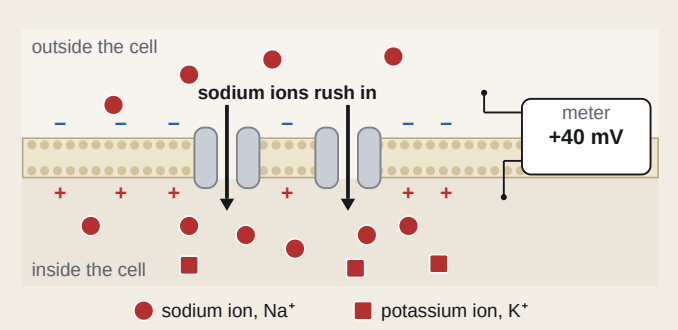
# A3 · The action potential, threshold and all-or-none · Notes

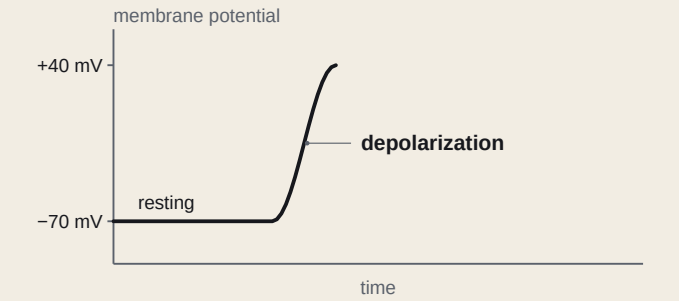
Goals: Describe depolarization and repolarization, and name the ion that moves in each. Say what the refractory period is and what the sodium-potassium pump does after an action potential. Read a graph of an action potential. Explain how an action potential moves along an axon in one direction. Explain the threshold level and the all-or-none response. Explain how the body tells a weak stimulus from a strong one.

Name: _____ Date: _____

## Slide 1 of 7 · Depolarization: sodium ions rush in

In lesson A2, a resting neuron had a resting potential of −70 mV. Sodium ions were mostly outside. Today a stimulus arrives.




### Key ideas

A stimulus opens _____. Sodium ions rush in.

The inside becomes _____. This reversal of charge is _____.

The membrane potential rises from −70 mV to _____.

A nerve impulse is an _____.

### Example

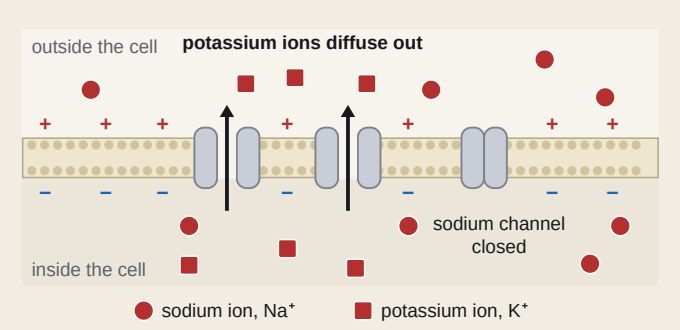
State what moves during depolarization, and which way.

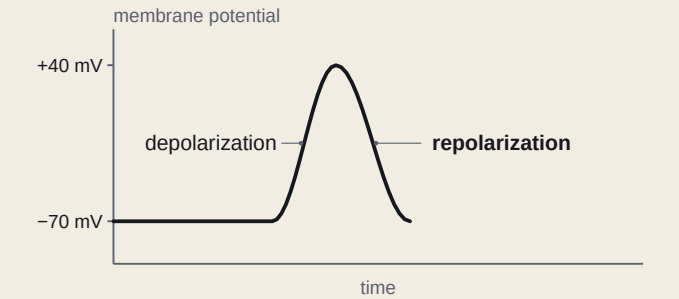
### Try it

State the membrane potential at the peak of an action potential. Say what the plus sign means.

## Slide 2 of 7 · Repolarization: potassium ions diffuse out

On the last slide, sodium ions rushed in. The membrane potential rose to +40 mV. The neuron cannot stay like that.




### Key ideas

After the peak, the sodium channels _____.

Then _____ open. Potassium ions diffuse out.

The inside becomes negative again. This is _____.

### Example

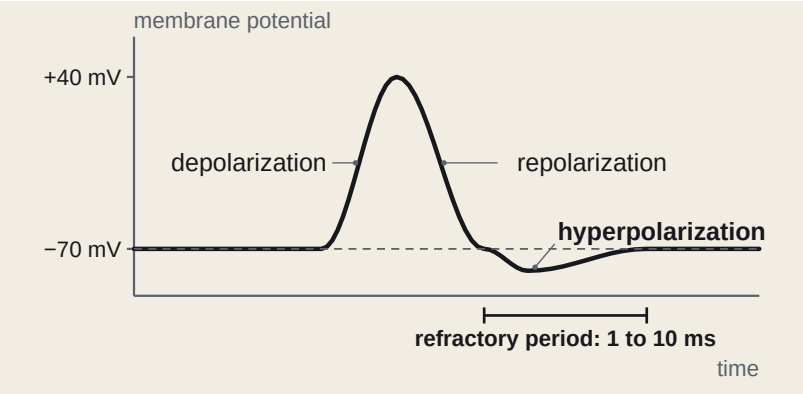
State what moves during repolarization, and which way.

### Try it

On a graph of an action potential, the line is falling. Name this part and the ion that is moving.

## Slide 3 of 7 · The refractory period

On the last slide, potassium ions diffused out and the inside became negative again. The neuron is still not quite back to rest.




### Key ideas

For a moment the inside is more negative than the resting potential: _____.

The time to return to rest is the _____. It lasts 1 to _____ ms.

The _____ puts the ions back.

### Example

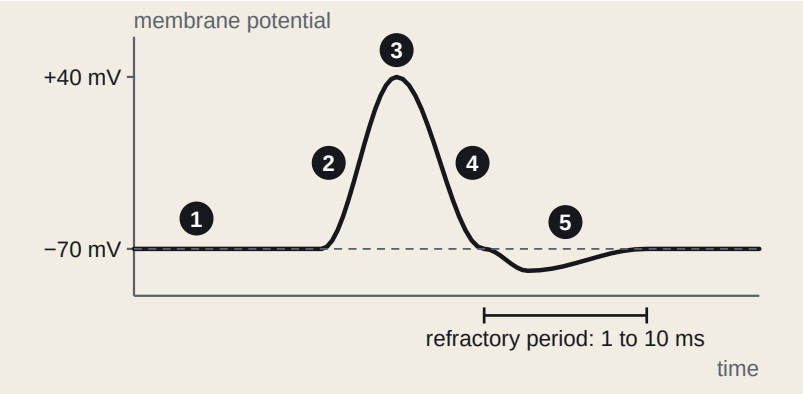
State what a membrane cannot do during its refractory period.

### Try it

Explain why the sodium-potassium pump is needed after an action potential.

## Slide 4 of 7 · Method: how to read an action potential graph

You have now seen every part of an action potential. Here the parts become five steps for reading any graph of one.




### Key ideas

Step 1: the flat line at −70 mV is the neuron _____.

Step 2: the rise is _____. Step 3: the _____ is +40 mV.

Step 4: the fall is _____.

Step 5: the dip and the return are the _____.

### Example

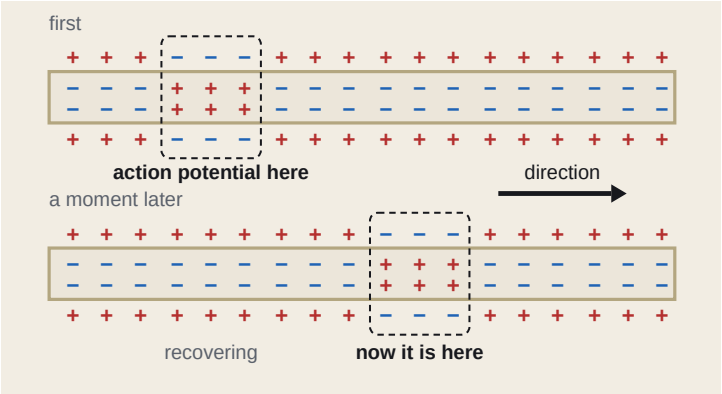
Use the five steps. The line on a graph is rising steeply. Name the step and what the ions are doing.

### Try it

Use the five steps. The line dips below −70 mV and comes back. Name the step.

## Slide 5 of 7 · How an action potential moves along the axon

So far you watched one small part of the membrane. An axon is long. Now you see how the action potential gets from one end to the other.




### Key ideas

Each action potential starts the _____ one along the axon.

The part behind is in its _____. So the action potential moves _____ only.

With a myelin sheath, the ion channels are at the _____.

### Example

Explain why an action potential does not travel backward along an axon.

### Try it

State where an action potential can happen on an axon with a myelin sheath.

## Slide 6 of 7 · Threshold and the all-or-none response

On the last slide, one action potential started the next. Now we go back to the start. Not every stimulus starts an action potential.

**One neuron, five stimuli**

| Strength of stimulus (units) | Action potential? | Peak |
|---|---|---|
| 1 | no | none |
| 2 | no | none |
| 3 | yes | +40 mV |
| 6 | yes | +40 mV |
| 12 | yes | +40 mV |

### Key ideas

The smallest stimulus that starts an action potential is the _____.

A stimulus _____ the threshold level gives no action potential.

A neuron fires _____ or not at all. This is the _____.

### Example

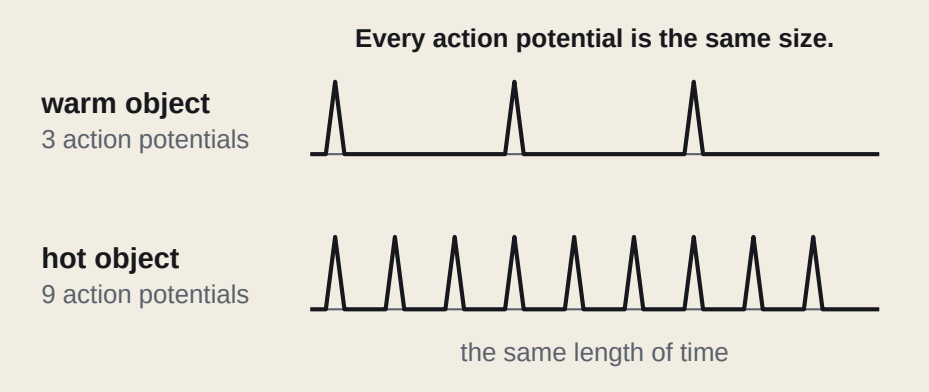
A neuron has a threshold level of 3 units. Predict the result of a stimulus of 2 units.

### Try it

The same neuron gets a stimulus of 12 units. Predict the peak of the action potential.

## Slide 7 of 7 · Telling a weak stimulus from a strong one

On the last slide, every action potential was the same size. Yet you can tell a warm object from a hot one. Here is how.




### Key ideas

A stronger stimulus makes a neuron fire more _____.

The number of action potentials in a given time is the _____.

A stronger stimulus also makes _____ fire.

### Example

A hot object and a warm object touch your hand. Compare the action potentials they cause in one neuron.

### Try it

Give the two ways the brain can tell that a stimulus is strong.