

# Chem 452 - Lecture 10

## Signal Transduction

### 111128

Here we look at the movement of a signal from the outside of a cell to its inside, where it elicits changes within the cell. These changes are usually mediated by protein kinases, which phosphorylate enzymes to turn them on or off. We will focus on three examples; the  $\beta$ -adrenergic receptor, which is involved in the "flight or fight" response, the insulin receptor, which is involved in regulating blood glucose levels, and the epidermal growth factor (EGF) receptor, which triggers cell growth in response to injury. Each example presents common themes such as secondary messengers, the amplification of a signal, and the activation of protein kinases. These signal pathways also provide examples of how multiple proteins can work together in complex ways to produce a concerted result.

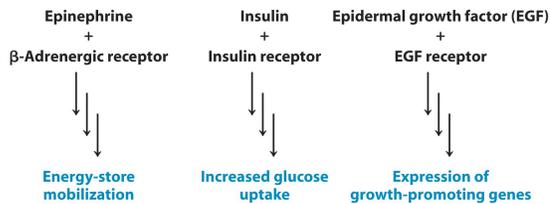
## Introduction

- † Signal transduction involves the changing of a cell's metabolism or gene expression in response to an external stimulus.
- † We will focus on three examples
  - The hormone **epinephrine** (adrenalin)
    - Regulates the "flight or fight response"
  - The hormone **insulin**
    - Regulates blood glucose levels after a meal
  - The hormone **epidermal growth factor (EGF)**
    - Stimulates cell growth after injury

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## Introduction

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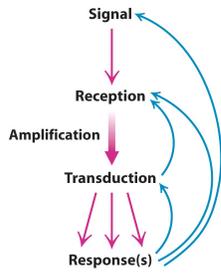
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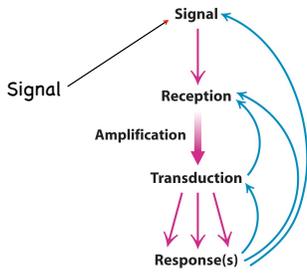
+ All three examples will present common themes



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## Introduction

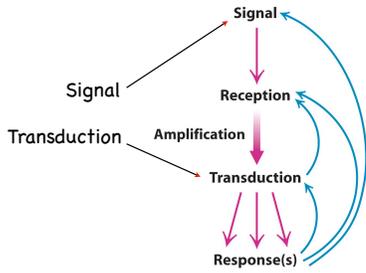
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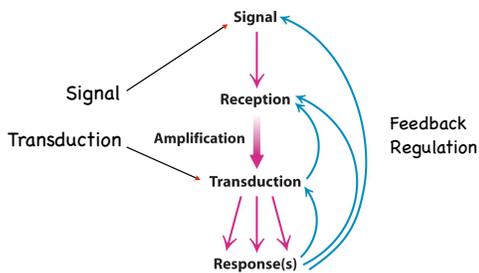
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Chem 452, Lecture 10 - Signal Transduction 3

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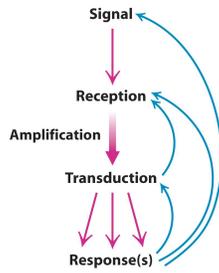
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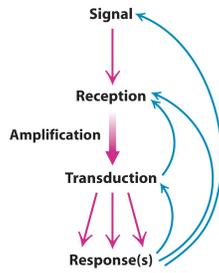


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## Introduction

+ All three examples will present common themes

1. Release of primary messenger



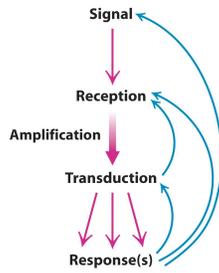
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## Introduction

+ All three examples will present common themes

1. Release of primary messenger

2. Reception of the primary messenger



Chem 452, Lecture 10 - Signal Transduction 4

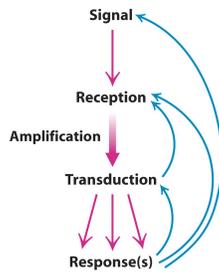
## Introduction

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1. Release of primary messenger

2. Reception of the primary messenger

3. Delivery of message to cell interior by secondary messenger

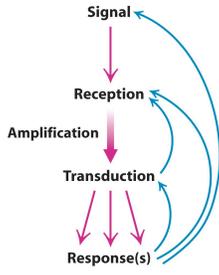


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# Introduction

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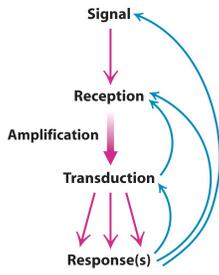
1. Release of primary messenger
2. Reception of the primary messenger
3. Delivery of message to cell interior by secondary messenger
4. Activation of effectors



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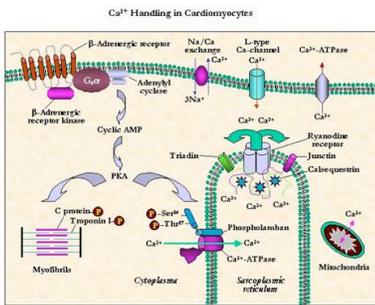


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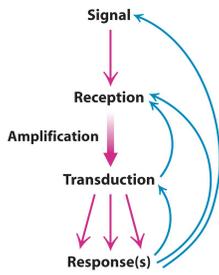


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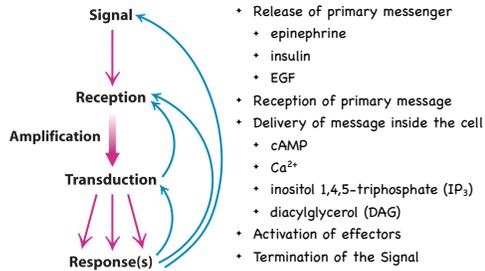
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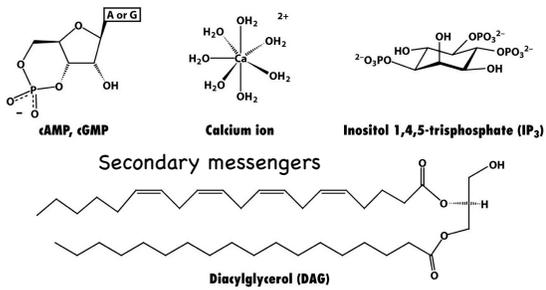
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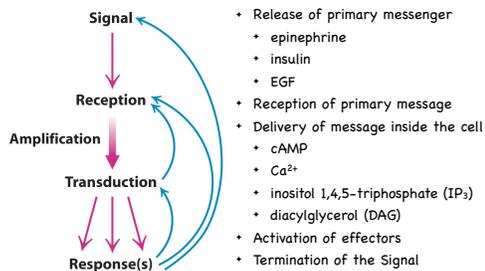
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Chem 452, Lecture 10 - Signal Transduction 5

## Introduction

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Chem 452, Lecture 10 - Signal Transduction 5

## G-Protein Receptors

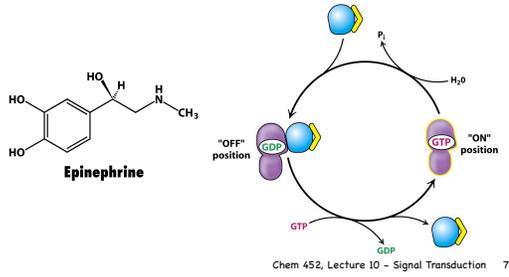
+ The receptors for epinephrine ( $\beta$ -adrenergic receptors) provide an example for a class of receptors called G-proteins.



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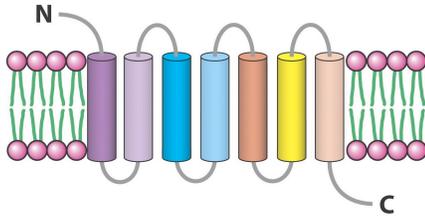
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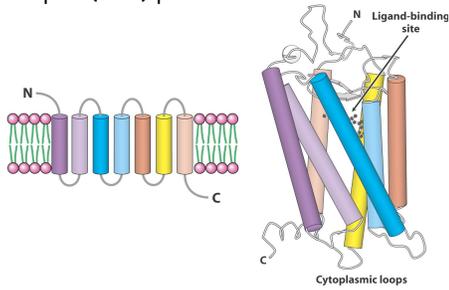
## G-Protein Receptors

- + G-protein receptors involve a 7-transmembrane receptor (7TM) protein.



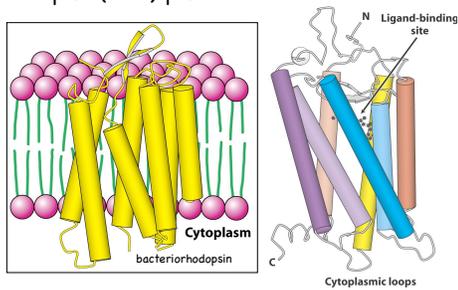
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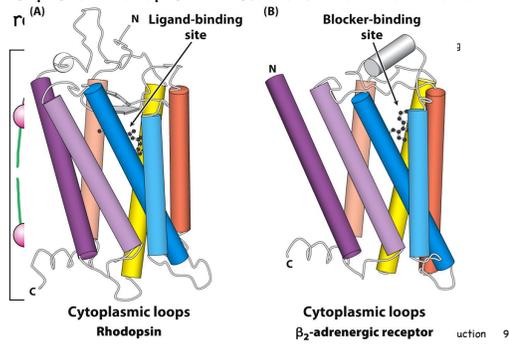
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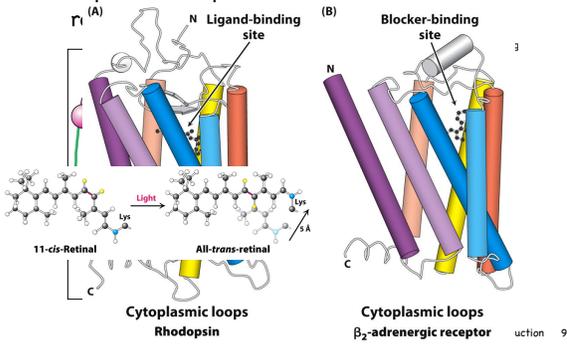
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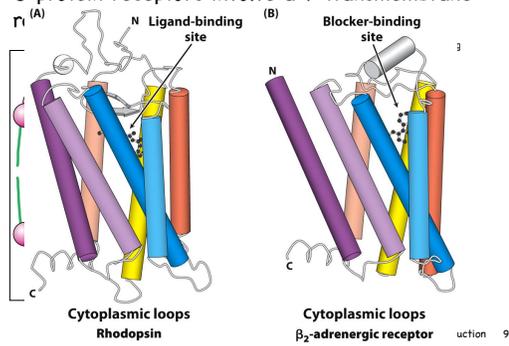
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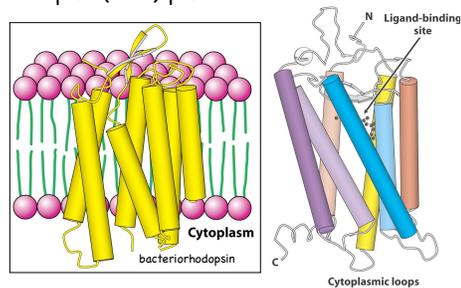
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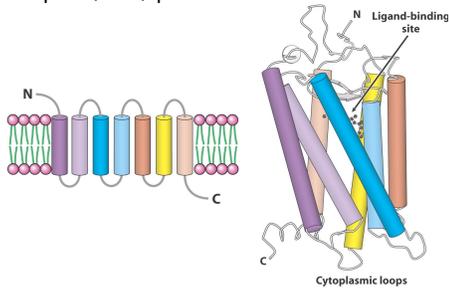
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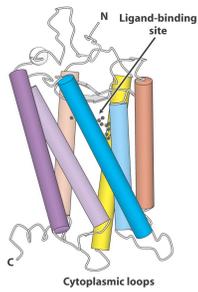


TABLE 14.1 Biological functions mediated by 7TM receptors

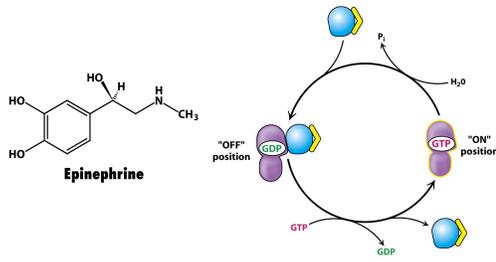
- Hormone action
- Hormone secretion
- Neurotransmission
- Chemotaxis
- Exocytosis
- Control of blood pressure
- Embryogenesis
- Cell growth and differentiation
- Development
- Smell
- Taste
- Vision
- Viral infection

Source: After J. S. Gutkind, *J. Biol. Chem.* 273(1998): 1839-1842.

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## G-Protein Receptors

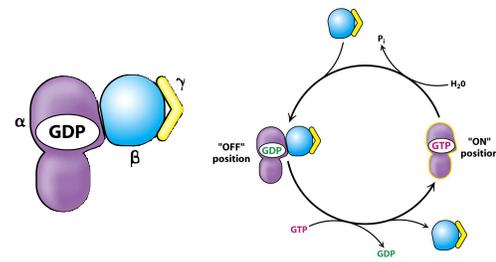
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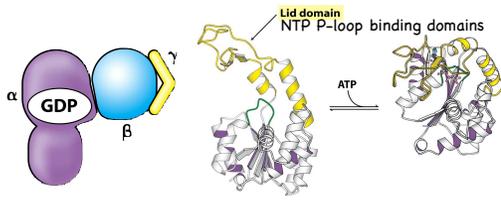
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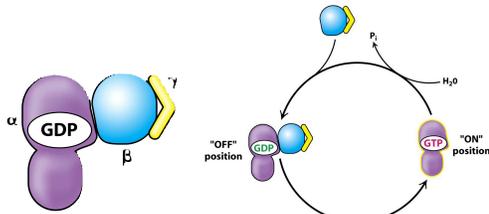
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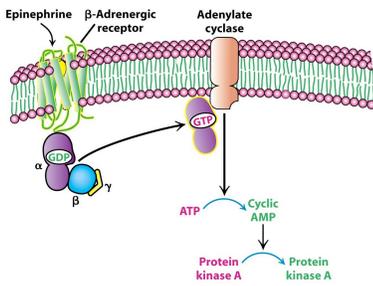
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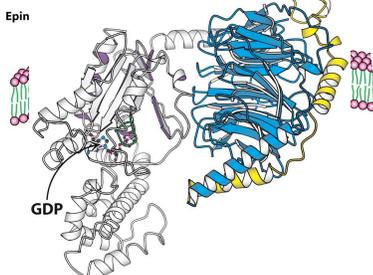
- † Ligand Binding to the 7TM receptor activates the G-protein.



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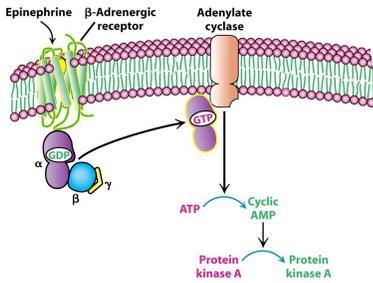
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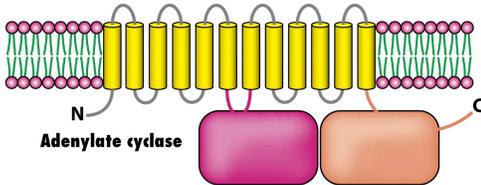
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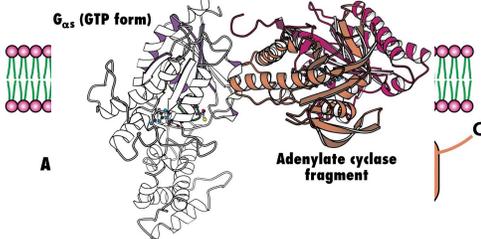
- † The activated G-protein ( $G_{\alpha s}$ ) goes on to activate the membrane bound enzyme adenylate cyclase.



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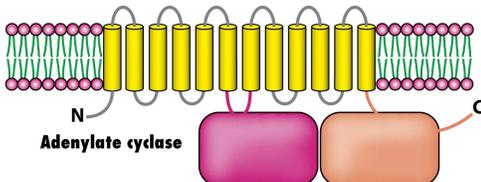
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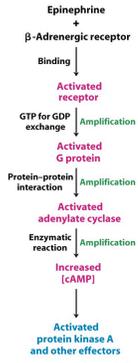
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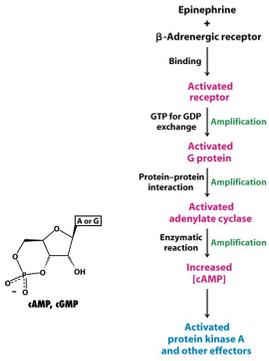
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# G-Protein Receptors



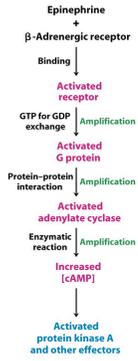
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# G-Protein Receptors



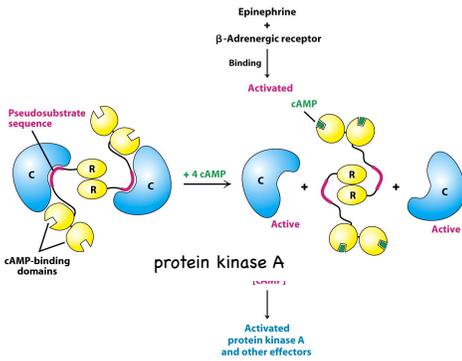
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# G-Protein Receptors



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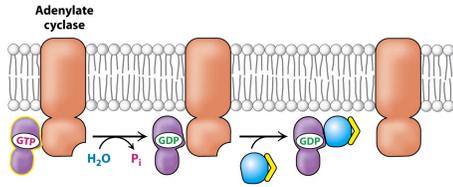


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## G-Protein Receptors

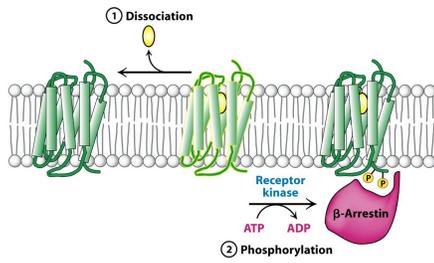
- Hydrolysis of GTP to GDP resets the activated G-protein.



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## G-Protein Receptors

- Resetting the receptor.



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## Next up

- Lecture 10, Signal Transduction (con'd). (Chapter 14)

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