비상! 병균 침입
면역의 첫 단계

POSTECH

생명과학과, 융합생명공학부

김유미

면역이란?

疫으로부터 免하여 준다

我 (self)와 非我 (non-self)의 투쟁

병원체 (pathogen)

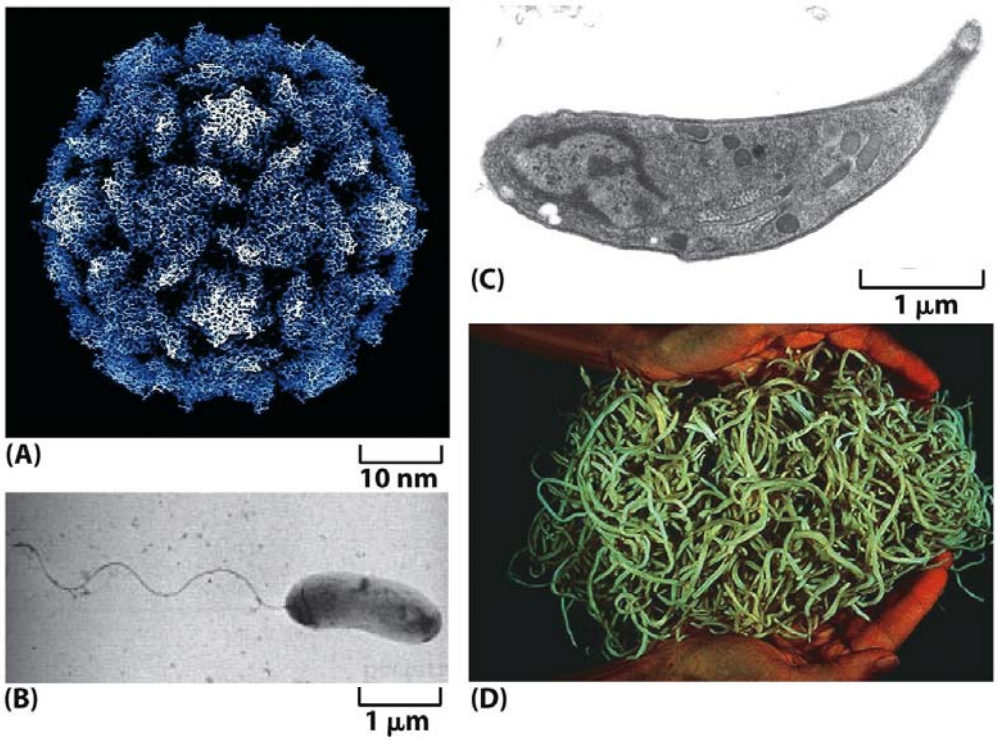
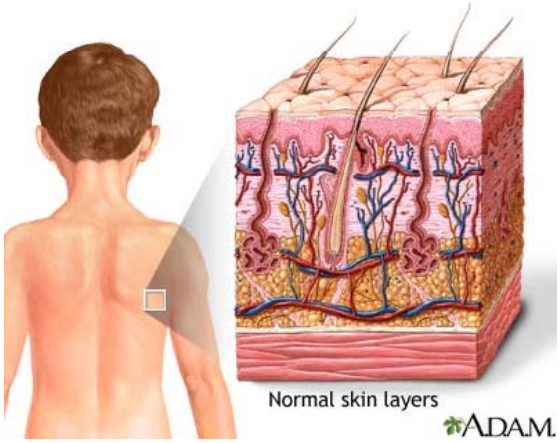


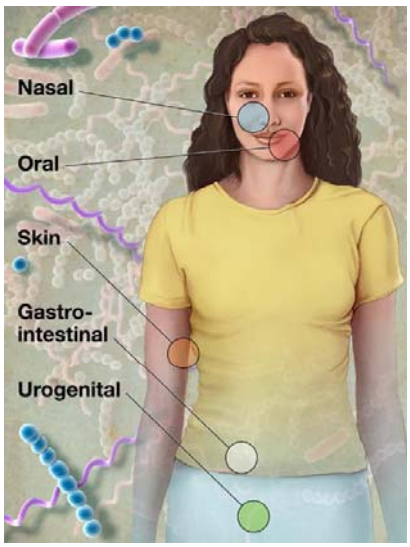
Figure 24-3 *Molecular Biology of the Cell* (© Garland Science 2008)

사람의 면역 체계

- 병원체의 인체 내 침입의 근본적 차단
  - 피부, 점액, 공생 세균 등



http://www.umm.edu/imagepages/19679.htm



http://www.sciencedaily.com/releases/2010/05/100520141214.htm

사람의 면역 체계

- 병원체의 인체 내 침입의 근본적 차단
  - 피부, 점액, 공생 세균 등

⬇

- 병원체의 비특이적 제거
  - 식작용 (phagocytosis) : 대식세포, 중성구

식작용 (phagocytosis)

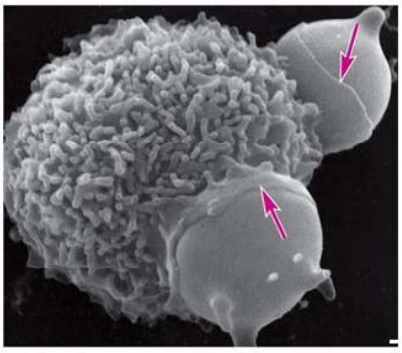
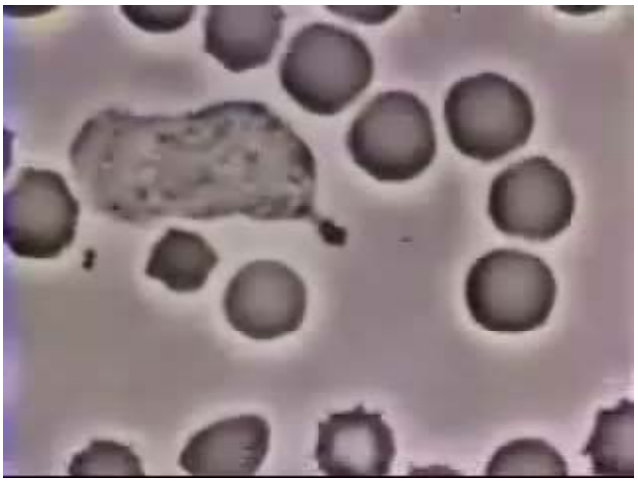


Figure 13-46 *Molecular Biology of the Cell*
(© Garland Science 2008)



Modified from http://www.youtube.com/watch?v=VAhM9OxZDkU
Original movie by David Rogers at Vanderbilt University

사람의 면역 체계

- 병원체의 인체 내 침입의 근본적 차단
  - 피부, 점액, 공생 세균 등

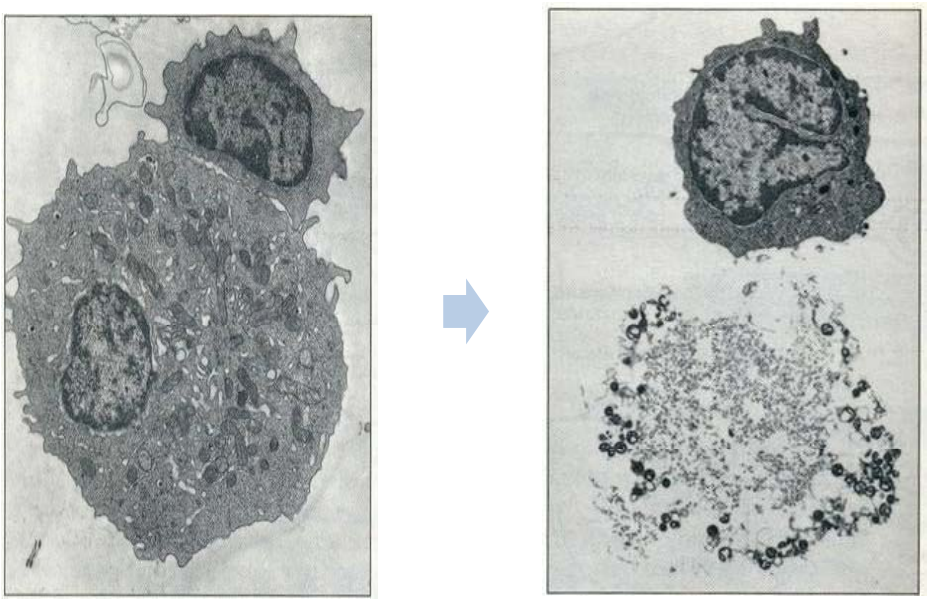
⬇

- 병원체의 비특이적 제거
  - 식작용 (phagocytosis) : 대식세포, 중성구
  - 세포 살해 : 자연살해세포

세포 살해 (cell killing)

Modified from http://www.youtube.com/watch?v=84MlWh1XN0Q

세포 살해 (cell killing)



사람의 면역 체계

- 병원체의 인체 내 침입의 근본적 차단
  - 피부, 점액, 공생 세균 등

⬇

- 병원체의 비특이적 제거
  - 식작용 (phagocytosis) : 대식세포, 중성구
  - 세포 살해 : 자연살해세포

선천성 면역

⬇

- 병원체 특이적 반응
  - 항체 생성 : B 림프구
  - 항원 특이적 세포 살해 : T 림프구

후천성 면역

감염 초기 반응

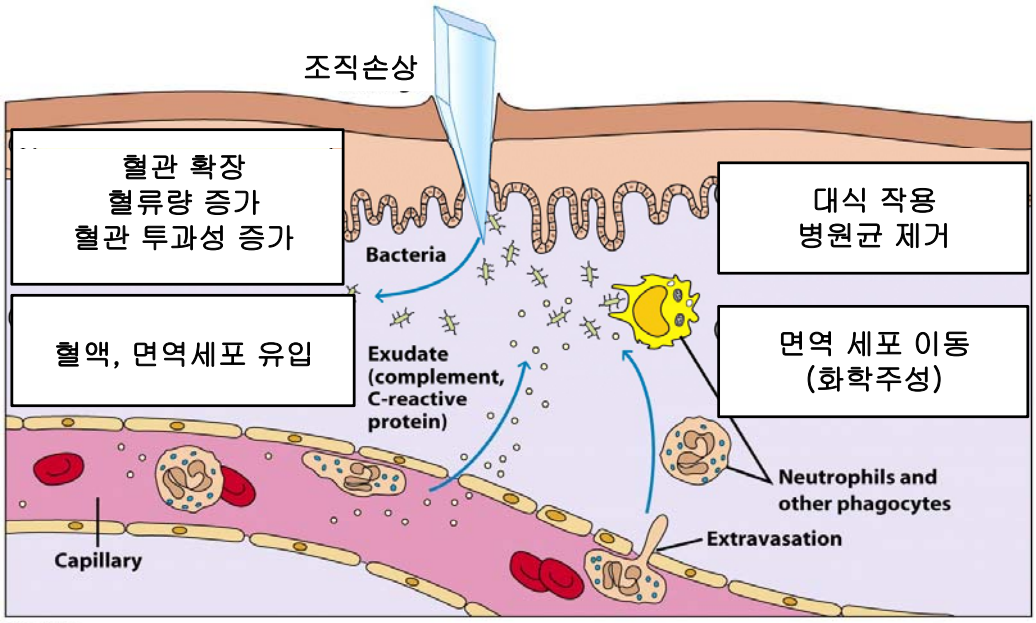
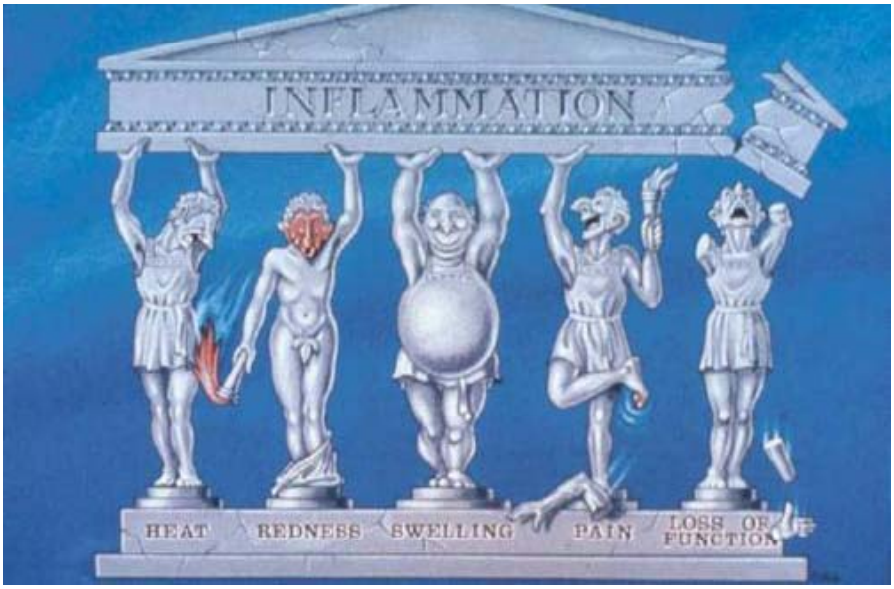


Figure 3-5
Kuby IMMUNOLOGY, Sixth Edition

염증 반응



염증의 증상 : 발열, 발적 (빨개짐), 종창 (부어오름), 통증

선천성 면역 세포는 어떻게 병원체를 구별할까?

我 (self)와 非我 (non-self) ?

면역 반응은 어떻게 시작될까?

수용체
(receptor)

非我 (non-self) ?

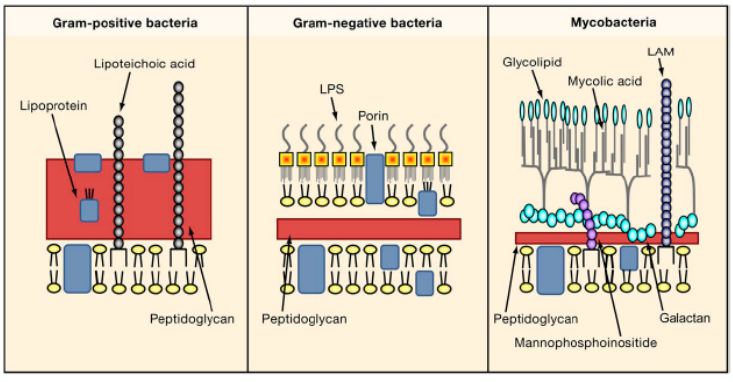
병원체 특이적 분자 구조 (패턴) ⟷ **패턴 인식 수용체**

(pathogen-associated molecular pattern, PAMP)

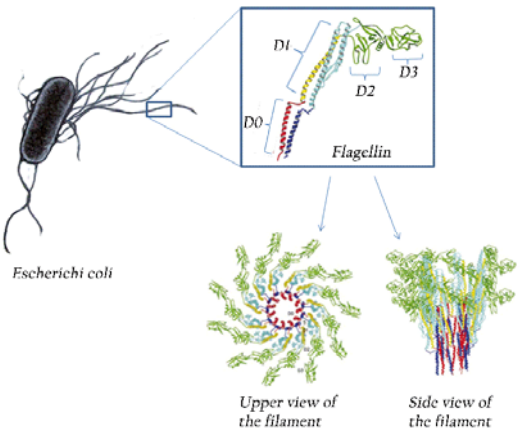
(pattern recognition receptor, PRR)

- 사람은 가지고 있지 않는 분자 구조
- 여러 미생물에 공통적으로 존재하는 분자 구조

- 박테리아 세포막 성분
- 편모 단백질 등



Akira, S. *et al.* Cell (2006) 124:783

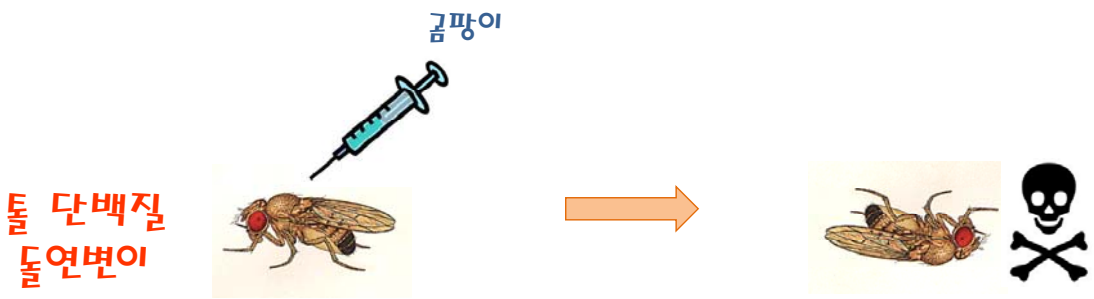


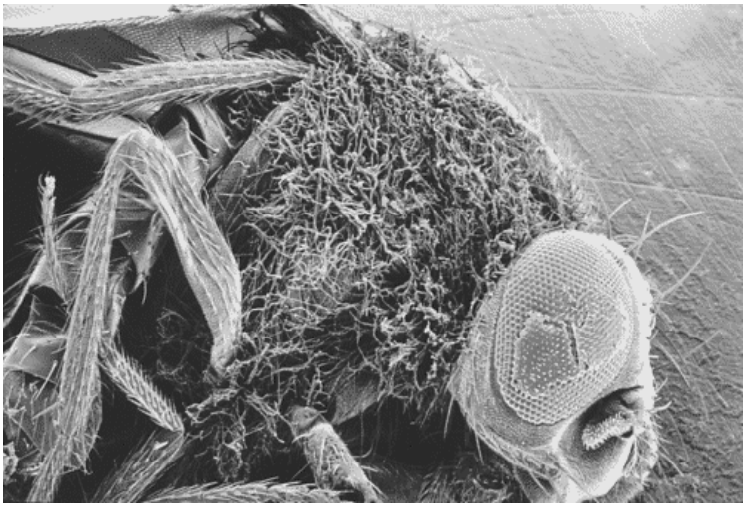
http://2008.igem.org/Team:Slovenia/Background/Flagellin

톨유사수용체 (toll-like receptor, TLR)

Jules A. Hoffmann

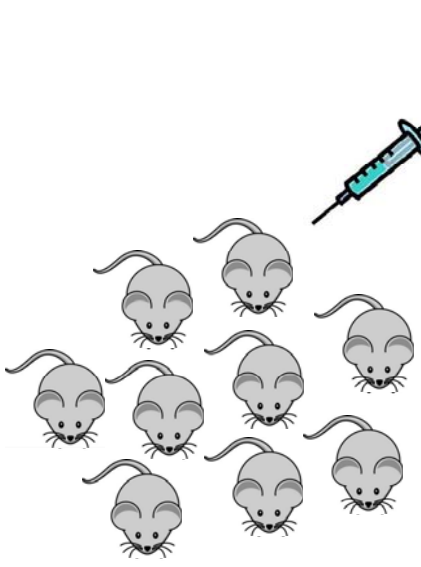
Bruce A. Beutler





Lemaitre, B. *et al.* Cell (1996) 86:973

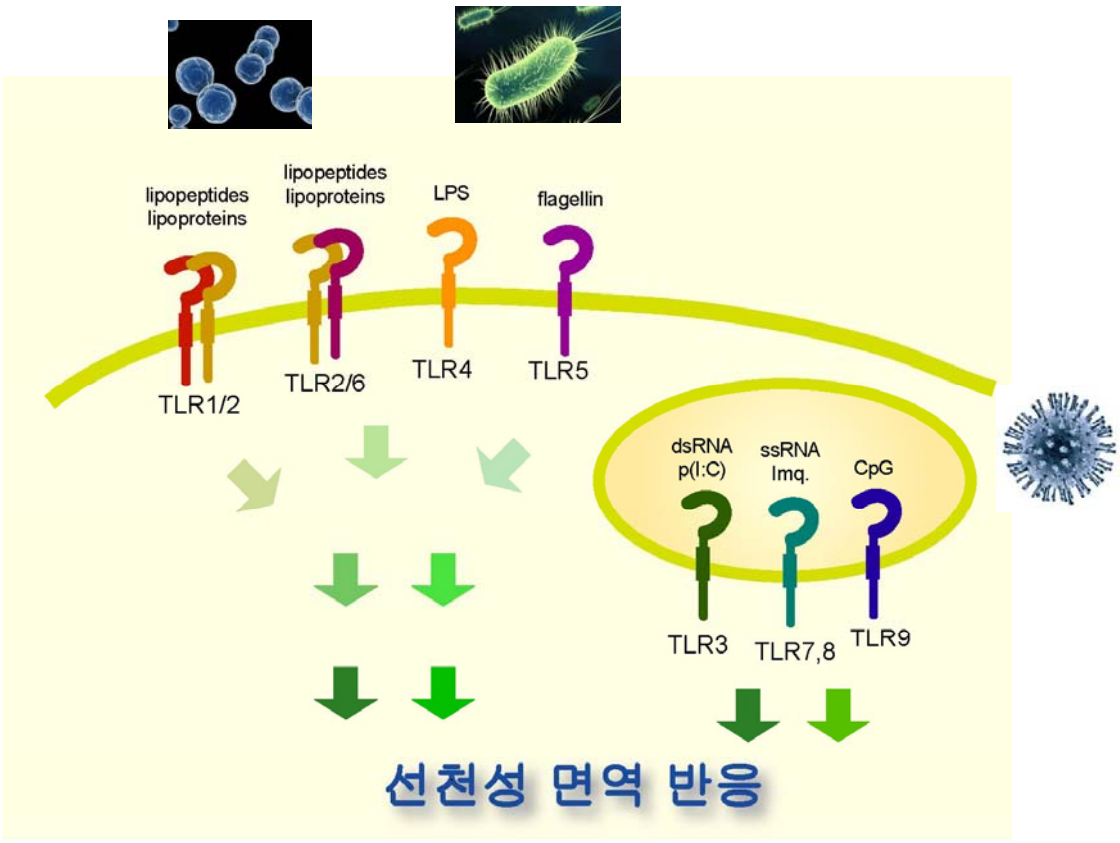
Jules A. Hoffmann



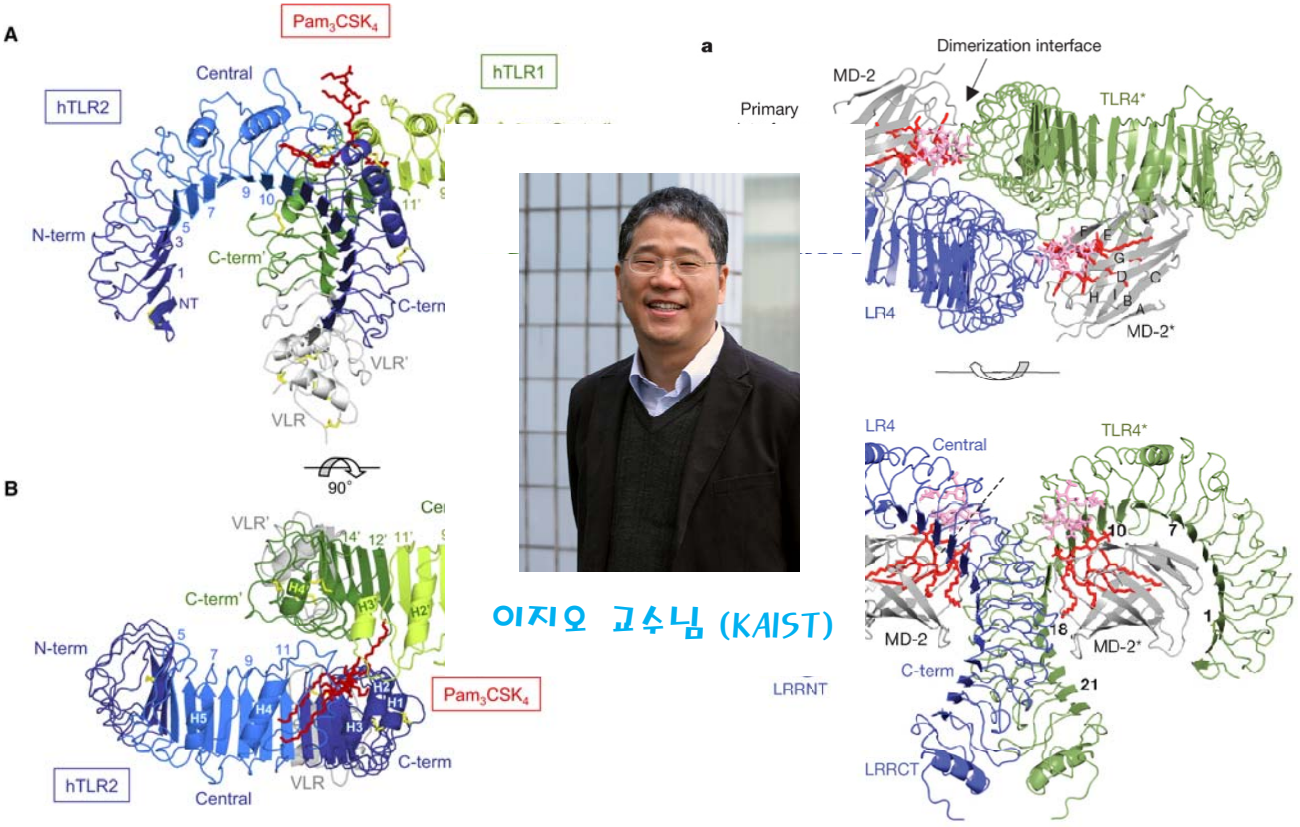
Bruce A. Beutler

어떤 유전자의 돌연변이?

톨유사수용체 (TLR)



성게 (*S. purpuratus*)



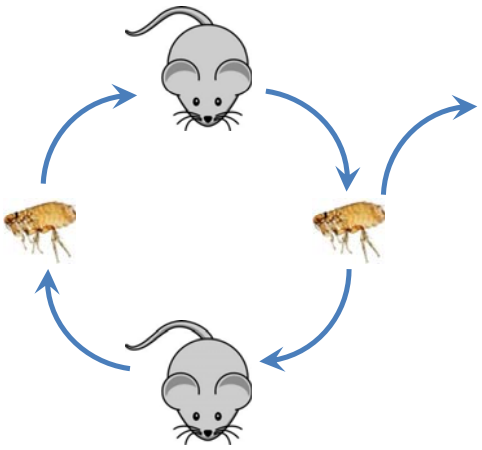
이지오 교수님 (KAIST)

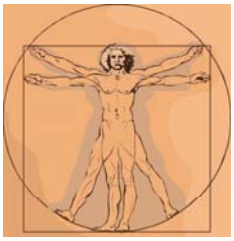
Jin, M.S. et al. *Cell* (2007)130:1071-1082

Park, B.S. et al. *Nature* (2008) 458:1191

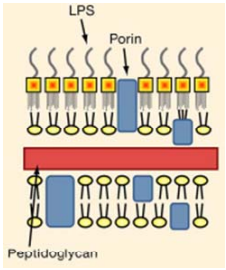
흑사병 (페스트)

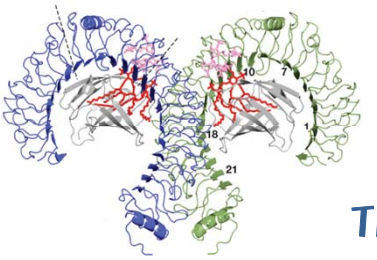
페스트균 (Yersinia pestis)



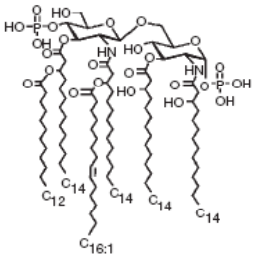


페스트균 LPS

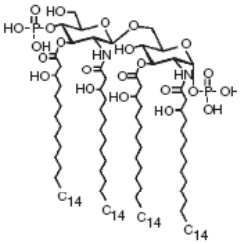




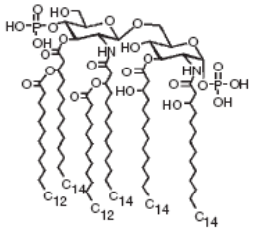
TLR-4



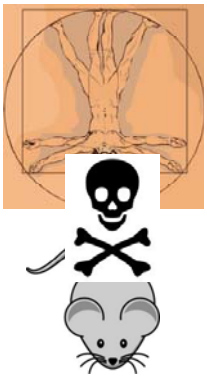
26°C



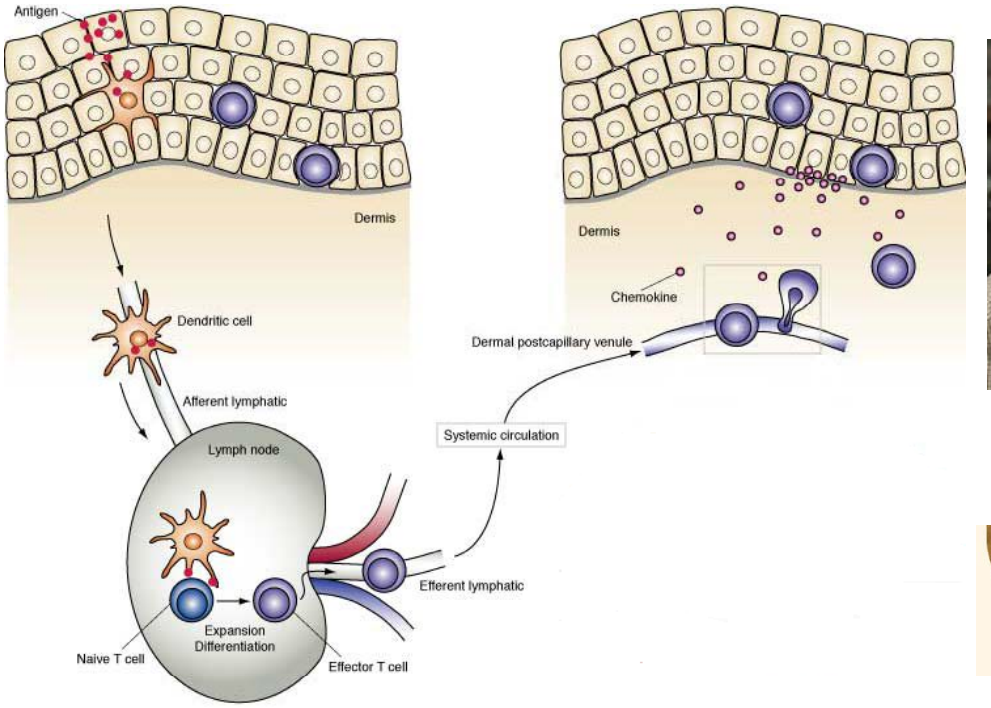
37°C

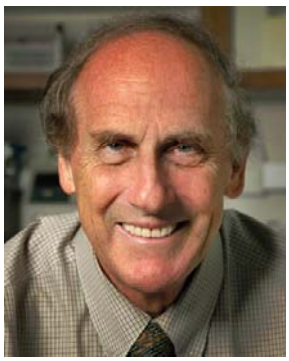


+ lpxL 37°C

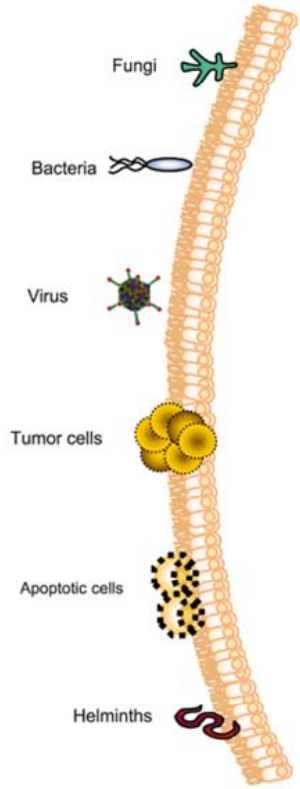


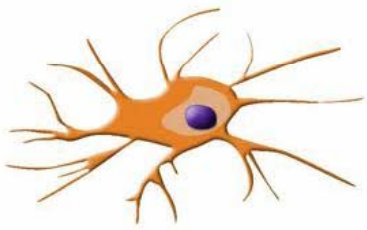
수지상세포



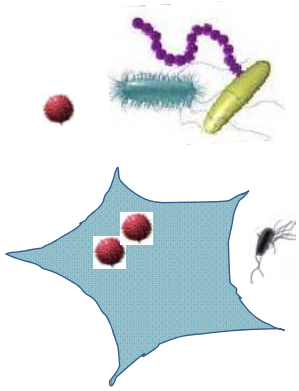


Ralph Steinman

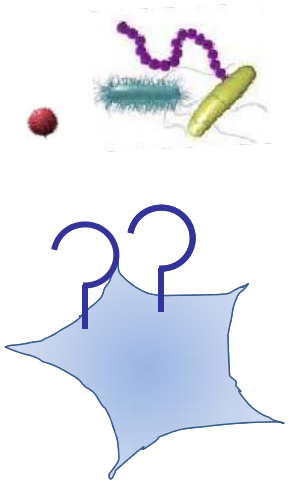




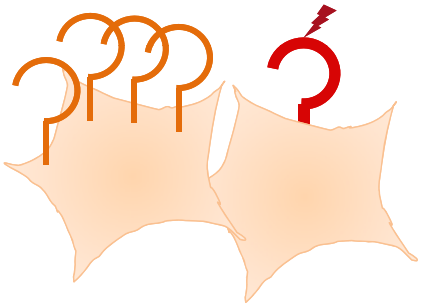
TLR은 후천성 면역 반응에도 중요함



감염



면역 반응



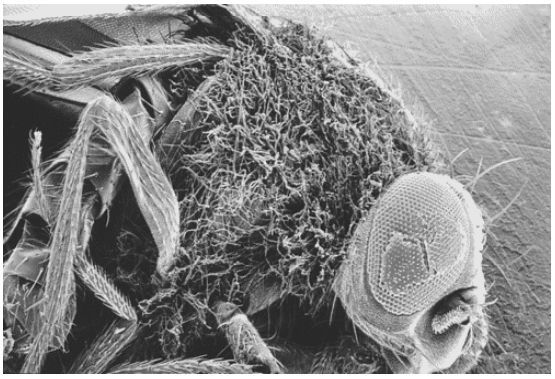
만성 염증
자가면역질환

적당한 면역반응이 일어나기 위해서는 TLR의 발현과 기능 조절이 중요 !

이런 지식을 어떻게 이용할 수 있을까?

- 면역 증강제
- 백신 보조제
- 항암 면역치료 보조제
- 알레르기, 천식 치료제
- 자가 면역 치료제

1996



2012