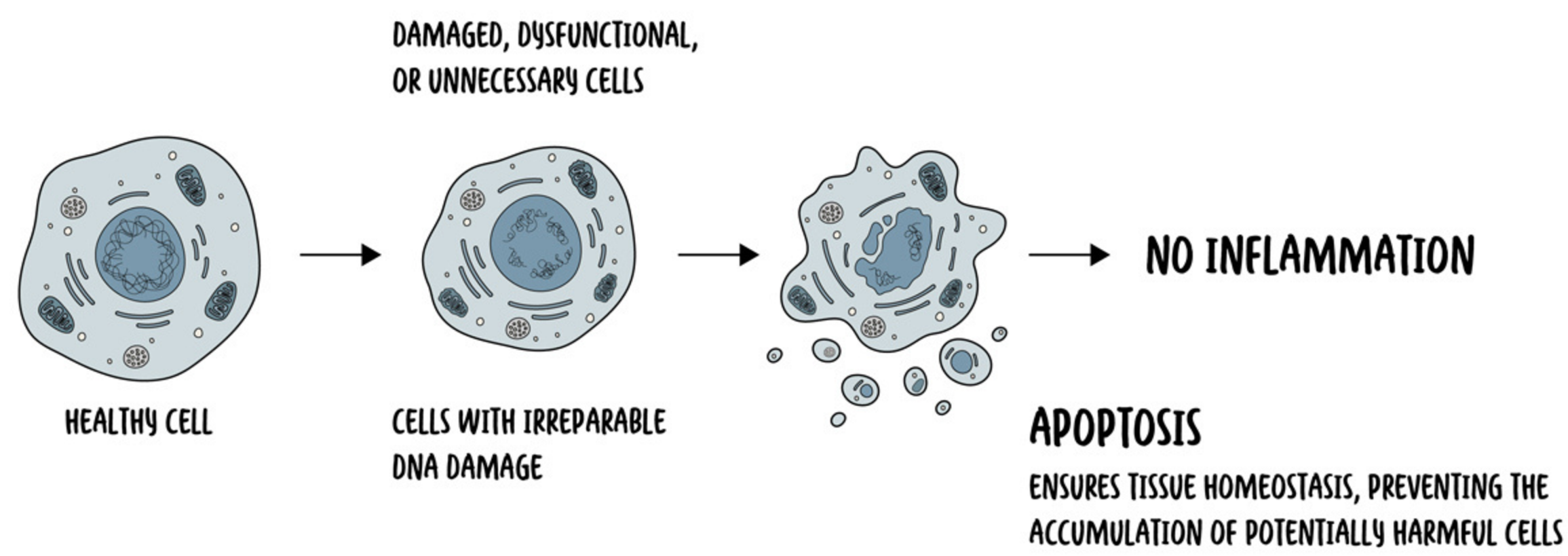
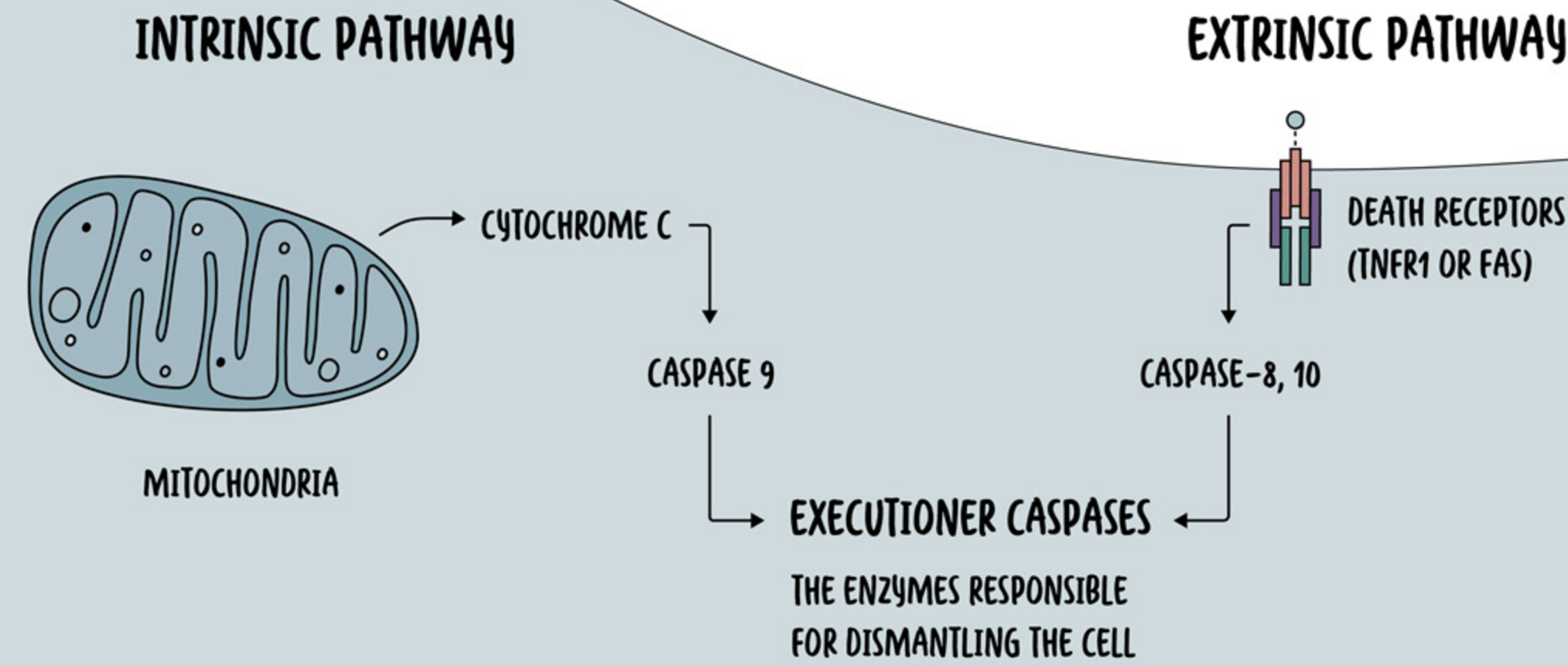


APOPTOSIS: PROGRAMMED CELL DEATH

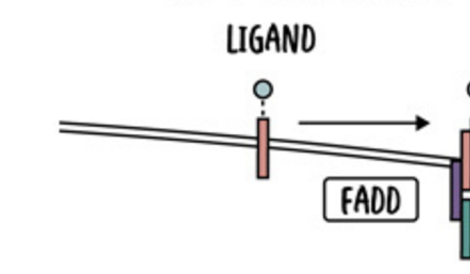


MECHANISMS OF APOPTOSIS



EXTRINSIC PATHWAY (DEATH RECEPTOR PATHWAY)

① TRIGGERING EVENTS



③ ACTIVATION



CASPASE CASCADE ACTIVATION

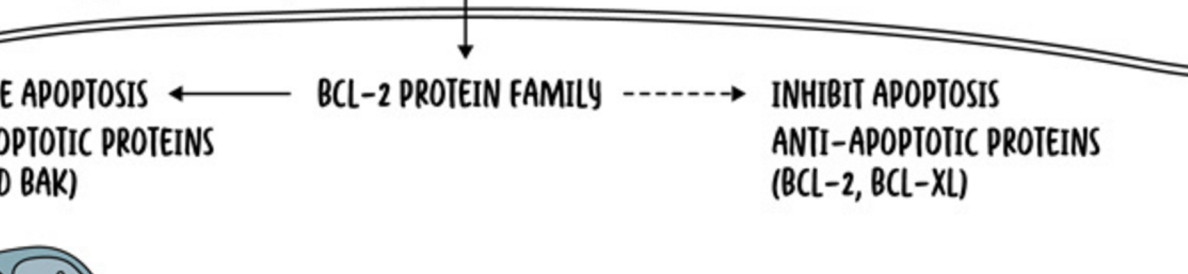
⑤ EXECUTIONER CASPASES (CASPASE-3, CASPASE-7)

⑥ APOPTOSIS

MACROPHAGES

INTRINSIC PATHWAY (MITOCHONDRIAL PATHWAY)

① DNA DAMAGE, HYPOXIA, OR ONCOGENE ACTIVATION



② MITOCHONDRIAL OUTER MEMBRANE PERMEABILIZATION



④ FORMATION OF THE APOPTOSOME

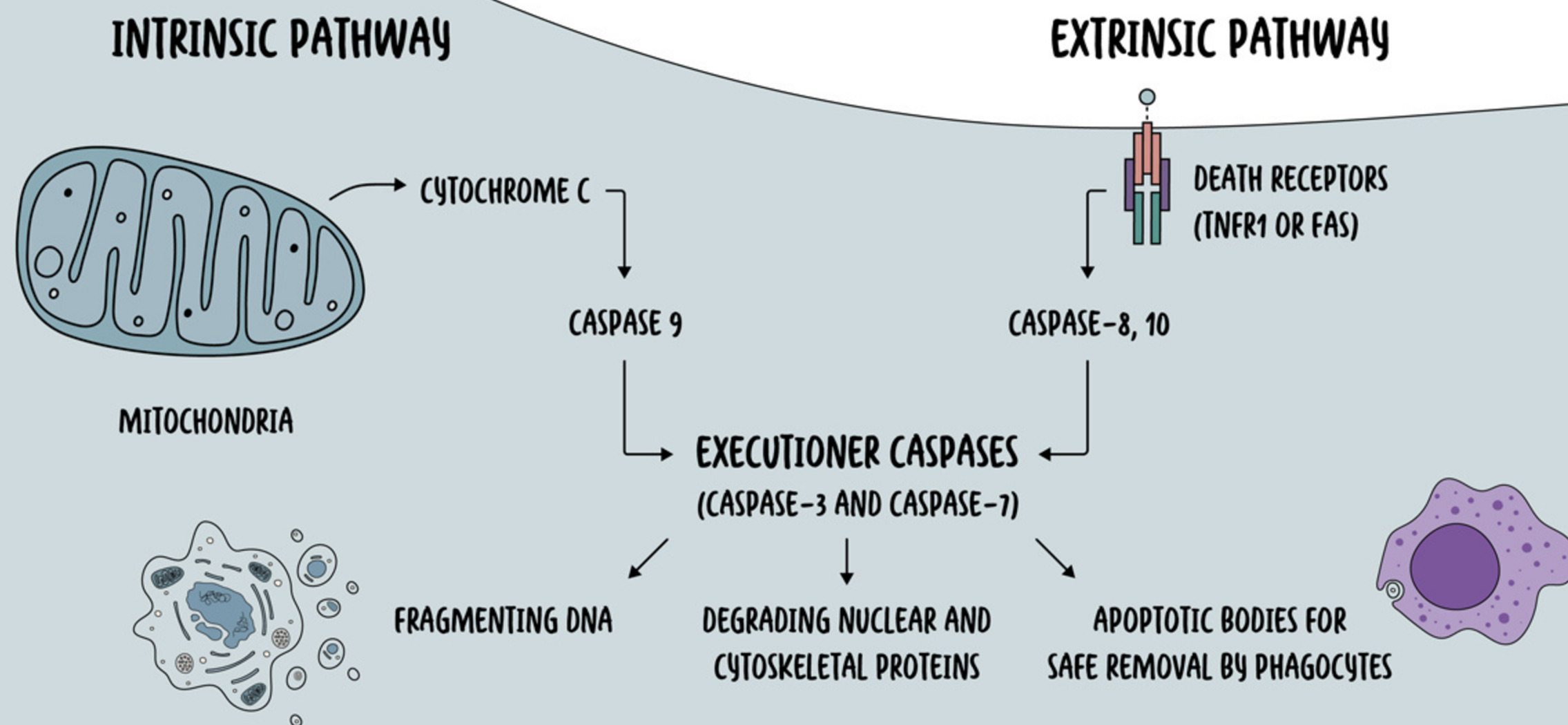
CASPASE CASCADE ACTIVATION

⑤ EXECUTIONER CASPASES (CASPASE-3, CASPASE-7)

⑥ APOPTOSIS

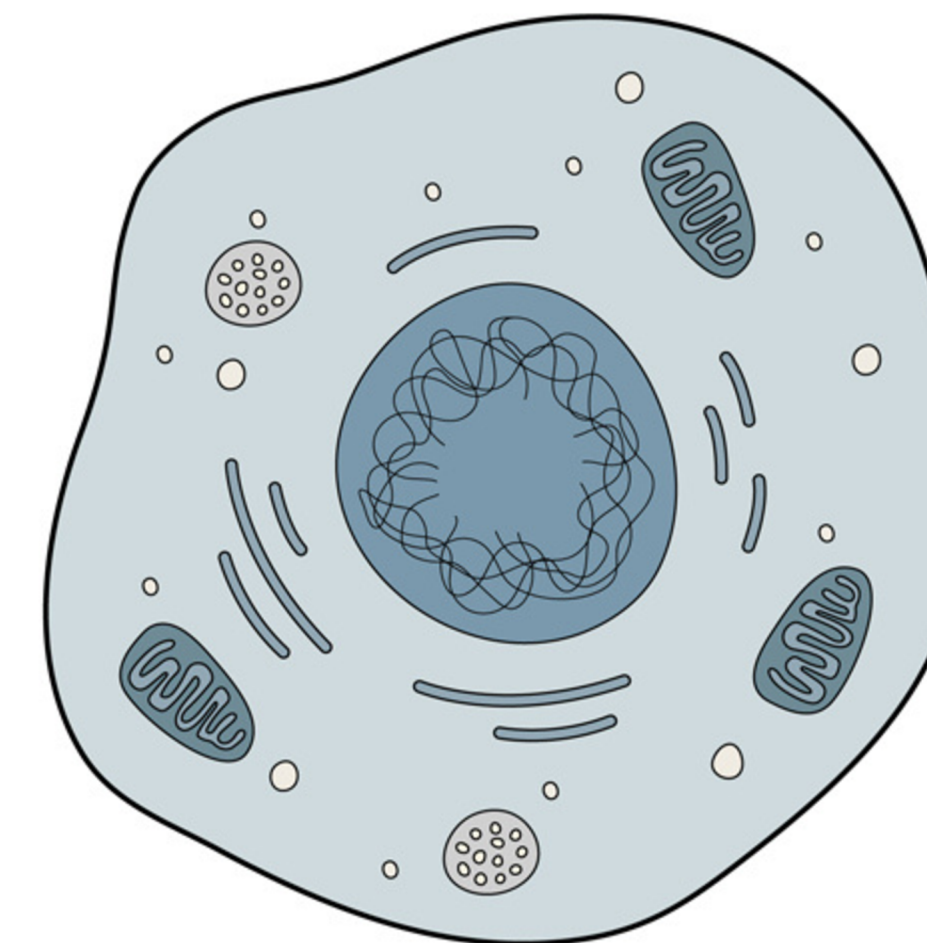
CHROMATIN CONDENSATION, DNA FRAGMENTATION, APOPTOTIC BODIES

EXECUTIONER CASPASES



MORPHOLOGY IN APOPTOSIS

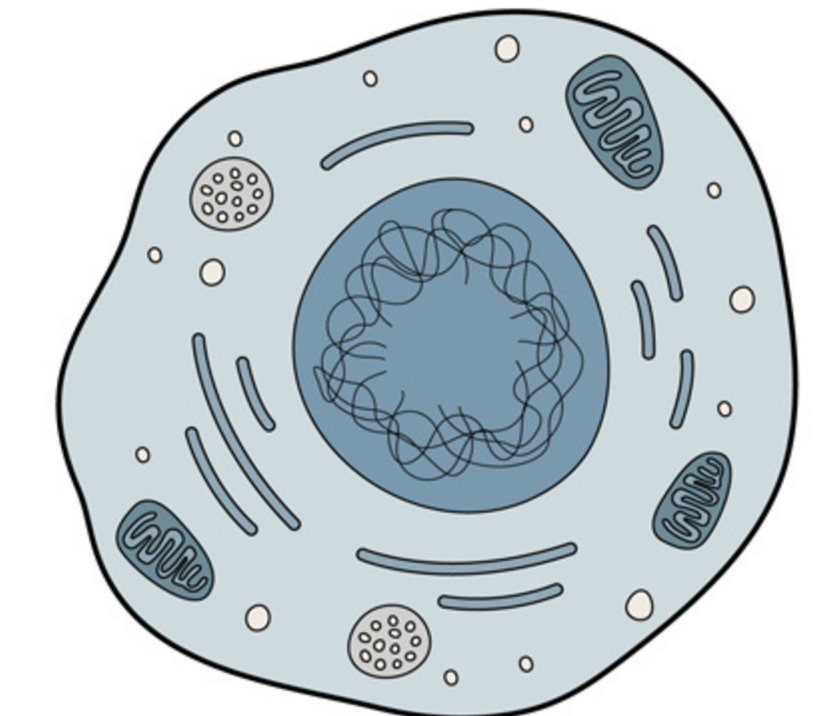
NORMAL CELL



MORPHOLOGY IN APOPTOSIS

① CELL SHRINKAGE

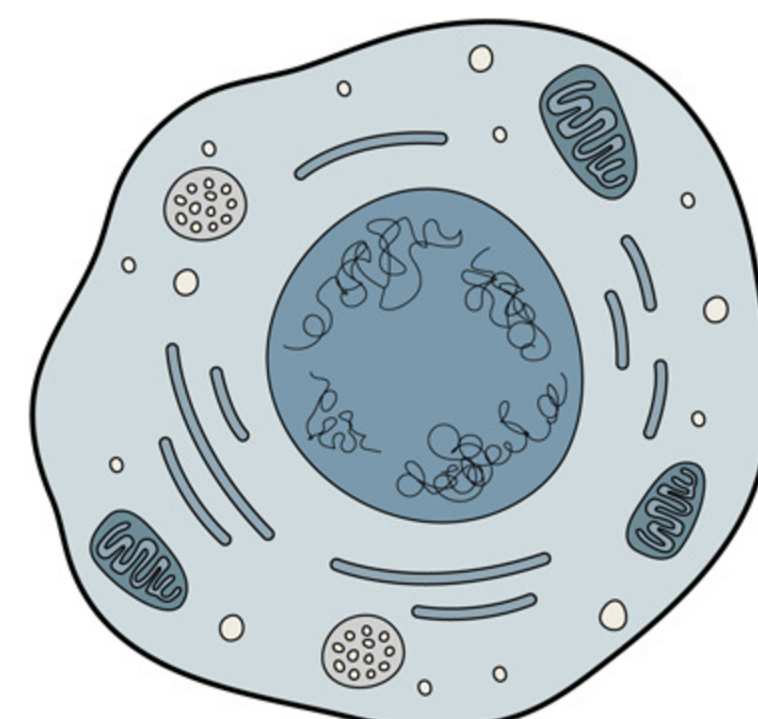
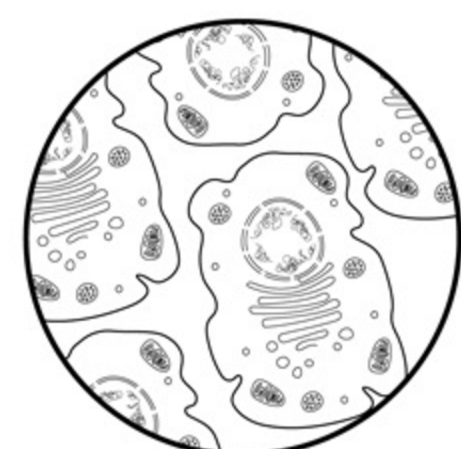
- DECREASES IN SIZE
- CYTOPLASM BECOMES DENSE
- ORGANELLES ARE MORE TIGHTLY PACKED



MORPHOLOGY IN APOPTOSIS

② CHROMATIN CONDENSATION

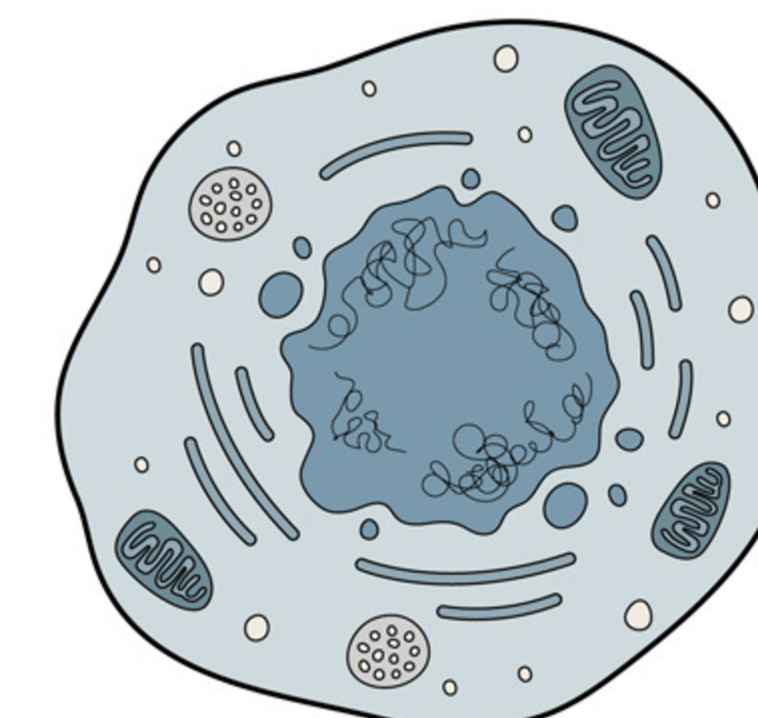
- AT THE NUCLEAR PERIPHERY
- CAN BE SEEN UNDER ELECTRON MICROSCOPY
- LEADS TO NUCLEAR FRAGMENTATION



MORPHOLOGY IN APOPTOSIS

③ NUCLEAR FRAGMENTATION (KARYORRHEXIS)

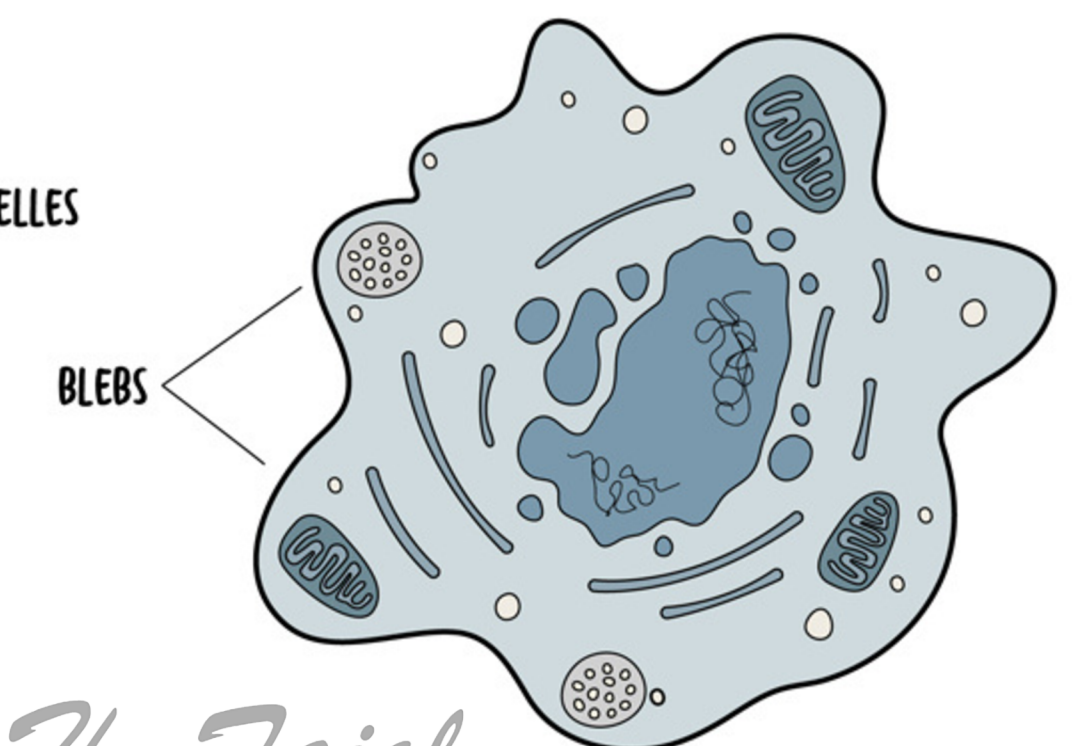
- NUCLEUS PROGRESSIVELY CONDENSES AND BREAKS UP
- THESE FRAGMENTS ARE OFTEN DISPERSED IN THE CYTOPLASM



MORPHOLOGY IN APOPTOSIS

④ MEMBRANE BLEBBING

- PROTRUSIONS CALLED BLEBS
- BLEBS CONTAIN PORTIONS OF CYTOPLASM AND ORGANELLES

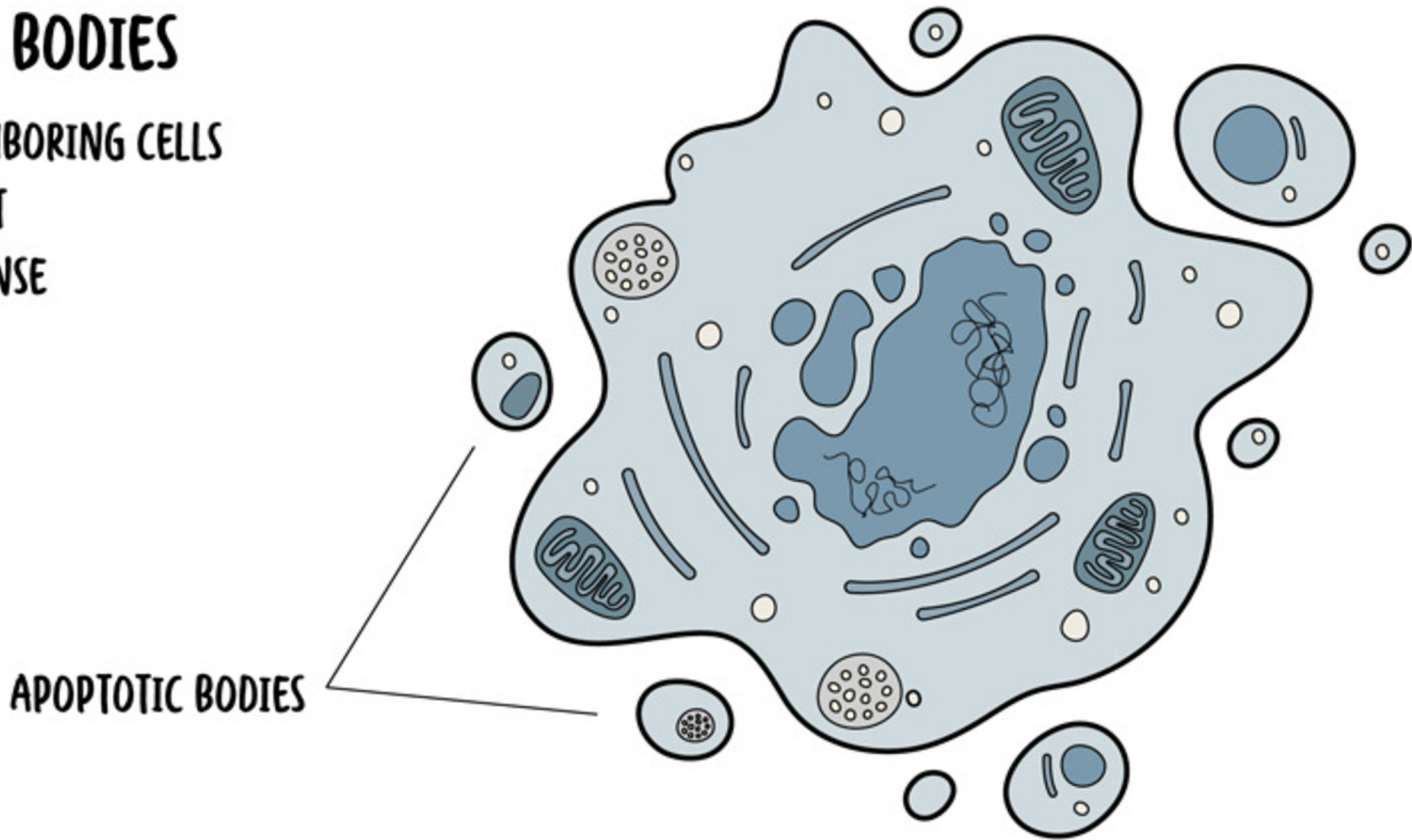


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MORPHOLOGY IN APOPTOSIS

⑤ FORMATION OF APOPTOTIC BODIES

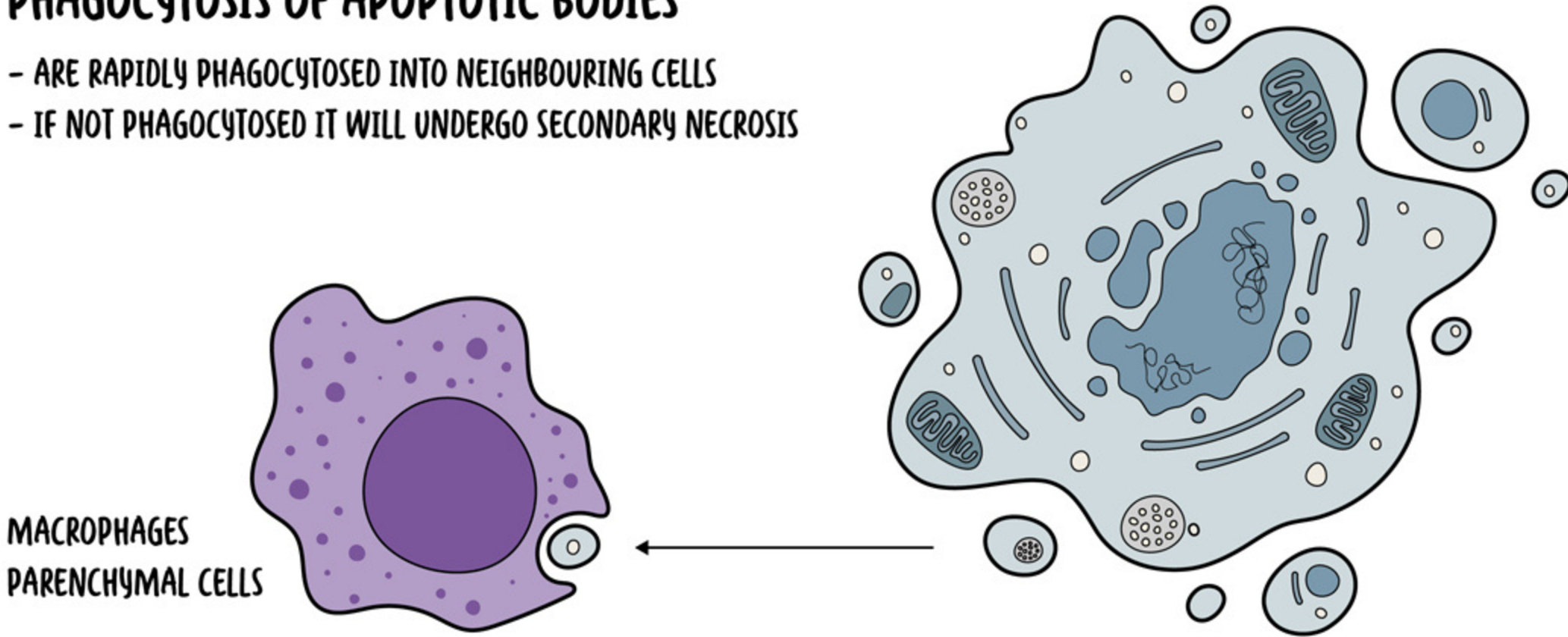
- LOSE THEIR CONNECTIONS WITH NEIGHBORING CELLS
- PLASMA MEMBRANE REMAINS INTACT
- AVOIDING AN INFLAMMATORY RESPONSE



MORPHOLOGY IN APOPTOSIS

⑥ PHAGOCYTOSIS OF APOPTOTIC BODIES

- ARE RAPIDLY PHAGOCYTOSED INTO NEIGHBOURING CELLS
- IF NOT PHAGOCYTOSED IT WILL UNDERGO SECONDARY NECROSIS



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