

# Pathophysiology I

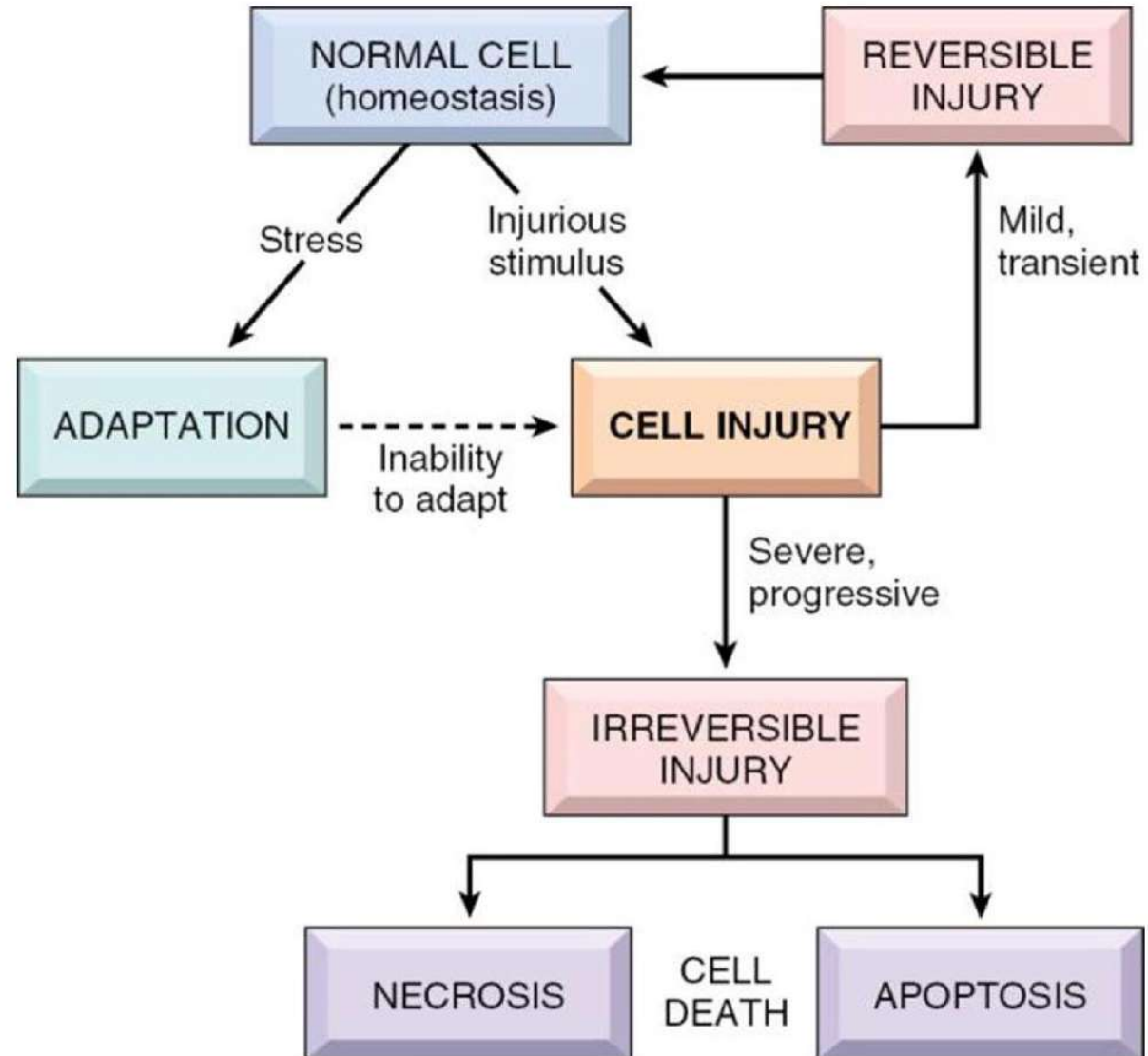
## Chapter 1: Alterations in cell function

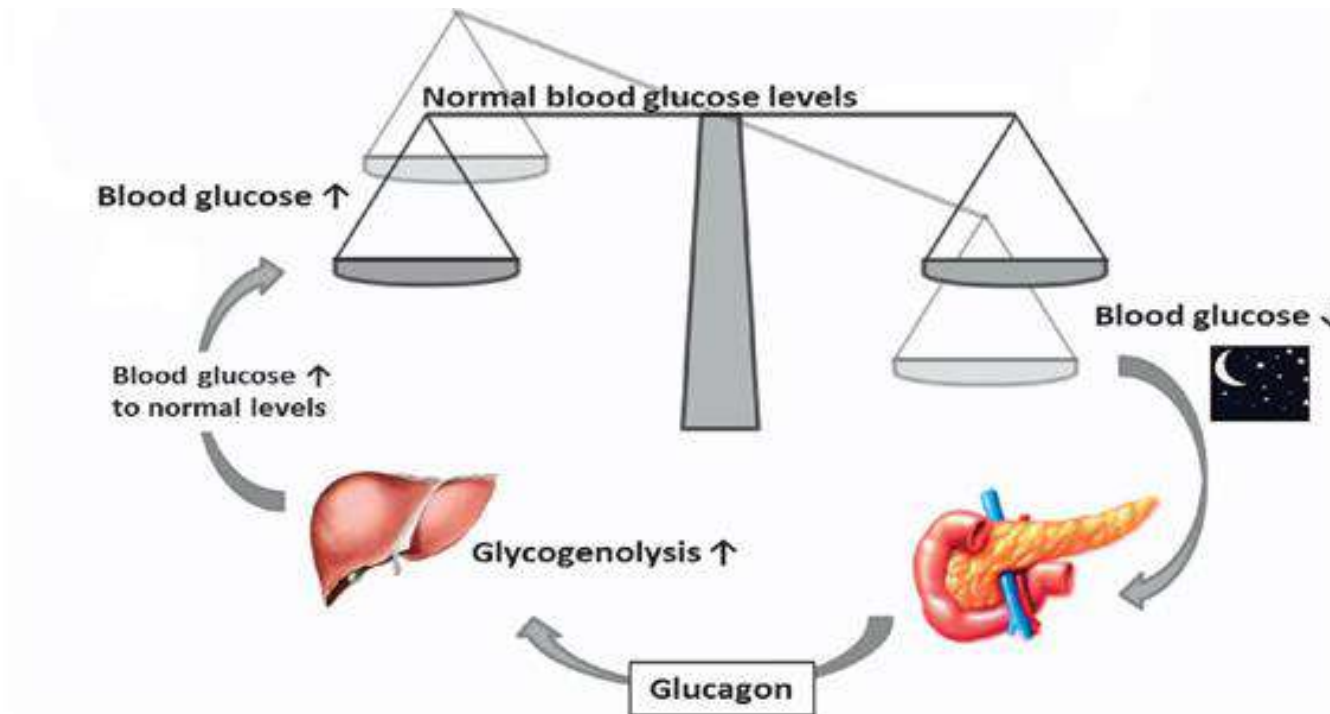
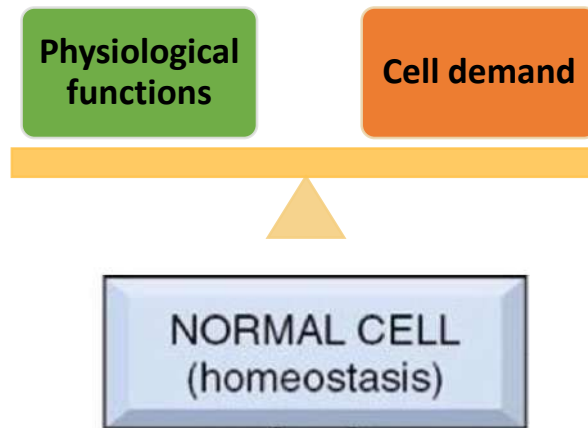
- Cell adaptation
- Cell injury
- Cell death

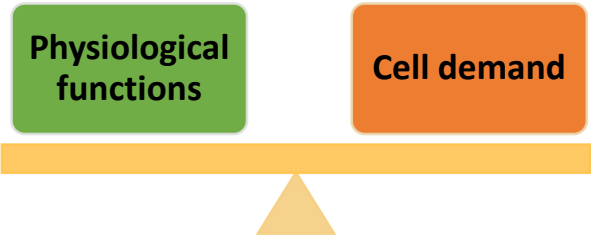
# Definitions

- **Physiology is the biological science that describes the functions and mechanisms operating within the body in the healthy state.**
- **Pathophysiology seeks to explain the mechanisms of functional changes associated with or resulting from a disease.**
- **Pathophysiology can also be defined as physiology of the disease.**
- **Pathogenesis refers to the mechanisms of development and progression of the disease.**

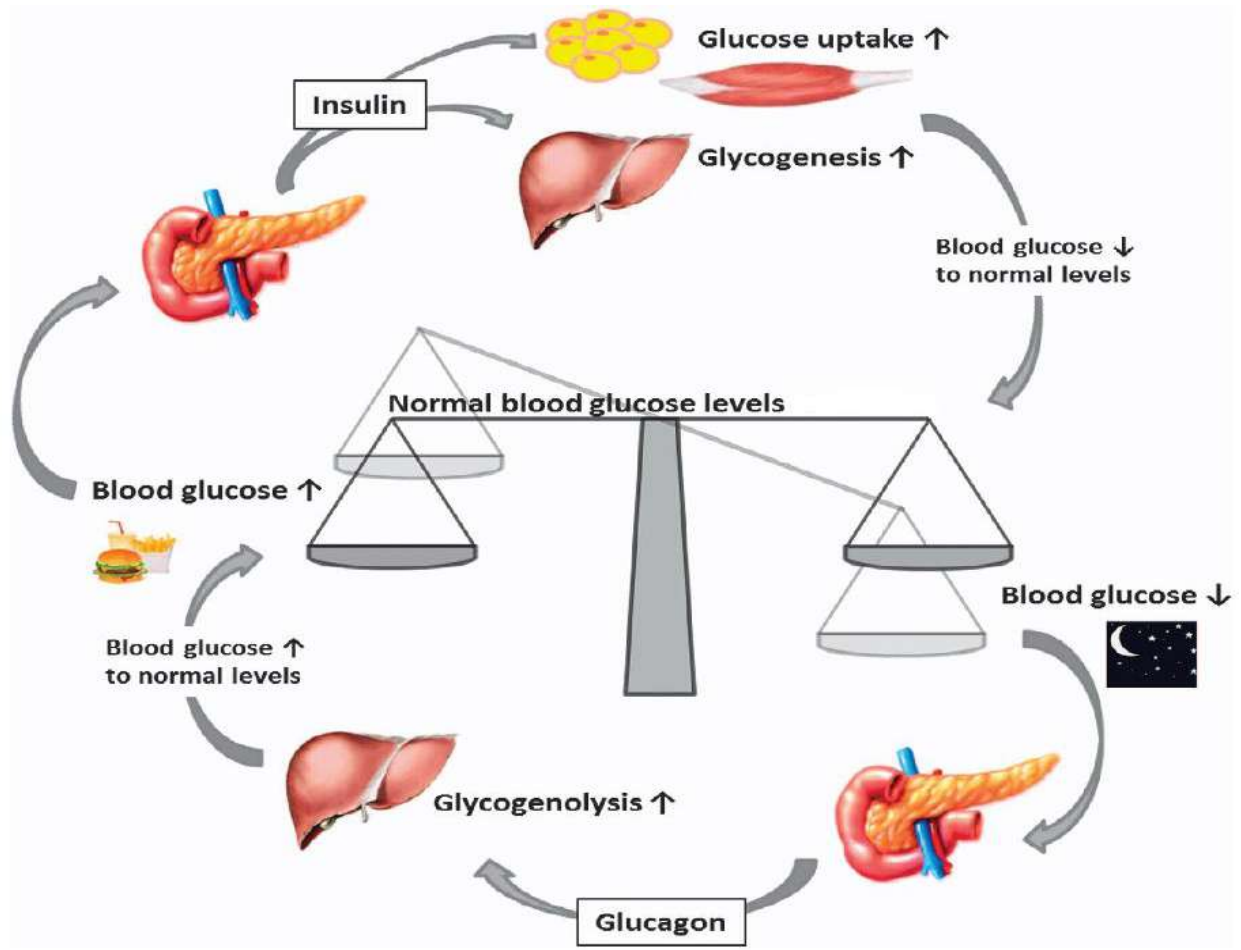
# Alteration of cell functions: Cellular responses to stress



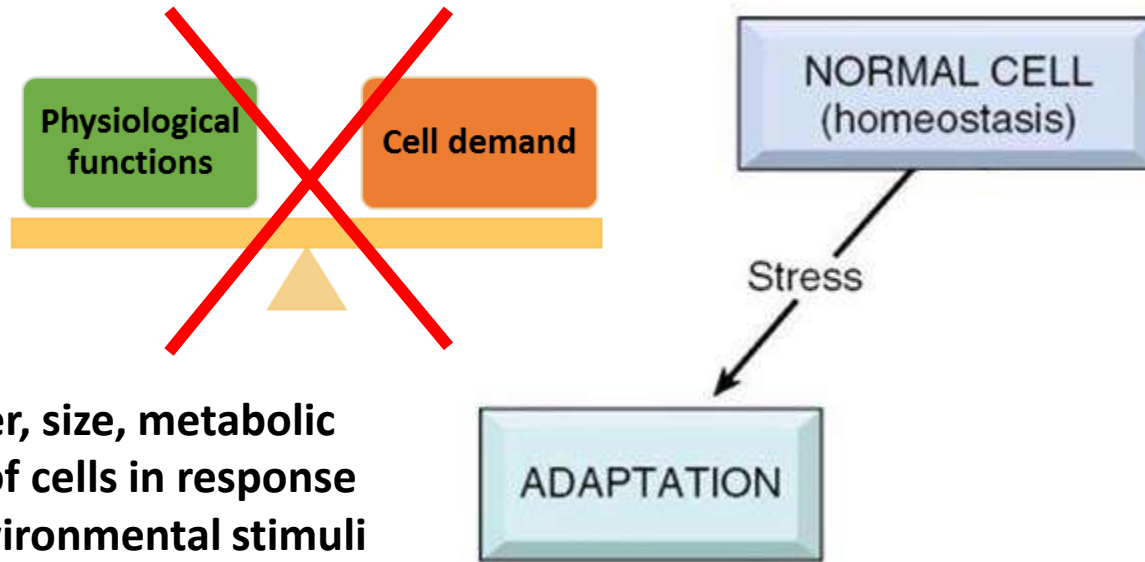




NORMAL CELL  
(homeostasis)



# Cellular responses to stress- cell adaptation

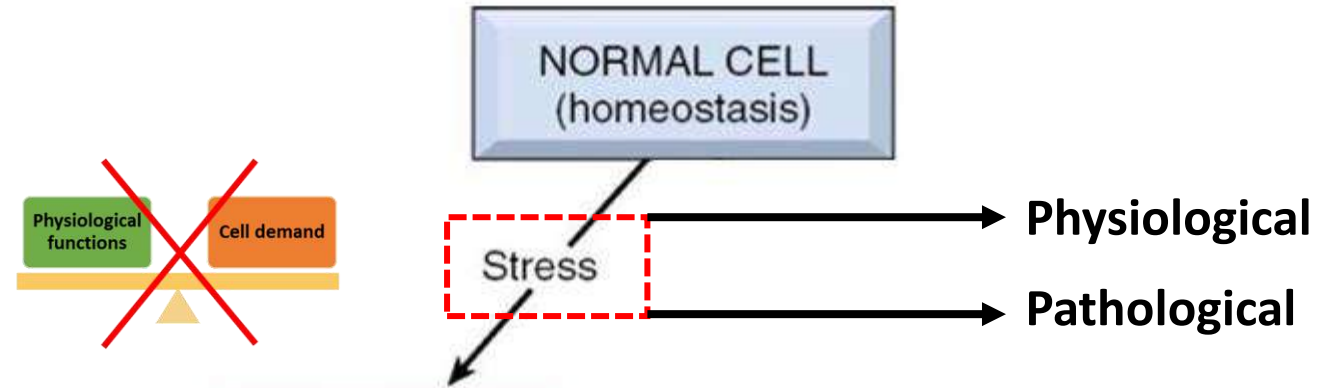


Changes in the number, size, metabolic activity, or functions of cells in response to internal and/or environmental stimuli

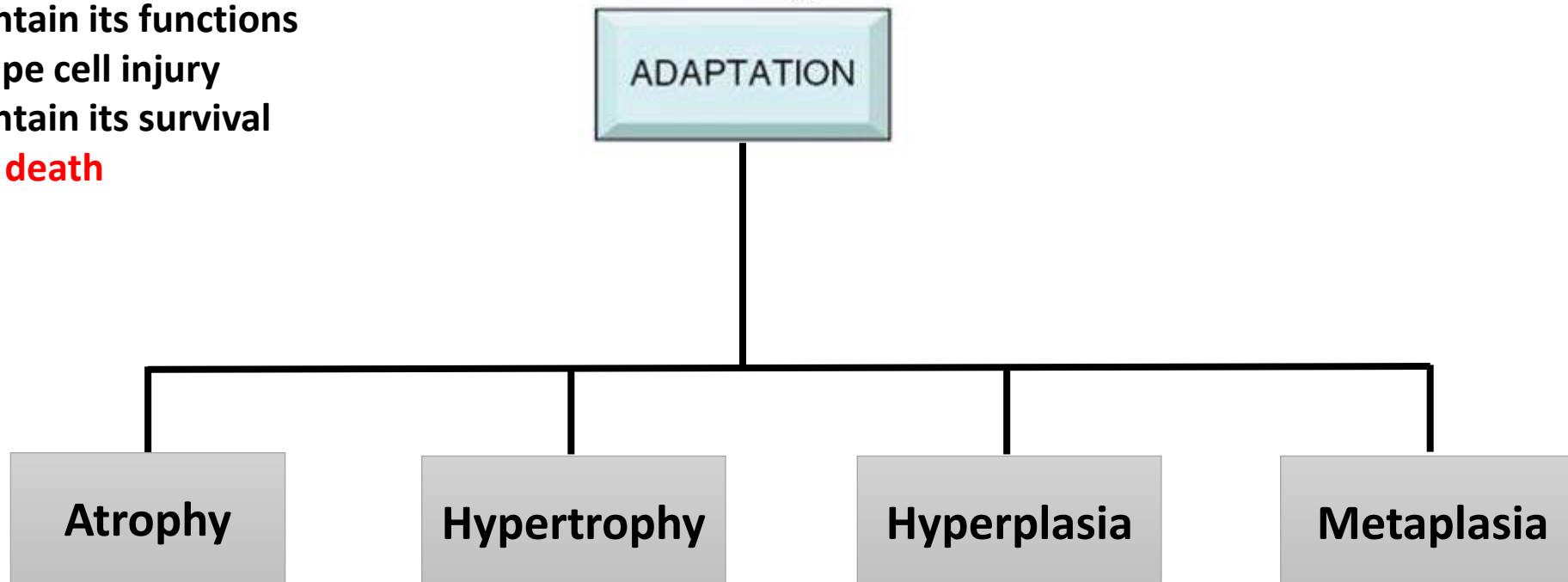
- To maintain its functions
- To escape cell injury
- To maintain its survival
- **No cell death**



# Cellular responses to stress- cell adaptation



- To maintain its functions
- To escape cell injury
- To maintain its survival
- **No cell death**

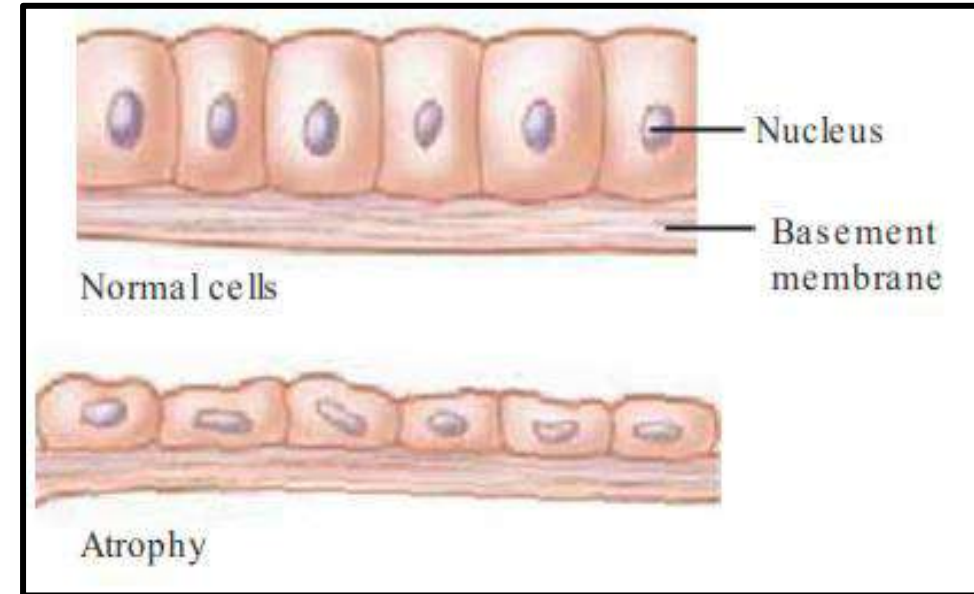




# Cellular responses to stress- cell adaptation

## 1. Atrophy

- Atrophy is a decrease in the size of cells due to a decrease in work demands.
- Causes of atrophy:
  - (1) disuse
  - (2) denervation
  - (3) poor nutrition
  - (4) ischemia or decreased blood supply



# Cellular responses to stress- cell adaptation

## 2. Hypertrophy

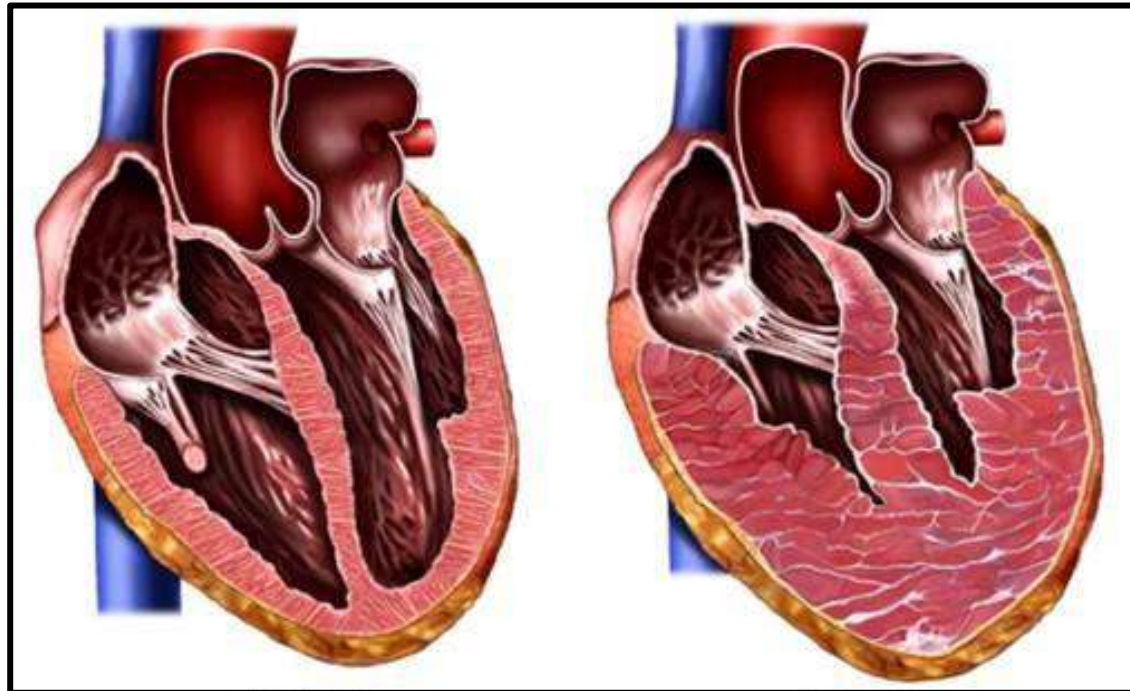
- Hypertrophy is an increase in the size of cells resulting in an increase in the size of the organ.
- No new cells.
- Hypertrophy may occur as the result of:
  - a. Normal physiological condition: The increase in muscle mass associated with exercise.



# Cellular responses to stress- cell adaptation

## b. Abnormal conditions:

- **Pathological hypertrophy:** myocardial hypertrophy from heart failure.
- **Compensatory hypertrophy:** If one kidney is removed, the remaining kidney enlarges to compensate for the loss.



Normal heart

myocardial hypertrophy

# Cellular responses to stress- cell adaptation

## 3. Hyperplasia

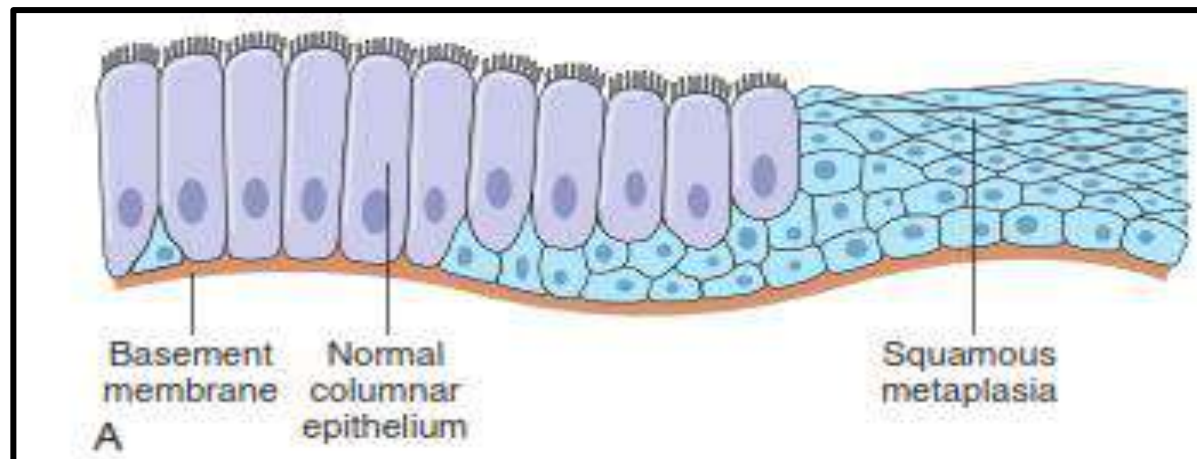
- Hyperplasia is an increase in the number of cells in an organ.
- **hormonal and growth factors stimulation**
  - a. **Physiological condition**
    - **Hormonal: Breast and uterus enlargement during pregnancy due to estrogen stimulation**
    - **Compensatory: Regeneration of liver after partial hepatectomy**
  - b. **Pathological condition: due to excessive hormonal and growth factors effect**
    - **Benign prostatic hyperplasia**

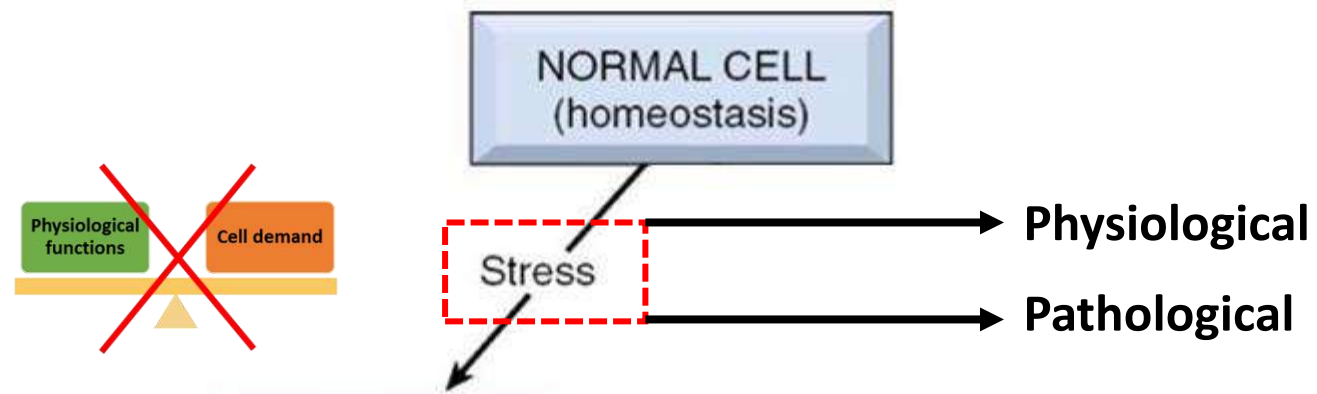
# Cellular responses to stress- cell adaptation

## 4. Metaplasia

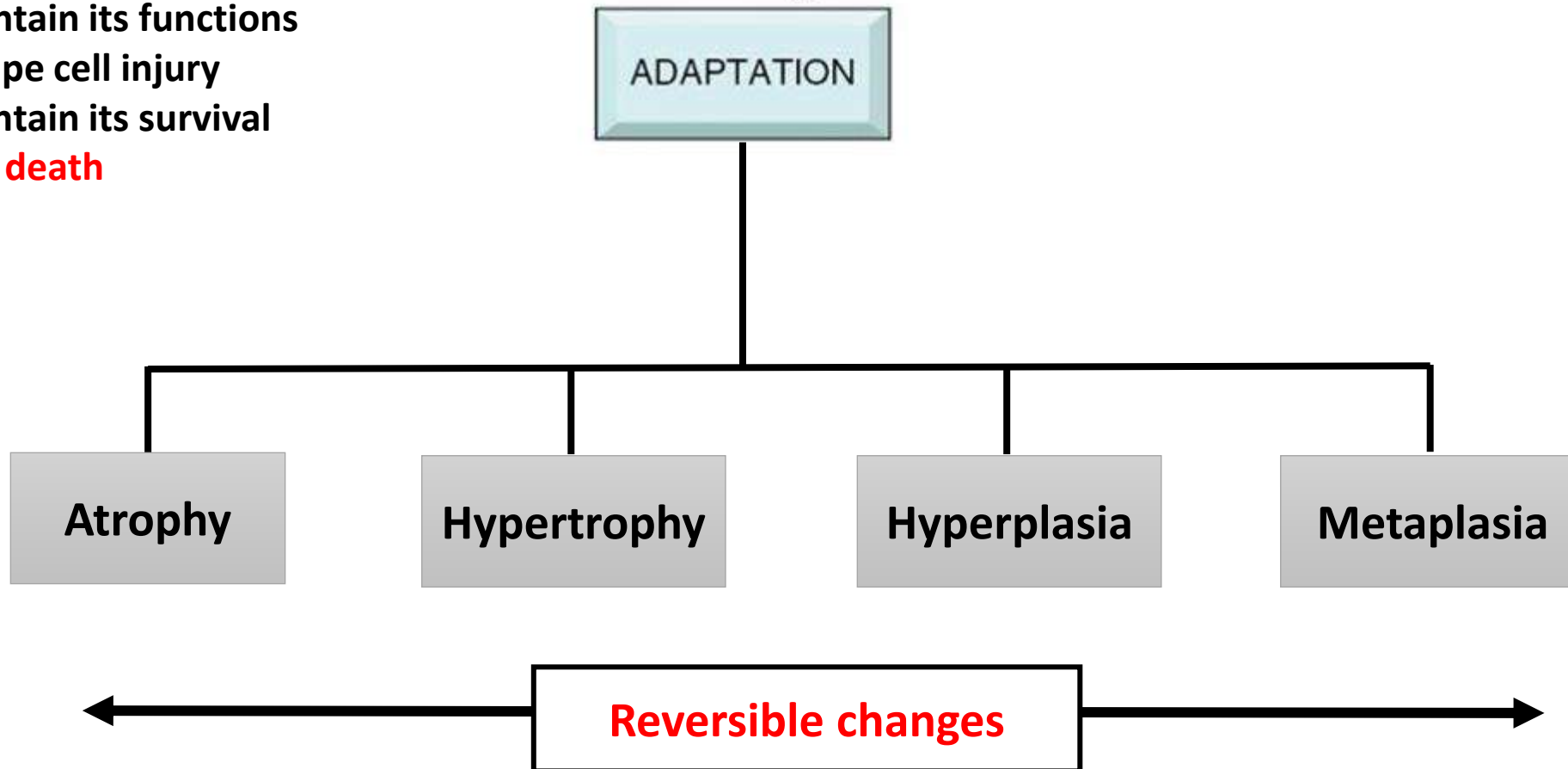
- Metaplasia is the conversion of one cell type to another cell type that might have a better chance of survival under stress.
- Metaplasia usually occurs in response to chronic irritation or inflammation.
- Example:

In respiratory system of smokers, the normal ciliated columnar epithelial cells of the trachea and bronchi are replaced by stratified epithelial cells

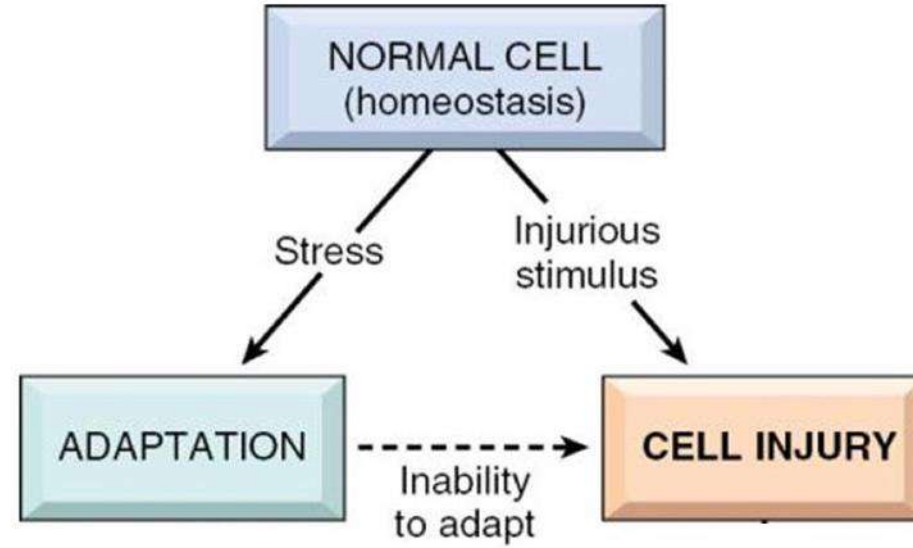




- To maintain its functions
- To escape cell injury
- To maintain its survival
- **No cell death**

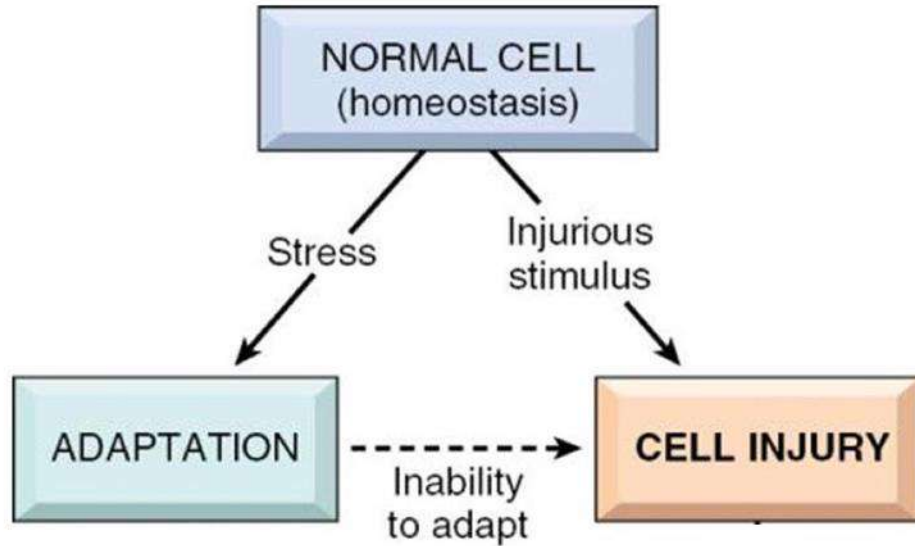


# Cellular responses to stress- cell injury





# Cellular responses to stress- cell injury



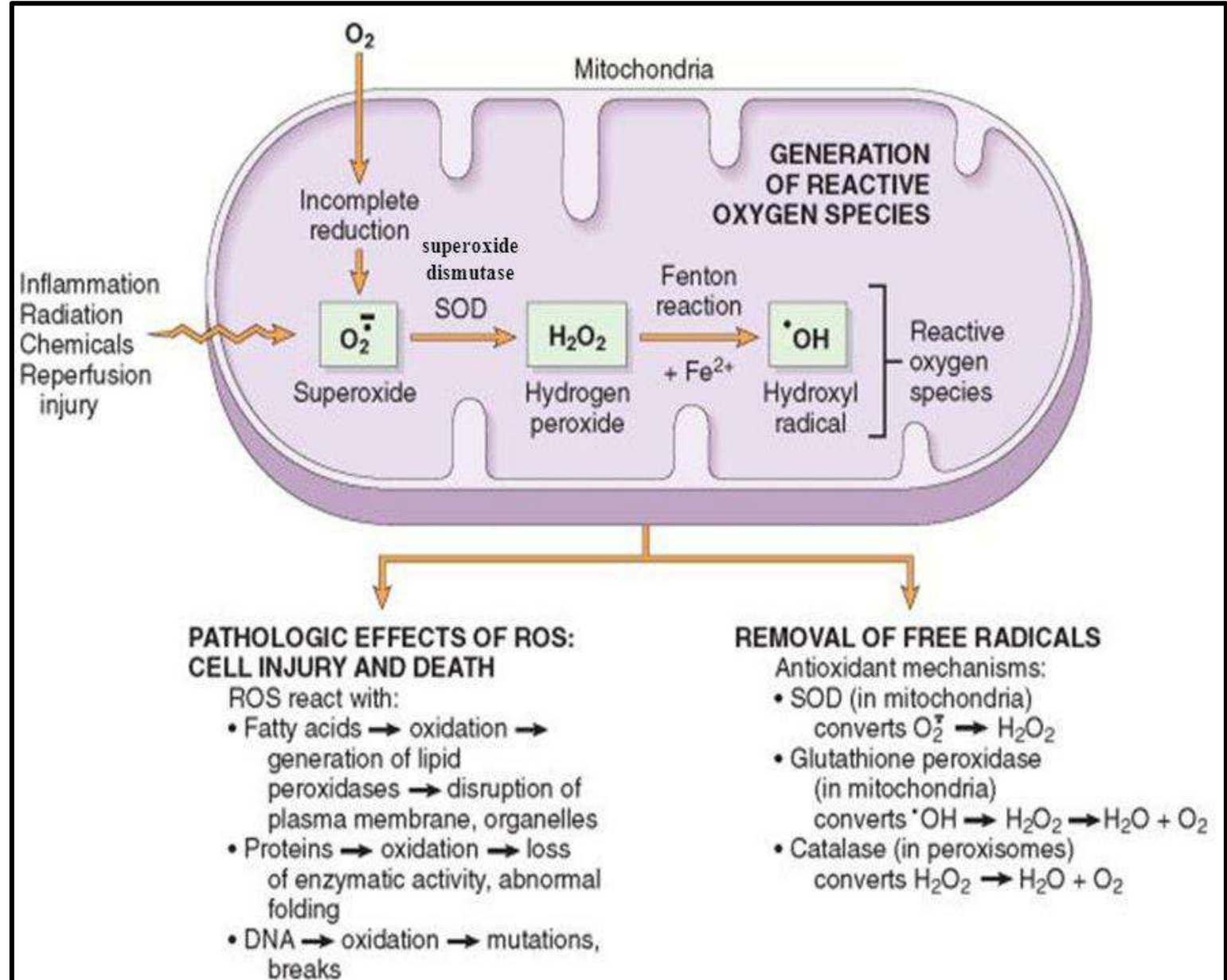
- **Changes in morphology, components, biochemical composition and functions of the cell due to its inability to adapt to a stress or its exposure to a strong injurious agent.**
- **Causes**
  1. **Physical stimuli**
  2. **Radiation**
  3. **Chemical stimuli**
  4. **Biological agents**
  5. **Nutritional imbalance**



# Cellular responses to stress- cell injury

## Mechanism of cell injury

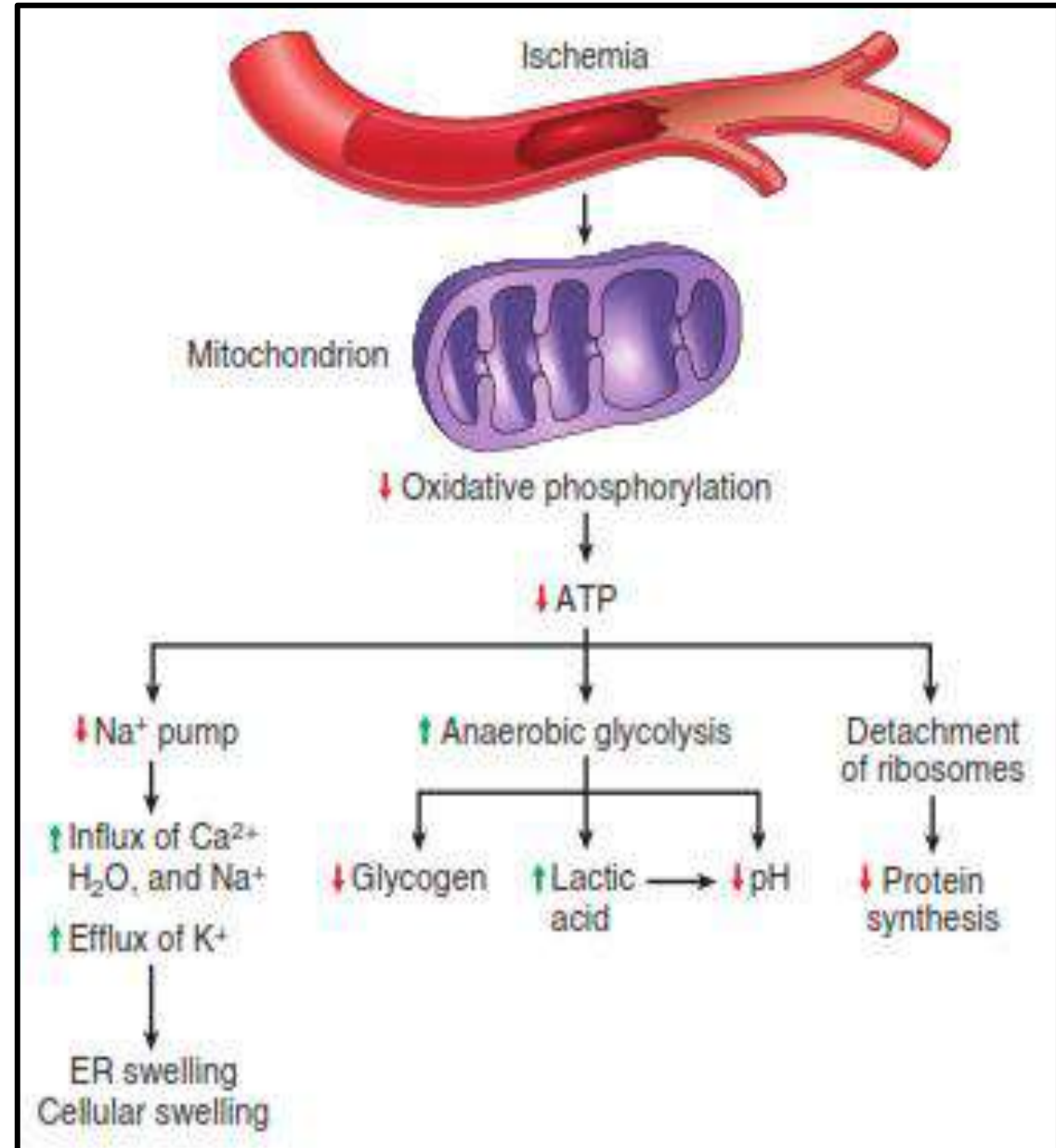
### 1. Free radical formation



# Cellular responses to stress- cell injury

## Mechanism of cell injury

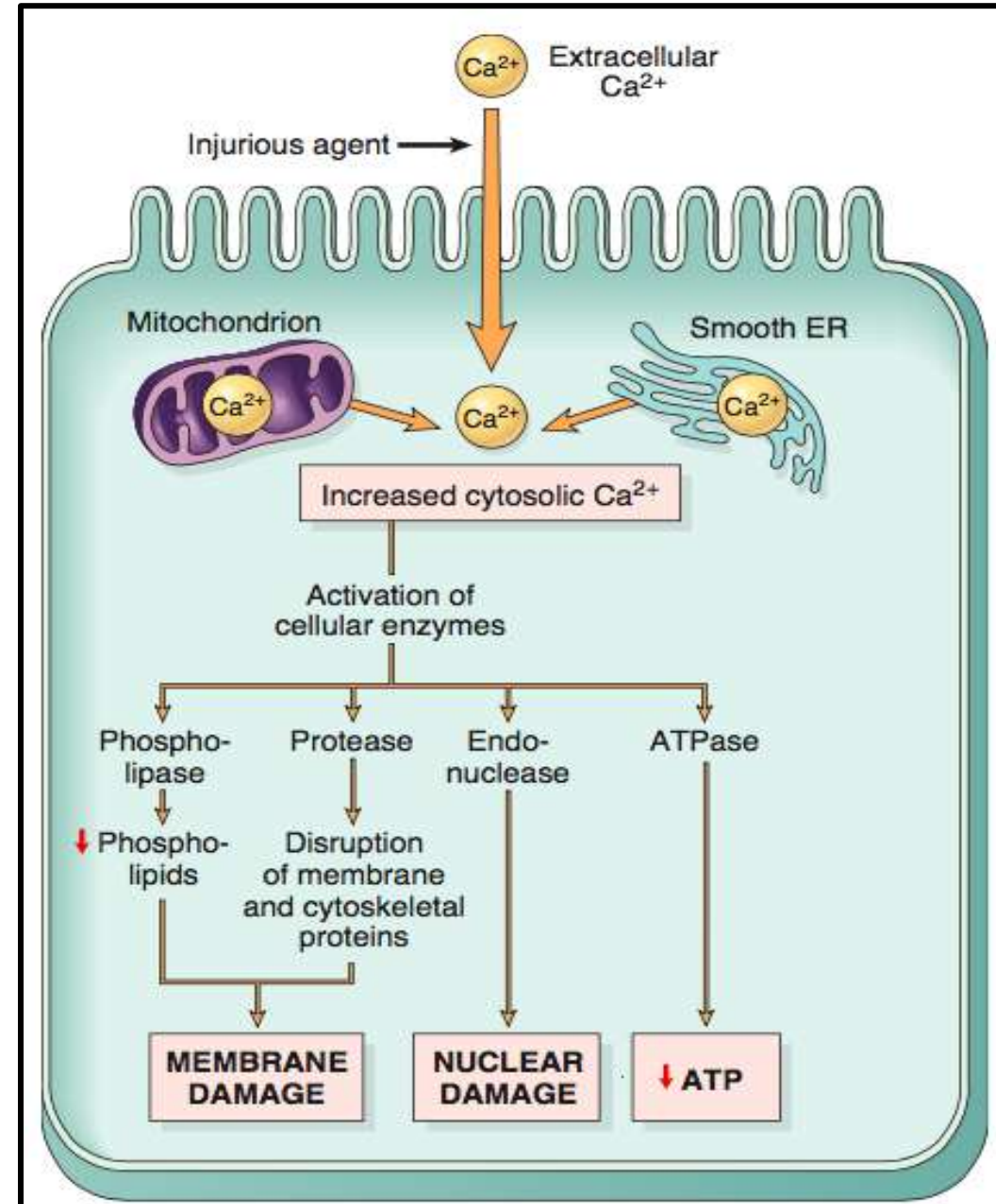
### 2. Hypoxia and ATP depletion



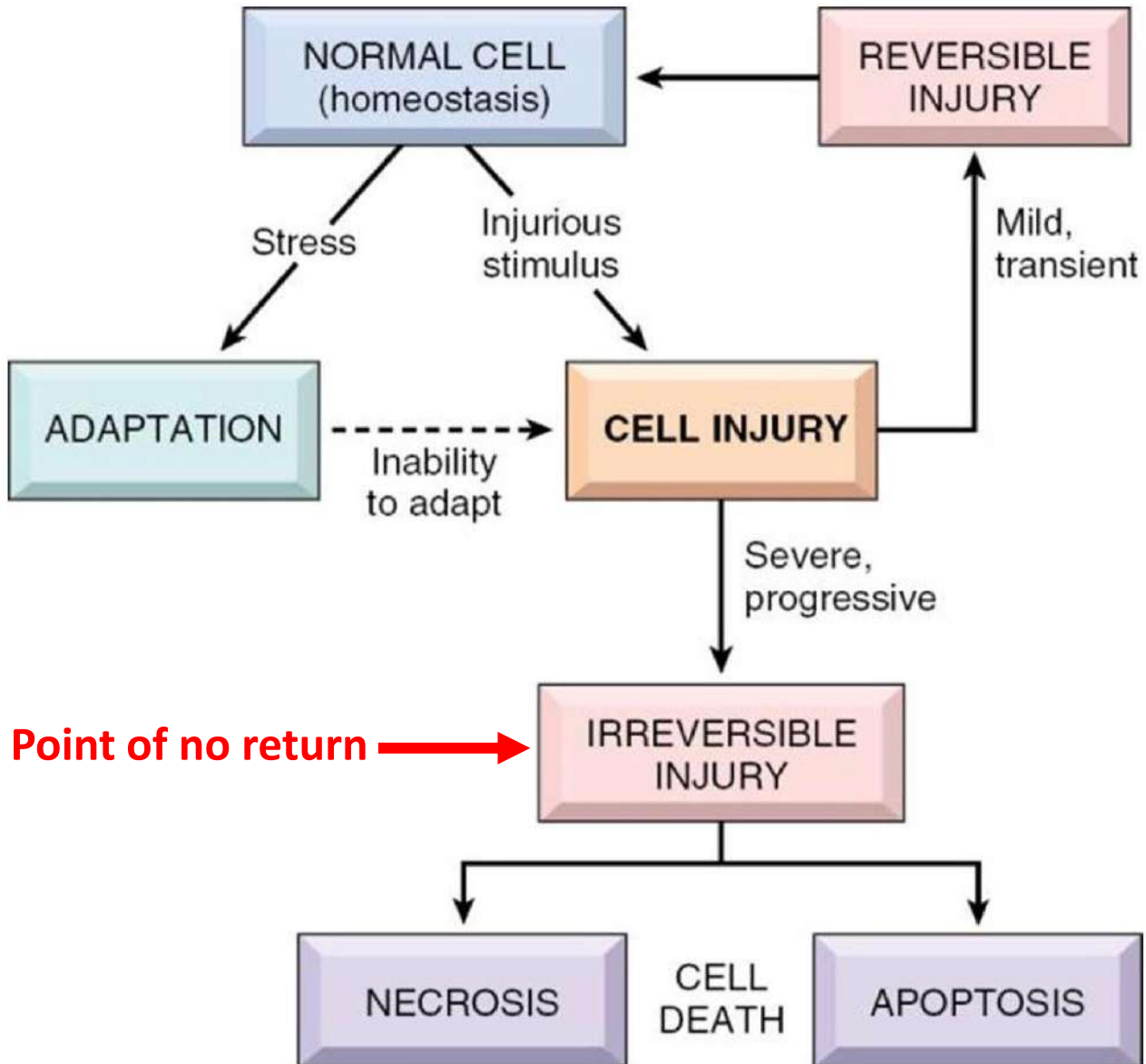
# Cellular responses to stress- cell injury

## Mechanism of cell injury

### 3. Increase of intracellular calcium



# Cellular responses to stress- cell death



The cellular response to injurious stimuli depends on its type, its duration, and its severity

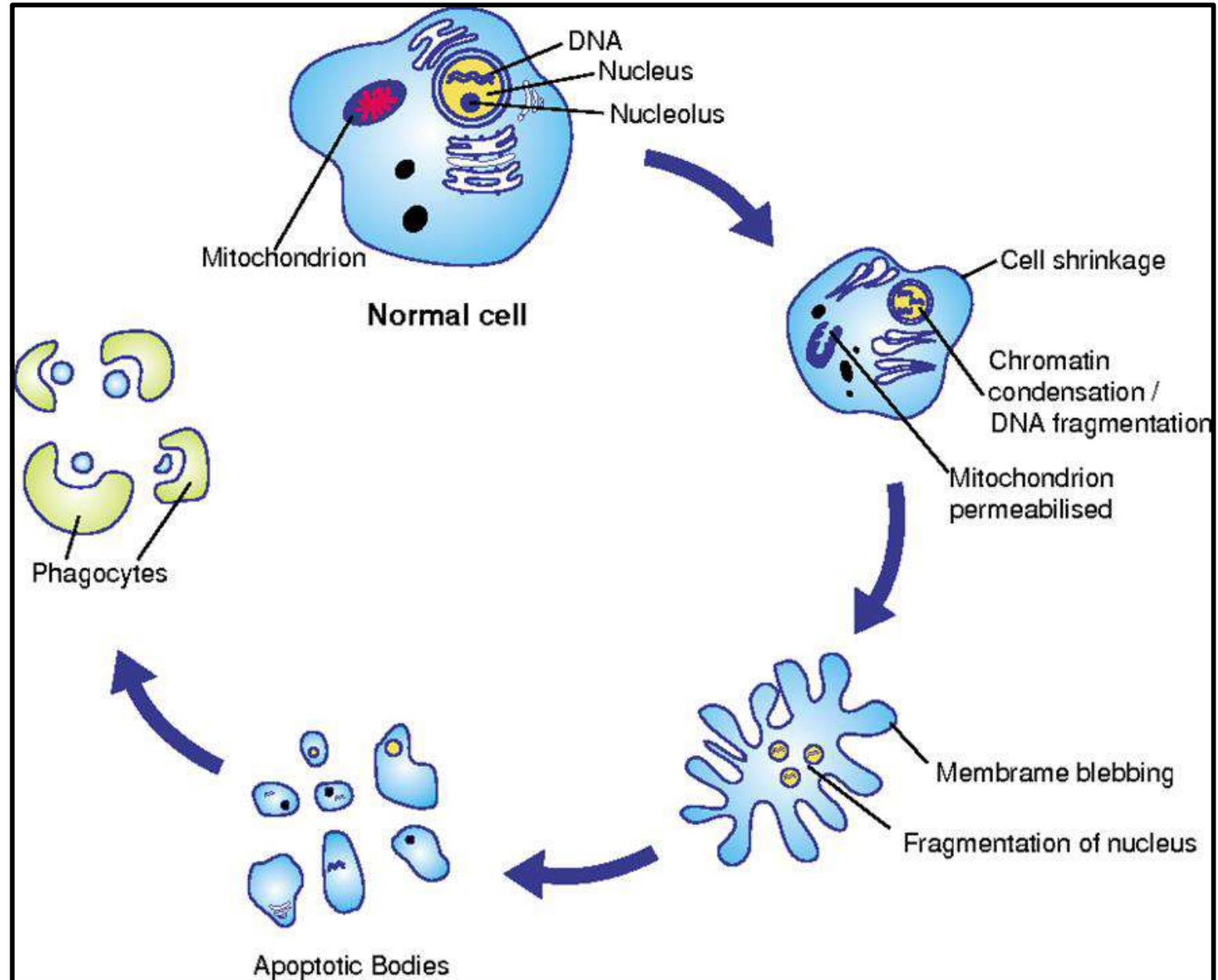
The consequences of an injurious stimulus also depend on the type, status, adaptability, and genetic makeup of the injured cell.



# Cellular responses to stress- cell death

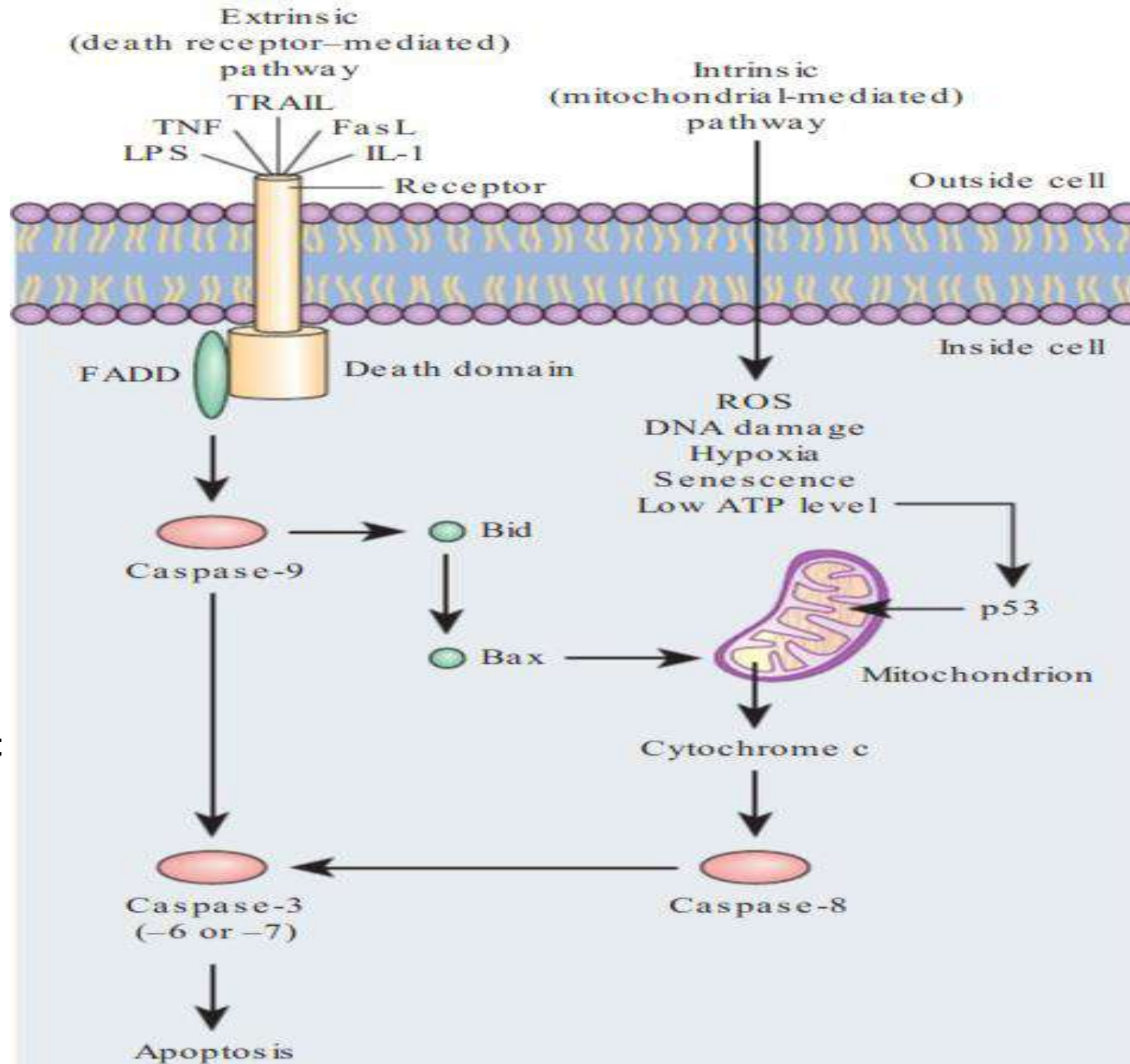
## 1. Apoptosis

- It is a programmed cell death that eliminates injured and aged cells.
- **Ongoing mechanism**



TNF-related apoptosis-inducing ligand (TRAIL)

## Pathways of apoptosis



Apoptotic proteins

Bcl-2 interacting-domain death agonist

Bcl-2-associated X protein

phosphoprotein 53

# Cellular responses to stress- cell death

## 2. Necrosis

- It is accidental and unregulated form of cell death resulting from damage to cell membranes and loss of ion homeostasis.

