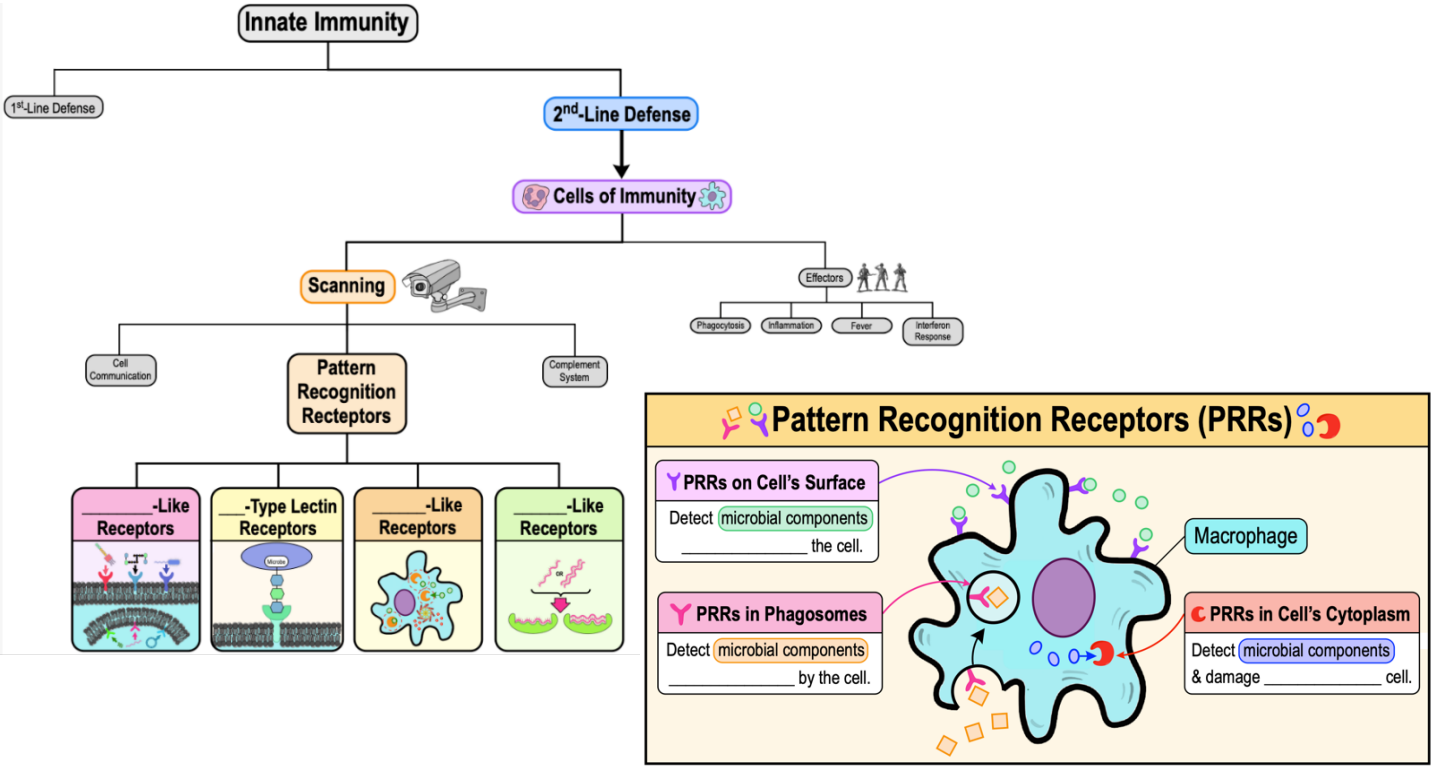
CONCEPT: PATTERN RECOGNITION RECEPTORS (PRRs)

●**Pattern Recognition Receptors (_____s):** receptors of immune cells that sense/detect signs of microbial invasion.

□ There are *many* types of PRRs that detect signs of microbial invasion in _____ areas:



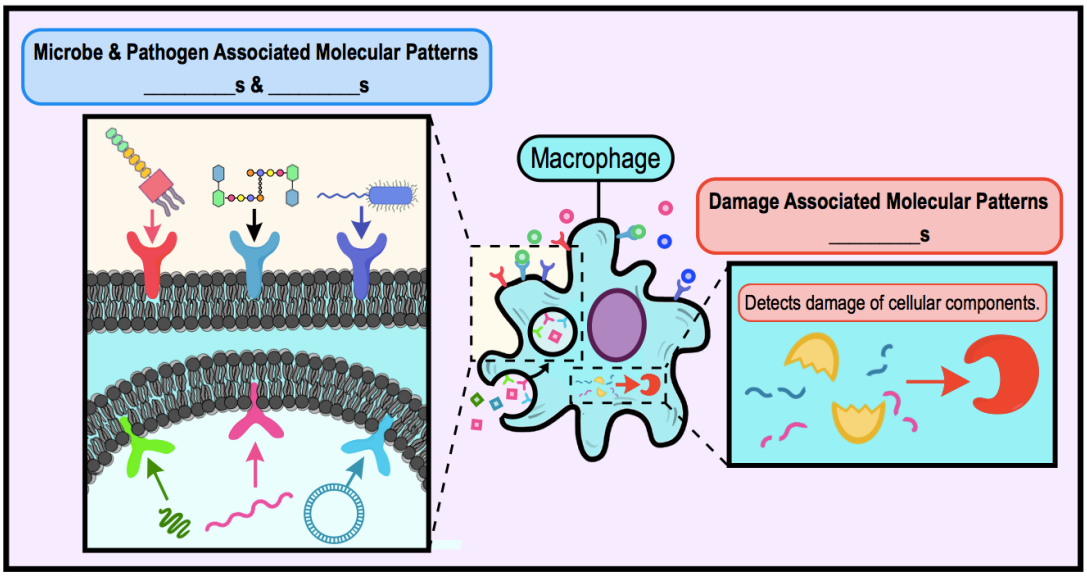
MAMPs & DAMPs

●Immune cells use PRRs to _____ different types of signs that indicate microbial invasion or host cell damage:

□ **Microbe/Pathogen-Associated Molecular Patterns (MAMPs/PAMPs):** signs of _____ or *pathogens*.

□ Examples: *lipopolysaccharide (LPS), peptidoglycan, viral nucleic acids, fungal cell walls, & flagellin*.

□ **Damage-Associated Molecular Patterns (DAMPs):** signs that indicate host cell _____.



CONCEPT: PATTERN RECOGNITION RECEPTORS (PRRs)

PRACTICE: Which of the following are PRRs least likely to detect?

a) Glycolysis enzymes.
b) Peptidoglycan.
c) Flagellin.
d) Lipopolysaccharide.
e) Foreign nucleotide sequences.

Toll-Like Receptors (TLRs)

●The most well-characterized type of PRRs are _____*-like receptors.*

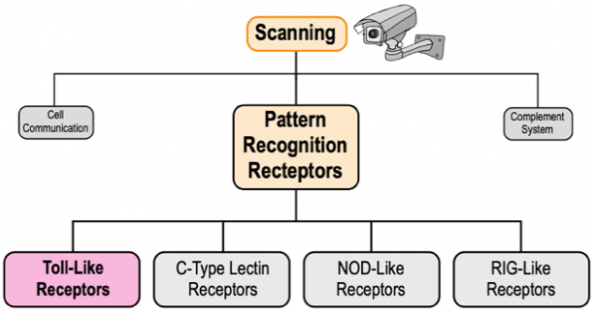
□ **Toll-Like Receptors (TLRs):** PRRs used to detect MAMPs _____ the cell or *ingested* by the cell.

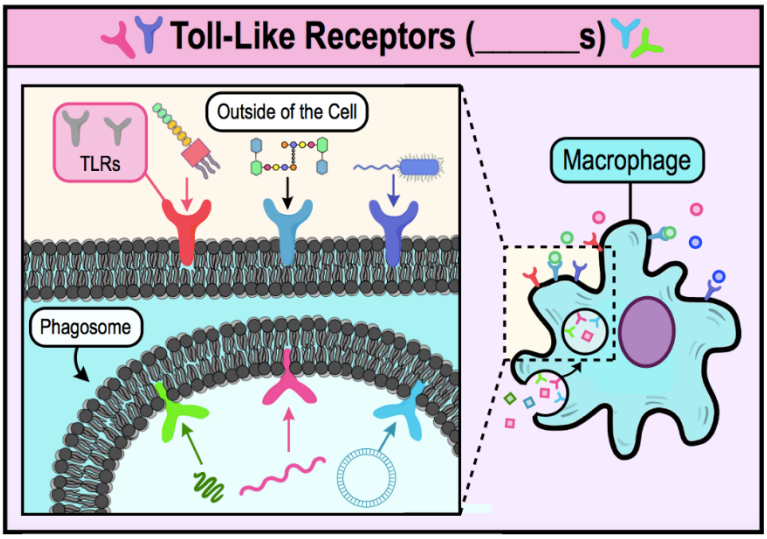
□ TLRs can be found on the cell _____ OR in the membranes of *endosomes* & *phagosomes.*

□ TLRs face *outward* on cell surface BUT face *inward* to monitor what is engulfed via endo/phagocytosis.

□ Recognize microbial _____ acids (Ex. dsRNA) not common in the host cell.

□ Microbial invasion detected by TLRs initiates an immune response.





PRACTICE: Toll-like receptors (TLRs) bind molecules on pathogens. Why is this helpful to the immune response?

a) It provides a highly specific response to very small and highly unique areas on an individual pathogenic microbe, providing the most specific and selective response possible.
b) It provides a general response to broad categories of molecules/cells that should NOT be in our system, as we don't have these molecules on our own cells.
c) These secreted molecules help bind pathogens and then direct them to receptors on the immune system cells that are best capable of eliminating them from our systems. TLRs are delivery mechanisms for the immune responses.
d) TLRs are capable of directly lysing (destroying) the microbes, helping our immune responses by eliminating pathogens.

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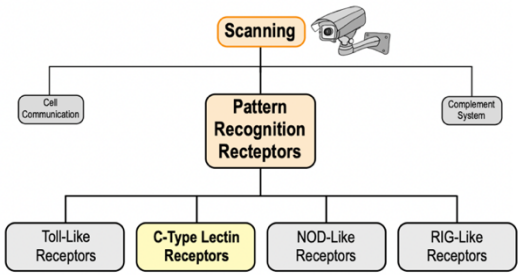
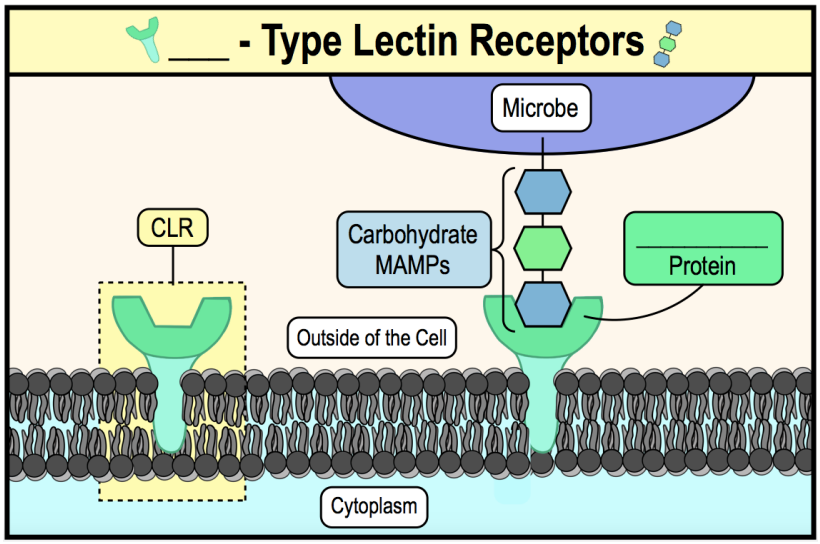
C-Type Lectin Receptors (CLRs)

●Another type of PRR located on the cell surface are the ____*-type lectin receptors.*

□ **C-type Lectin Receptors (_____s):** cell surface PRRs that bind to *carbohydrate* MAMPs on microbial surfaces.

□ **Lectins:** proteins that bind to *specific* _____.





PRACTICE: Which of the following is *not* considered a MAMP (Microbe/Pathogen-Associated Molecular Pattern)?

a) Carbohydrates on microbial surfaces.
b) Peptidoglycan from gram + bacteria.
c) Damaged host cell DNA.
d) Lipopolysaccharide (LPS).

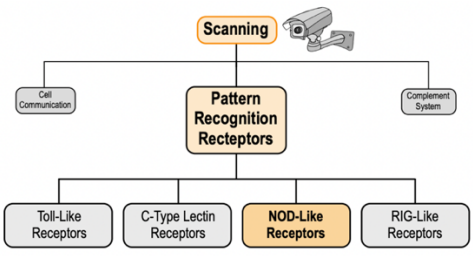
Nucleotide-binding & Oligomerization Domain (NOD)-Like Receptors

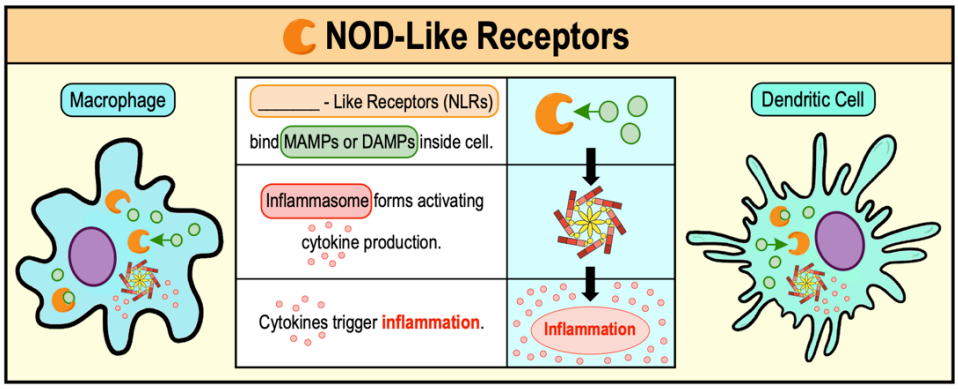
●**NOD-Like Receptors (NLRs):** _____ receptor proteins that detect *intracellular* MAMPs or DAMPs.

□ Play an important role in the immune response of *macrophages* & *dendritic cells*.

□ When NLRs detect MAMPs, they combine with cytoplasmic proteins to form an _____.

□ **Inflammasome:** activates pro-inflammatory *cytokine* production leading to _____.





CONCEPT: PATTERN RECOGNITION RECEPTORS (PRRs)

PRACTICE: Why are NOD-like receptors (NLRs) important for macrophage cells?

a) Macrophages commonly ingest infectious material and use NLRs to detect intracellular MAMPs.

b) Macrophages are unstable and commonly have intracellular damage and use NLRs to detect DAMPs.

c) Macrophages use NLRs to detect MAMPs which triggers the formation of RIG-like receptors.

d) Macrophages are the only cells able to detect viral infection and use NLRs to detect viral RNA.

Retinoic acid Inducible Gene (RIG)-Like Receptors

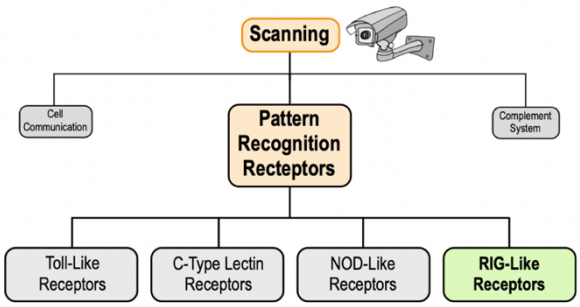
●A second type of cytoplasmic PRR that detects _____ MAMPs are the *RIG-like receptors.*

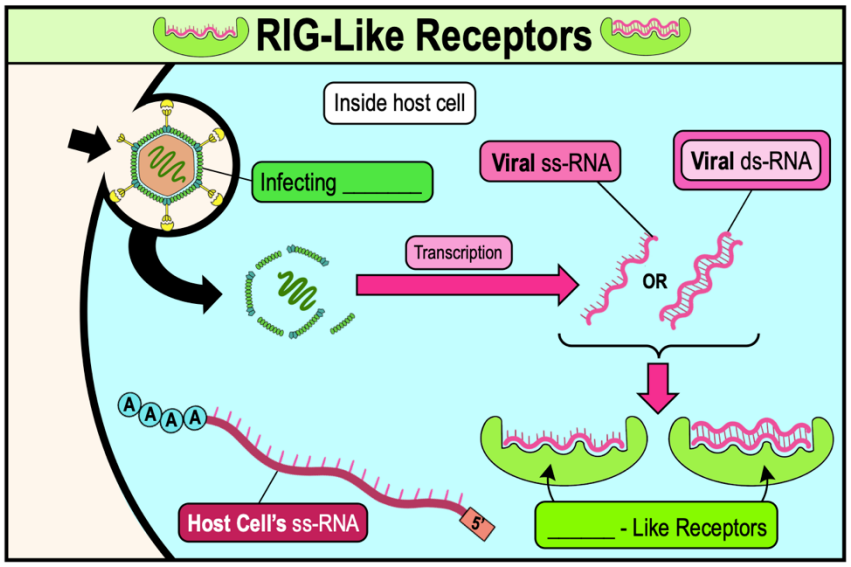
□ **RIG-Like Receptors:** cytoplasmic proteins that detect _____ RNA & are found in *most* types of host cells.

□ Distinguishes between host and viral RNA by _____ features:

1) Viral RNA can be _____-stranded & host RNA is not.

2) Host cell RNA has a ____' cap & viral RNA does not.





PRACTICE: What defining features of viral RNA allows the RIG-like receptors to distinguish infecting viral RNA from the host cell's RNA?

a) Viral RNA has a 5' cap while host cell RNA does not.

b) Viral RNA has a poly-A tail while host cell RNA does not.

c) Viral RNA can be double stranded while host cell RNA is single stranded.

d) Viral RNA has a circular formation while host cell RNA is linear.

e) None of the above.

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PRACTICE: In addition to peptidoglycan, which molecule(s) unique to bacteria would PRRs recognize?

a) Lipopolysaccharide (LPS).
b) Fungal cell walls.
c) Flagellin proteins.
d) Tubulin proteins found in cilia.
e) A and C.
d) B and D.
f) All of the answers would be recognized by PRRs.

PRACTICE: Toll-like receptors are receptor proteins on _____.

a) Granulocytes that destroy parasitic helminths.
b) Phagocytes that recognize foreign or microbe-associated molecules.
c) Viruses entering the body which stimulate the immune system.
d) Mucus producing cells that trigger mucus production when they bind with an allergen.

PRACTICE: Which type of pattern recognition receptor when bound to MAMPs triggers the formation of the inflammasome?

a) NOD-Like Receptors.
b) RIG-Like Receptors.
c) Toll-Like Receptors.
d) C-Type Lectin Receptors.

PRACTICE: Toll-like receptors:

a) Are cytokines.
b) Each recognize a specific "danger" molecule.
c) Are embedded in cellular membranes.
d) Are part of adaptive immunity.
e) b and c.

PRACTICE: _____ on phagocytes bind to PAMPs on bacteria, triggering uptake & destruction of the bacterial pathogens?

a) PRRs.
b) PAMPs.
c)
c) AMPs.
d) PMNs.