Regulation and homeostasis
- List and describe the components in specific 2nd messenger signal transduction pathways
- Define each of the following and predict their effect on signal transduction:
  - one ligand on one receptor (tonic control)
  - receptor isoforms (one ligand, >1 receptor)
  - agonists for one receptor (>1 ligand, receptor)
  - two ligands, two receptors (antagonistic control)

Class problem set:
1. Norepinephrine (NE) is a large protein. Would the receptors for NE be inside the target cell or on the target cell membrane?
2. When NE binds an α₁ receptor on a cell’s membrane, there is an increase in IP₃ and DAG in the cell. What membrane bound amplifier enzyme is activated to cause the IP₃ and DAG increase?
3. What ion will be increased in the ICF due to IP₃?
4. What ICF enzyme will be activated by DAG?
**Receptor isoforms:**

Norepinephrine acts on α and β receptors.

Note, receptors are on different tissues and illicit different effects.

**Agonists for same receptor.**

Norepinephrine and Epinephrine activate the same receptors.

**Example of antagonistic control through different receptors on same tissue**

Norepinephrine and Acetylcholine activate different receptors for opposite effects.

- NE speeds heart rate, adrenergic receptors
- ACh slows heart rate, cholinergic receptors
Predict the responses for the following:

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Effector tissue</th>
<th>Response?</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑ NE</td>
<td>blood vessel with α₁ receptors</td>
<td></td>
</tr>
<tr>
<td>↑ ACh</td>
<td>blood vessel with α₁ receptors</td>
<td></td>
</tr>
<tr>
<td>↑ NE</td>
<td>heart SA node cells</td>
<td></td>
</tr>
<tr>
<td>↓ NE</td>
<td>blood vessel with β₂ receptors</td>
<td></td>
</tr>
</tbody>
</table>