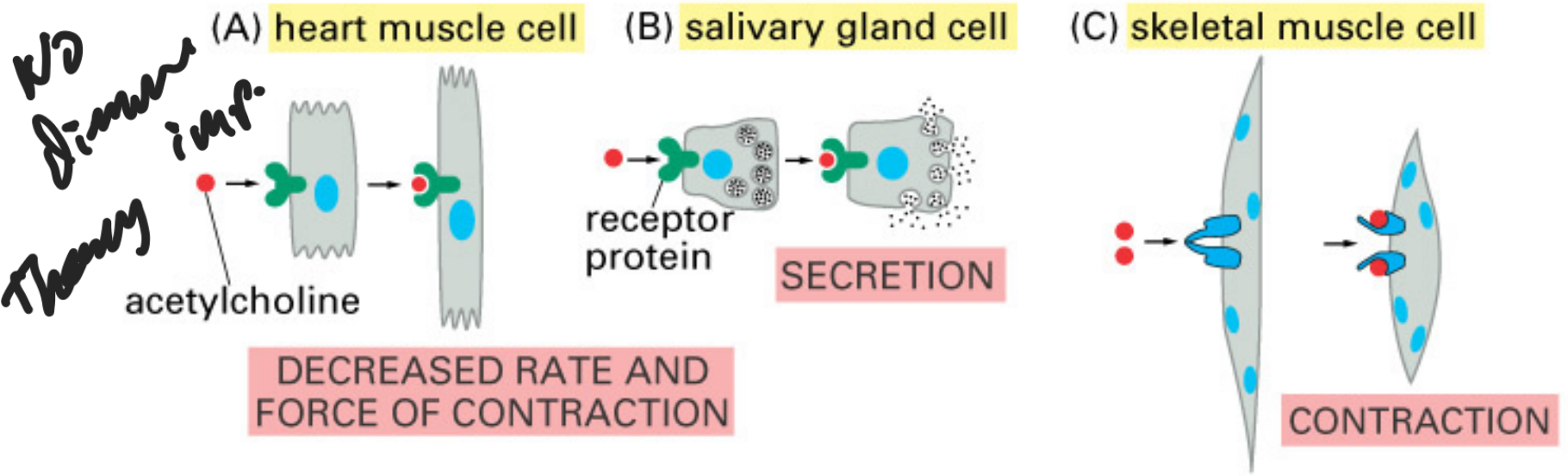
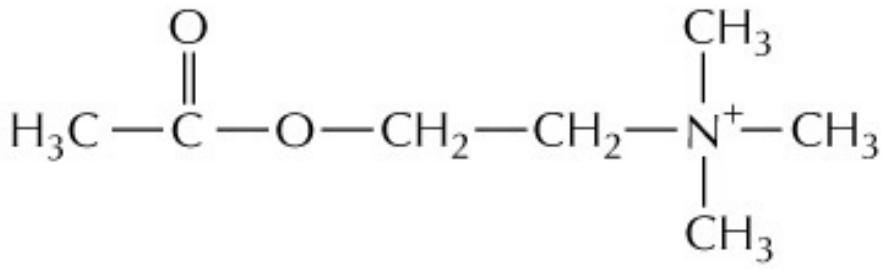
The same signal molecule may interact with different cells with entirely different effects. Here is an example of acetylcholine



(D) acetylcholine



Acetylcholine has a role in both branches of your nervous system
It has a half-life of about 2 minutes.

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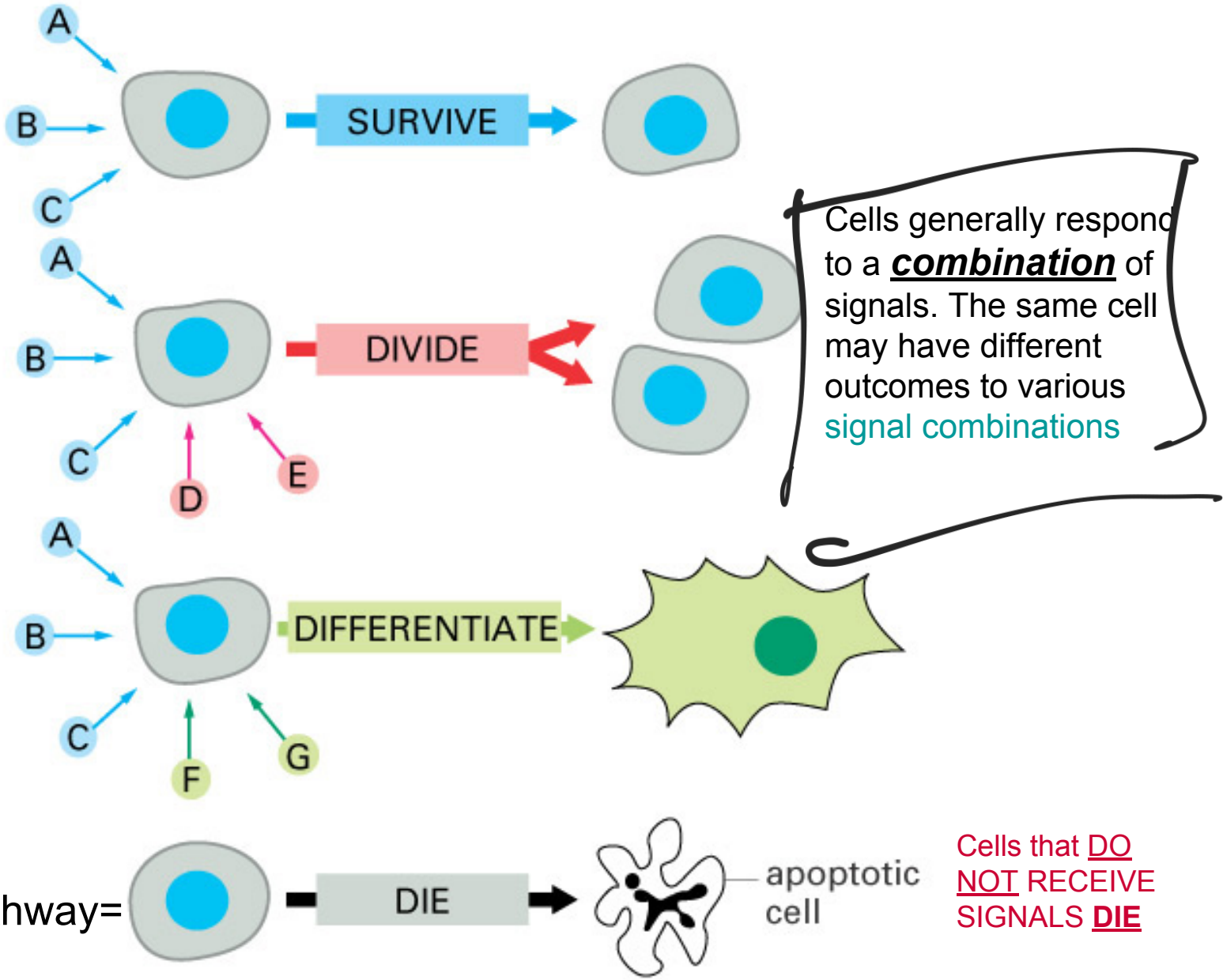


Cells generally respond to a ***combination*** of signals. The same cell may have different outcomes to various signal combinations

The default pathway=

Cells that DO NOT RECEIVE SIGNALS **DIE**

Figure 16-6 Essential Cell Biology, 2/e. (© 2004 Garland Science)

How do these signals work

At which level?

Where?

How many?

General Plan of Action

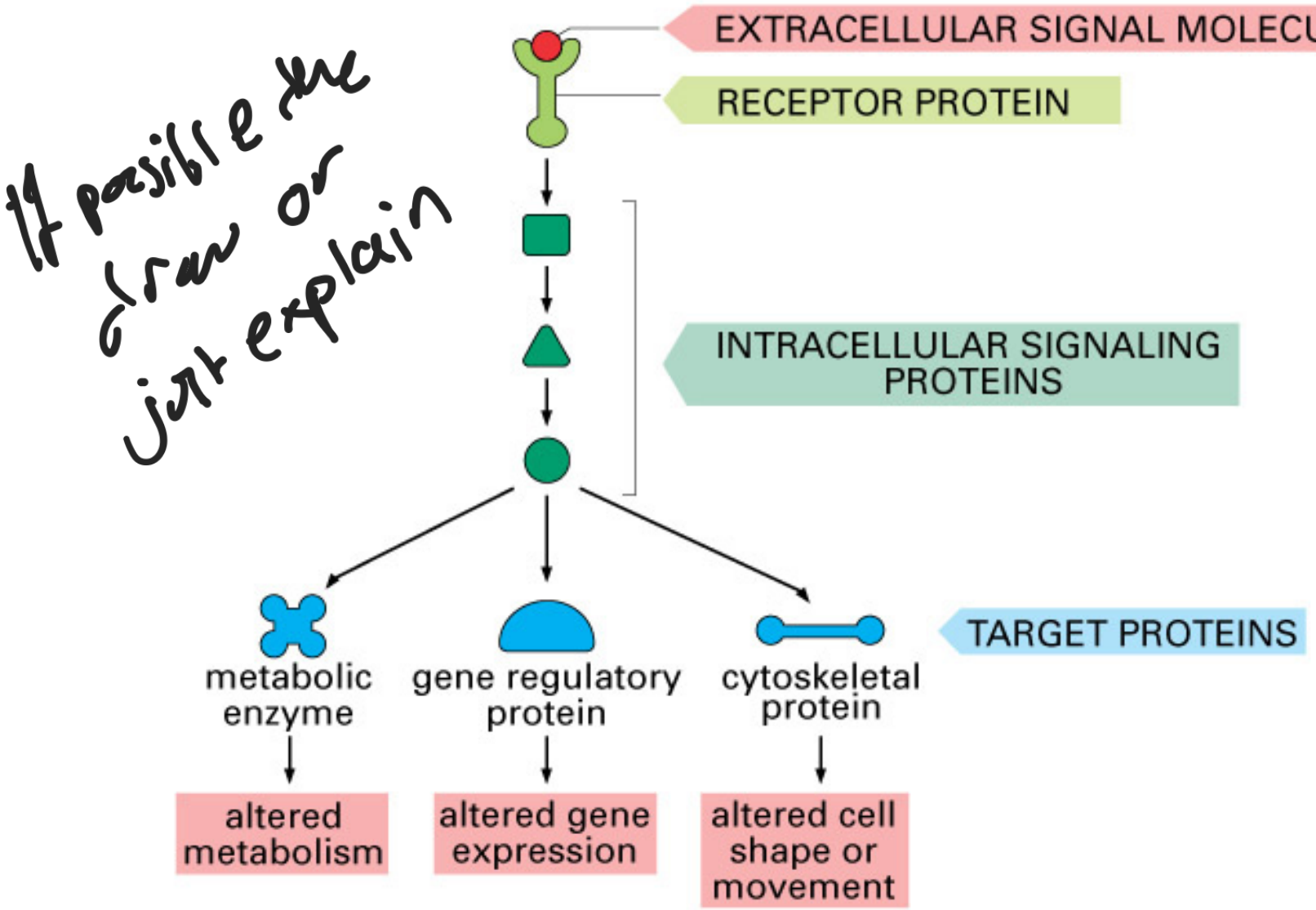


Figure 16-7 Essential Cell Biology, 2/e. (© 2004 Garland Science)

- Each cell responds to a limited set of signals - why?

- These signals change the activity of internal cellular proteins which chances the behavior of the cell

- These signals follow a chain of events known as the signal cascade
  - A system of relaying information from the site of reception to the point of action
  - Normally the signal is amplified too - a small input is quickly converted to a large response

General Overview 2

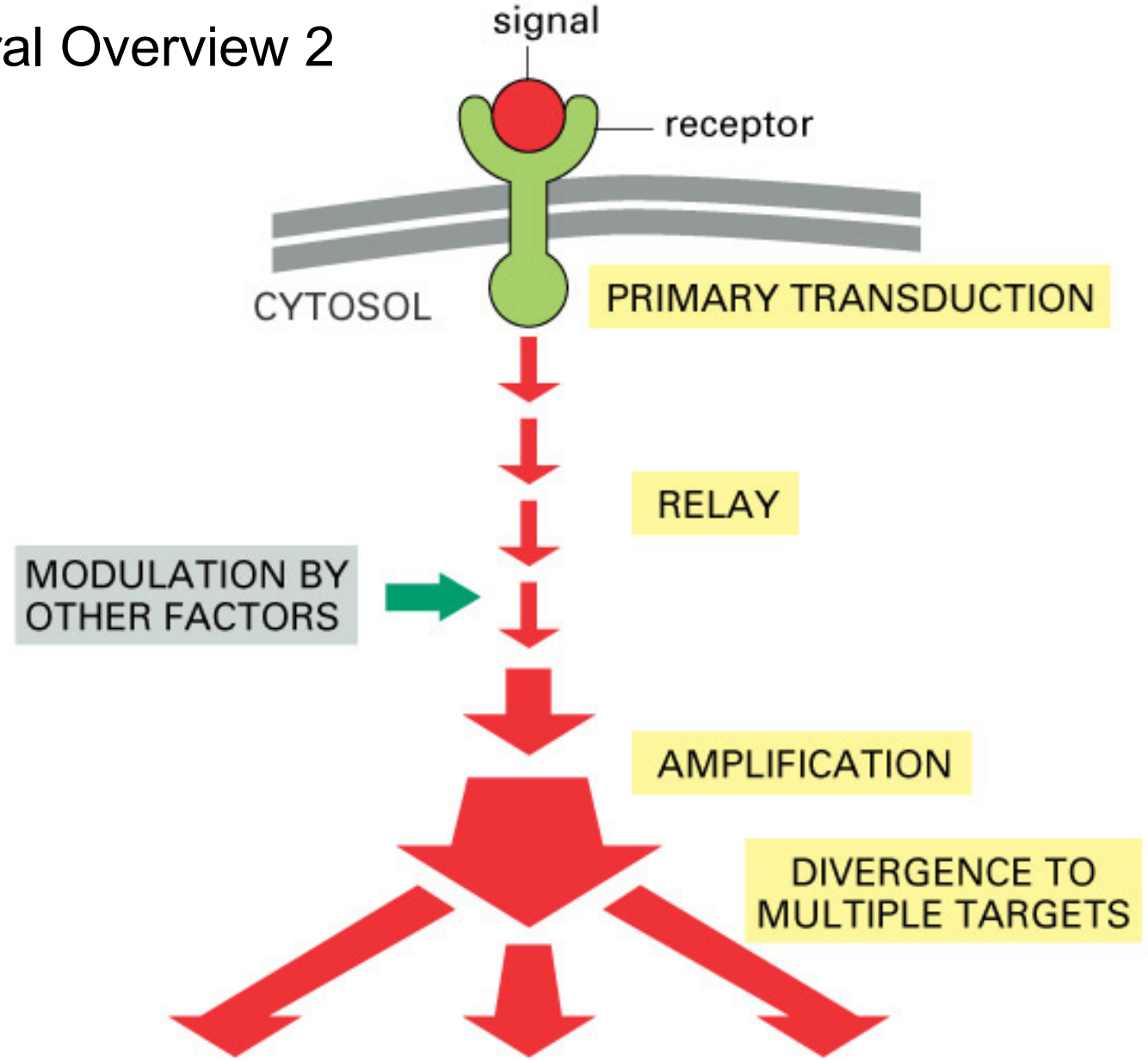
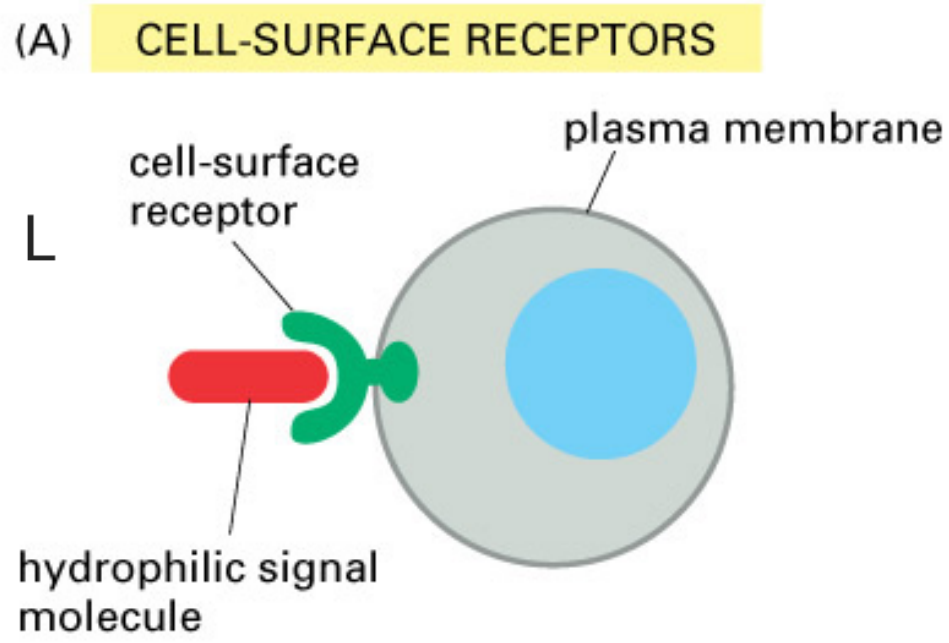
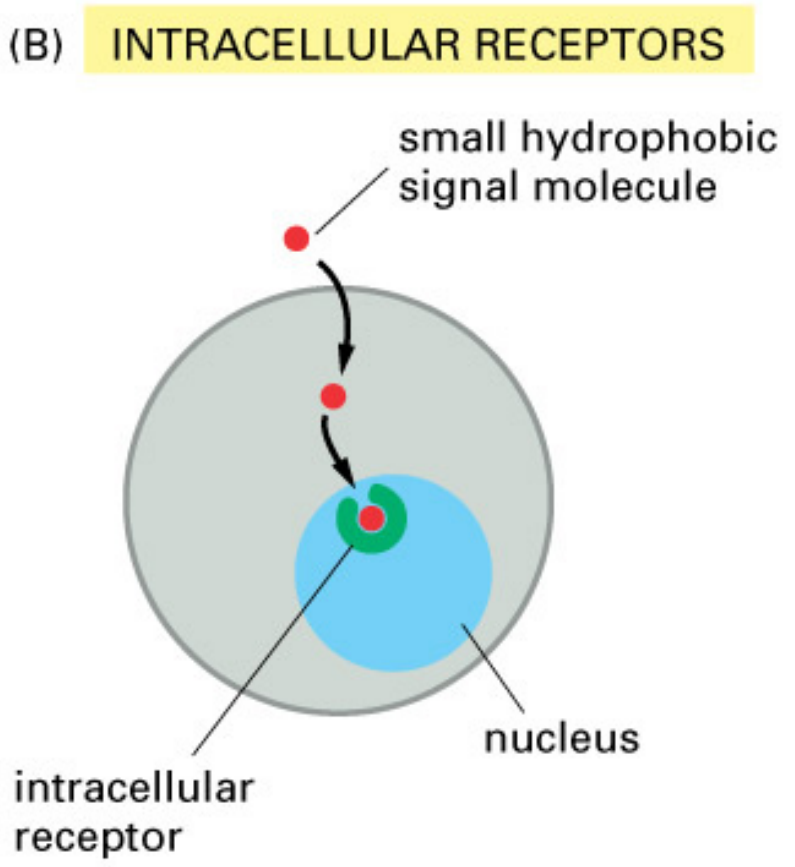


Figure 16-8 Essential Cell Biology, 2/e. (© 2004 Garland Science)

Some signal molecules act at the cell surface whilst others can enter the cell readily and act inside such as steroids.



The red signal molecule has a target receptor to which it binds and that's that. Note that it is usually hydrophilic.



Other receptors enter the cell. If they must pass through the membrane without P's they are..

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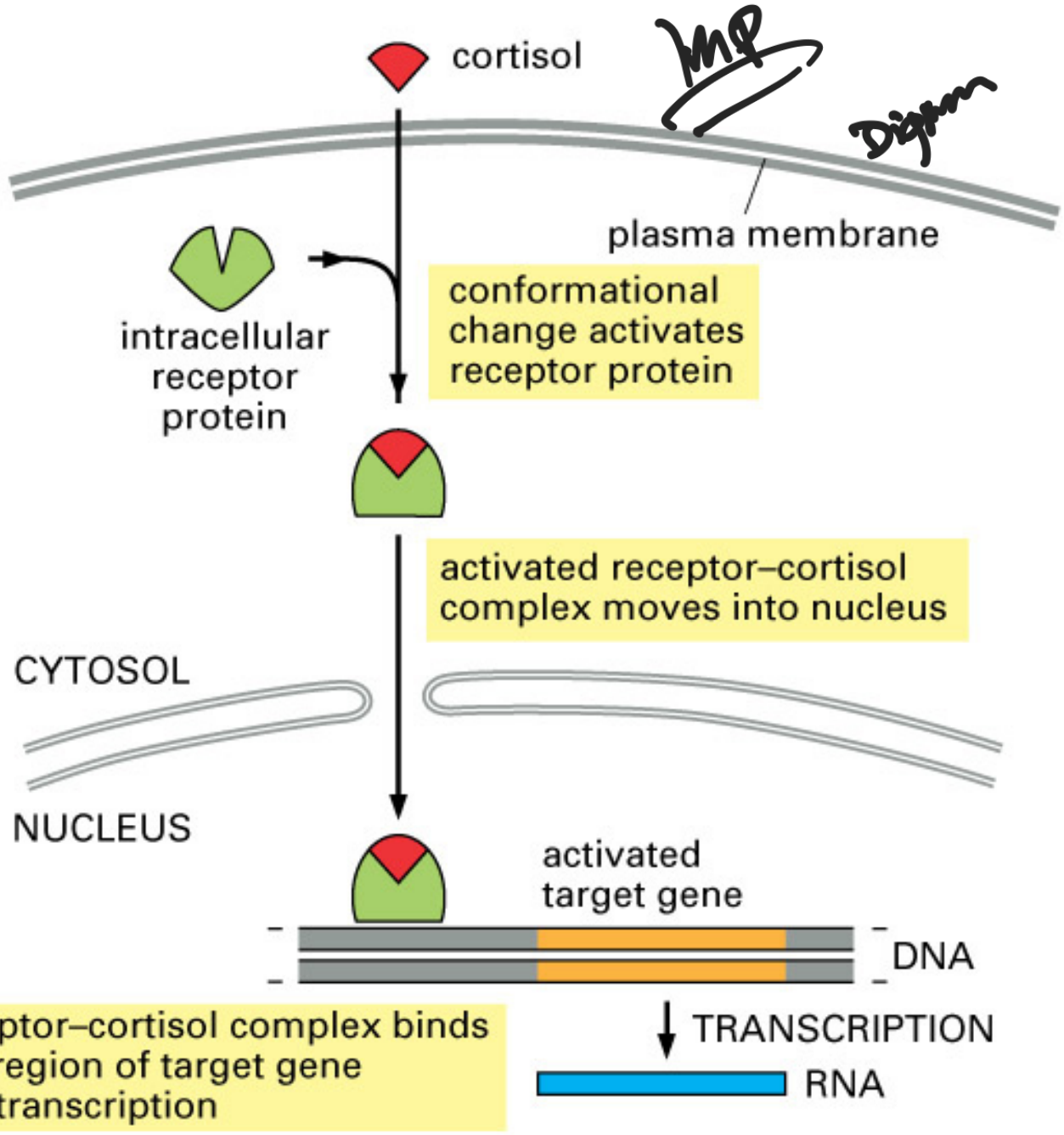
A simple example of how a steroid works.

-The signal can enter the cell through the membrane and bind to its target protein.

-This is now able to enter through the nuclear pore and control transcription directly of certain target genes



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Ion-channel linked receptors

- All nerve impulses are generated via ion-channel linked receptors
  - The release of neurotransmitter causes the ion-channel on the target neuron to allow the passage of ions (which?) into the cell. This action is propagated through the nerve cell along its axon.

Many interactions taking place within the cell act to turn **on** or **off** proteins. These are known as molecular switches.

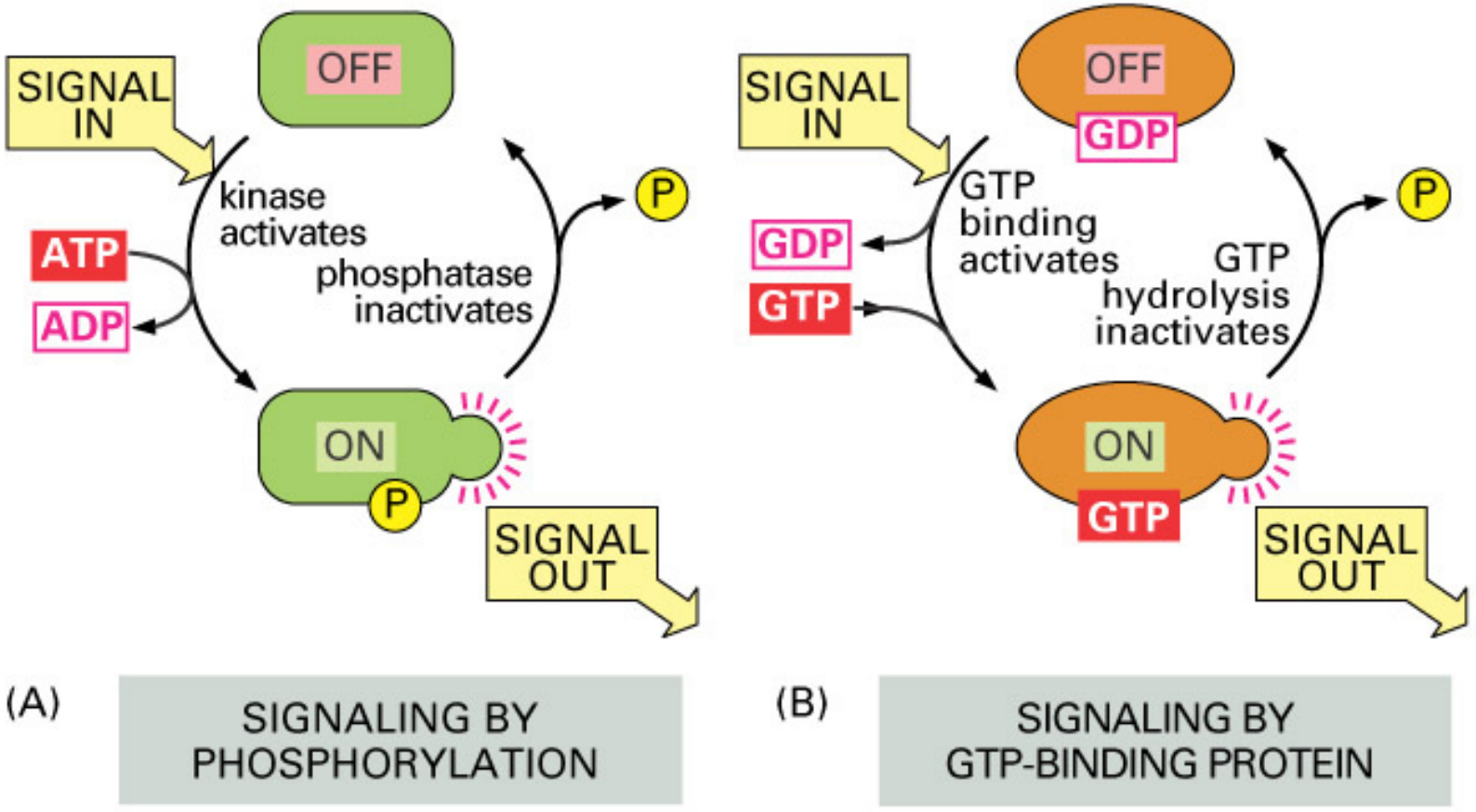
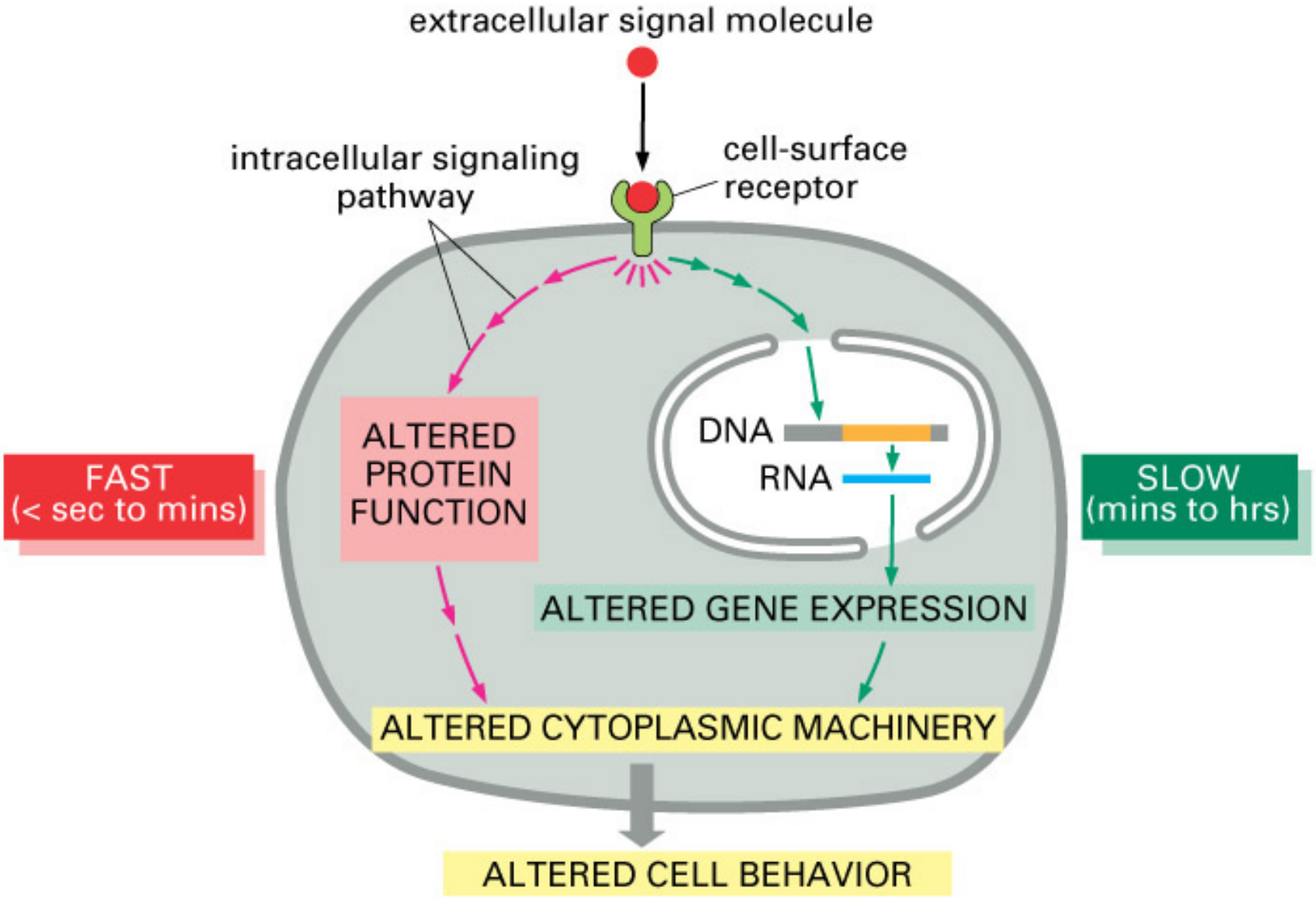


Figure 16-15 Essential Cell Biology, 2/e. (© 2004 Garland Science)

Some cellular responses are quick, whilst others are slow.



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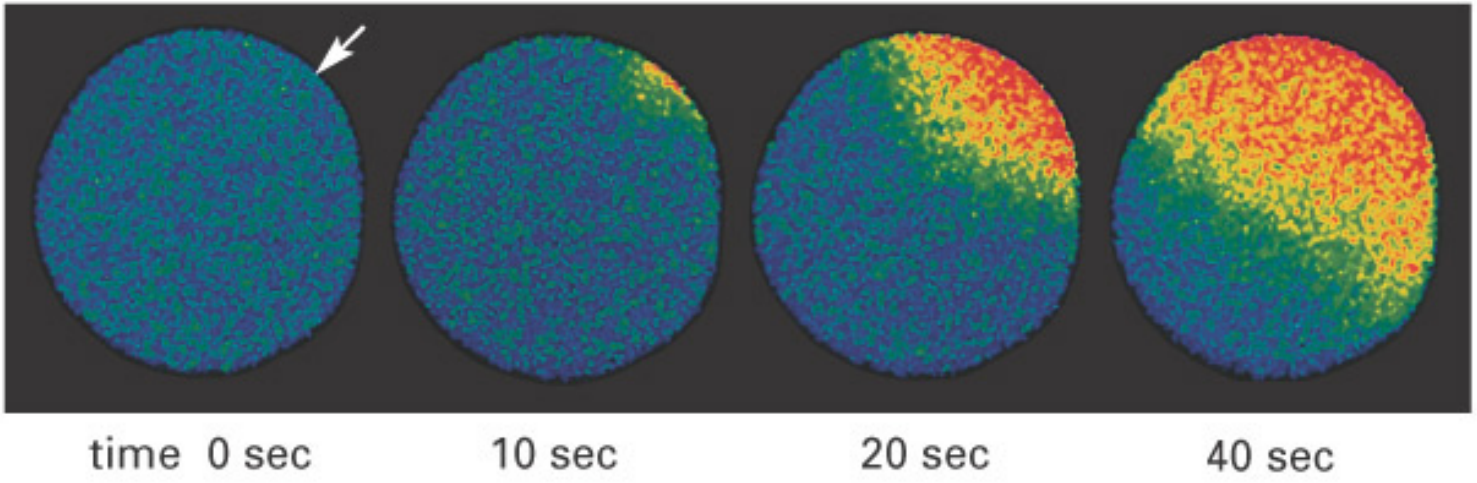
Calcium has a very important role to play as an intercellular messenger.
As we know the concentration of calcium is extremely low in the cytoplasm of a typical cell, compared to the outside and to that of the ER.



In this example fertilization results in the wave of receptors opening up to permit the influx of calcium into the cell. This results in a change in the cell surface which both initiates cell division and prevents other sperm from entering the cell.

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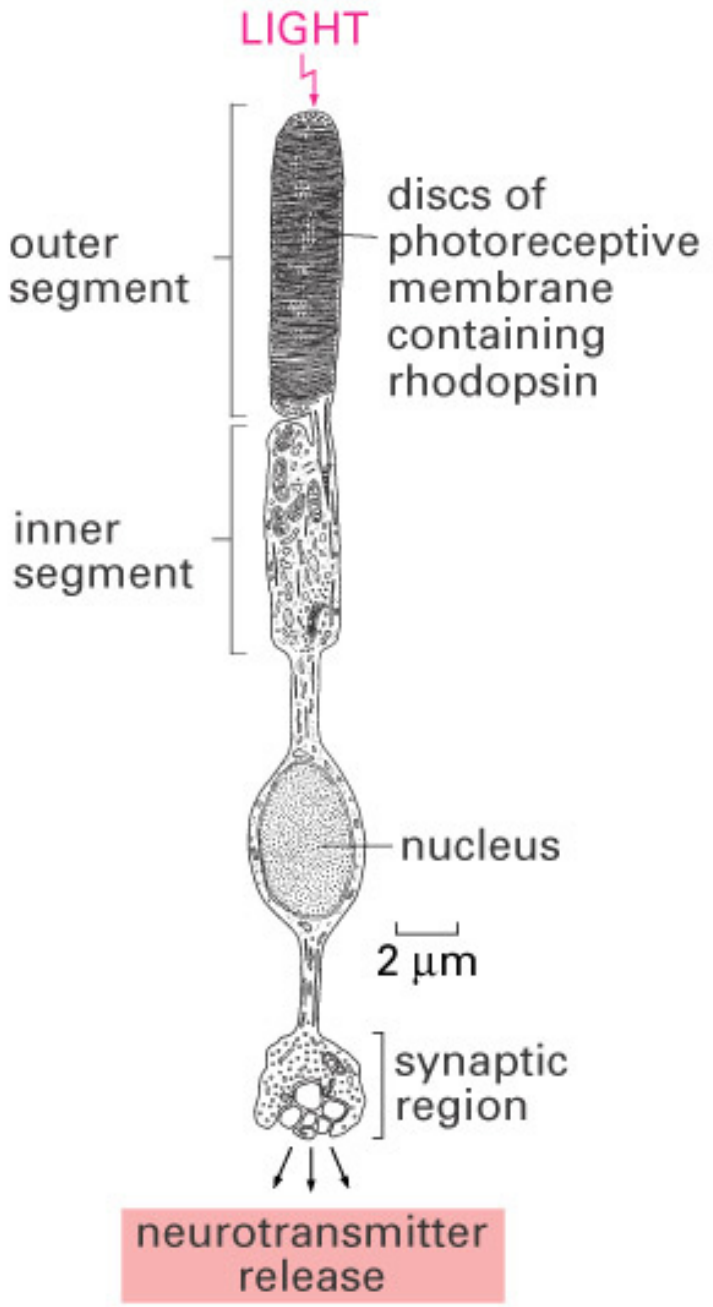
The speed at which signaling cascades operate is clearly illustrated by the photoreceptors of the eye.

The human eye has two forms of receptors - rods and cones
The cones are further divided depending on the wavelength of light they respond to - red, green, and blue



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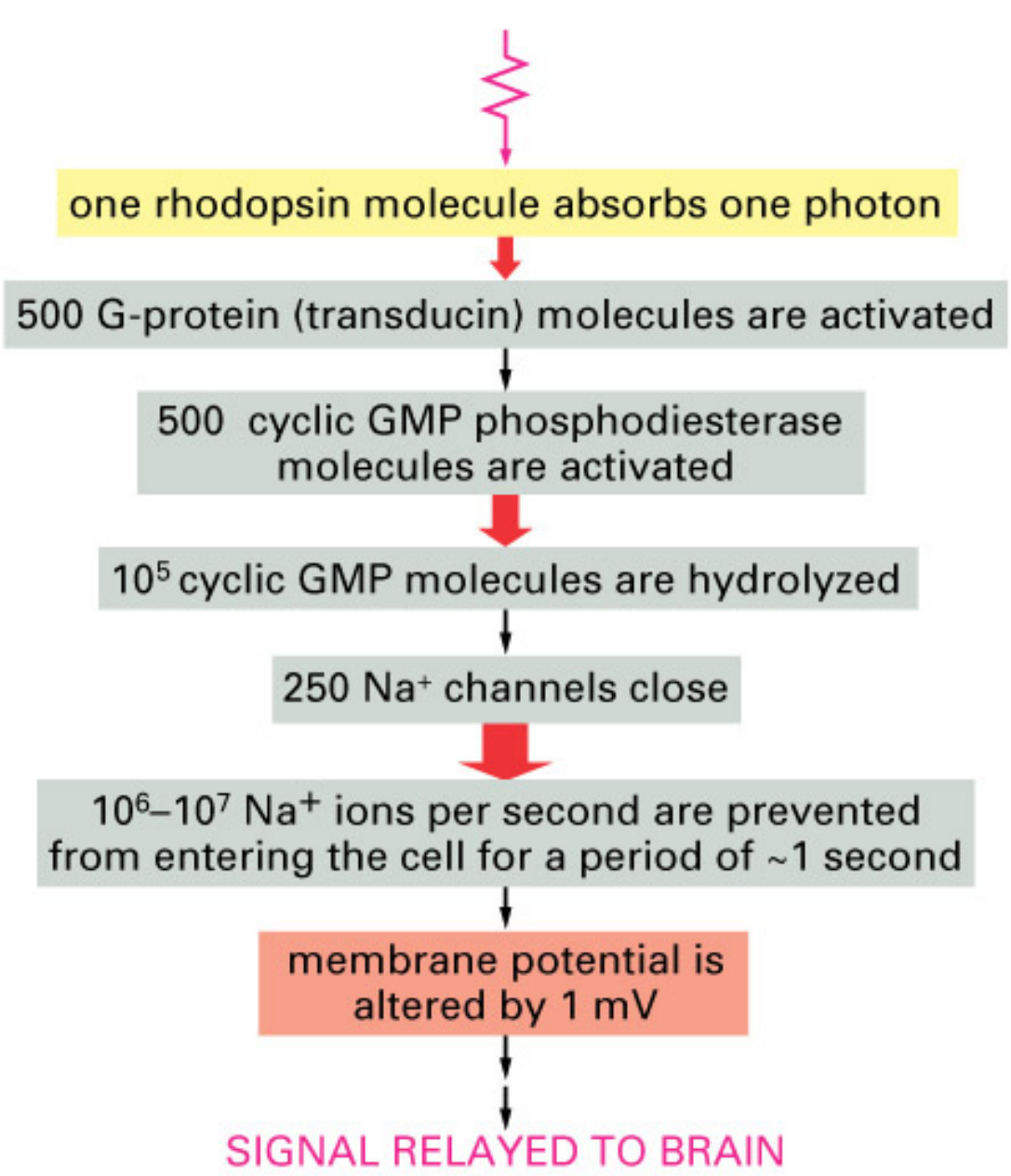

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