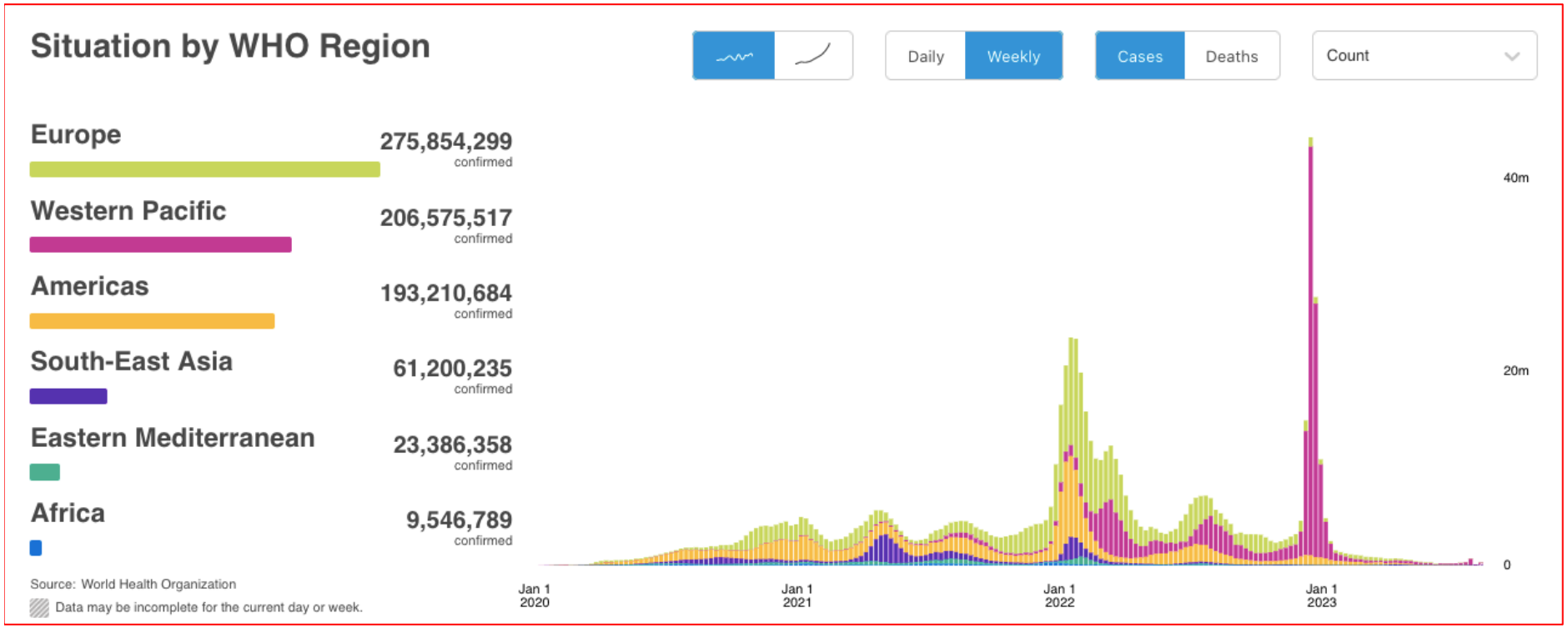
MCB 55 – Fall 2024

Plagues & Pandemics

Instructors:
Robert Beatty, Laurent Coscoy and Molly Ohainle



Waves of SARS CoV-2 infections

https://covid19.who.int/

Plagues & Pandemics

Colored electron micrograph image of SARS CoV-2

https://covid19.who.int/

Intended audience for this class

This class is intended for lower division science majors and any non-science majors

This class covers historical, biological and public health aspects of infectious diseases.

We do assume you have taken (and remember at least some) high school biology.

This is an MCB class – so be prepared for science; but scientific understanding alone will not suffice to get you through this class

Important Credit Detail

You will NOT receive credit for this class if you have PREVIOUSLY taken:

MCBC100A	Biophysical Chemistry
MCB102	Survey of Biochemistry
Chem 135	Biochemistry
MCB150	Molecular Immunology
MCBC103/PMBC103/PHC102	Bacterial Pathogenesis

But **you WILL receive credit** for any of these upper division classes **AFTER you have taken MCB55.**
You can get credit if you are taking MCB102 or any of these classes concurrently-this semester.

Class questions

1. Class attendance is usually the key for doing well. No section for class. No GSI. No textbook.
This means you really need to come to class.

2. Lectures will be recorded and will be posted on bCourses within a week. Lecture slides will be available to download through bCourses.berkeley.edu. Readings will be posted on bCourses.

3. Please pay attention to your berkeley.edu email address for announcements!! This is our only way to communicate with you.

Class Structure

Part 1: BEATTY

Module 1: Immunity and Vaccines

Module 2 : Bacteria Infections Today

Module 3: Parasites

Sept 25: Midterm 1 on Part 1

Part 2: COSCOY

Module 4: Zoonotic Viruses

Module 5: Forever Viruses

Module 6 : Viruses and Cancer

Oct 27 : Midterm 2 on Part 2

NOTE- The Final exam is on Thursday Dec 14 at the end of the exam period.
Do NOT plan on leaving for holiday break early

Part 3: OHAINLE

Module 7: Historically-Important Viruses

Module 8: The Big Ones

Module 9: Viruses Within / Module 10: The Biggest One

Dec 14 : Final Exam on Part 3

Safe and Inclusive Environment

The class should be safe and inclusive for everyone.

The Office for the Prevention of Harassment and Discrimination (OPHD) is responsible for ensuring that Cal provides an environment for faculty, staff and students that is free from discrimination and harassment on the basis of race, color, national origin, age, sex, gender, gender identity, and sexual orientation.
Get help if you need- ask_ophd@berkeley.edu, or go to http://survivorsupport.berkeley.edu/

We value the diversity of students, faculty, and staff at UC Berkeley. We welcome all our students in our class and hope that you always feel included. If there are aspects of the instruction within this course that result in barriers to your inclusion, please let us know

Mental Health

Starting college is a big adjustment and can test your mental health challenges.
Be patient with yourself, be patient with your classmates and be patient with your MCB55 instructors.

Take care of yourself and pay attention to symptoms of depression. Mental health issues can diminish academic performance and daily activities.

If you need mental health support, or are concerned about a friend, UC Berkeley offers many services, such as free short-term counseling at University Health Services. An excellent campus website having links to many resources is: https://recalibrate.berkeley.edu/

Questions we will explore:

What are the causes of infectious diseases?

Why do some people get sick and not others?

Which infectious diseases have impacted human populations?

Which infectious diseases are emerging infections?

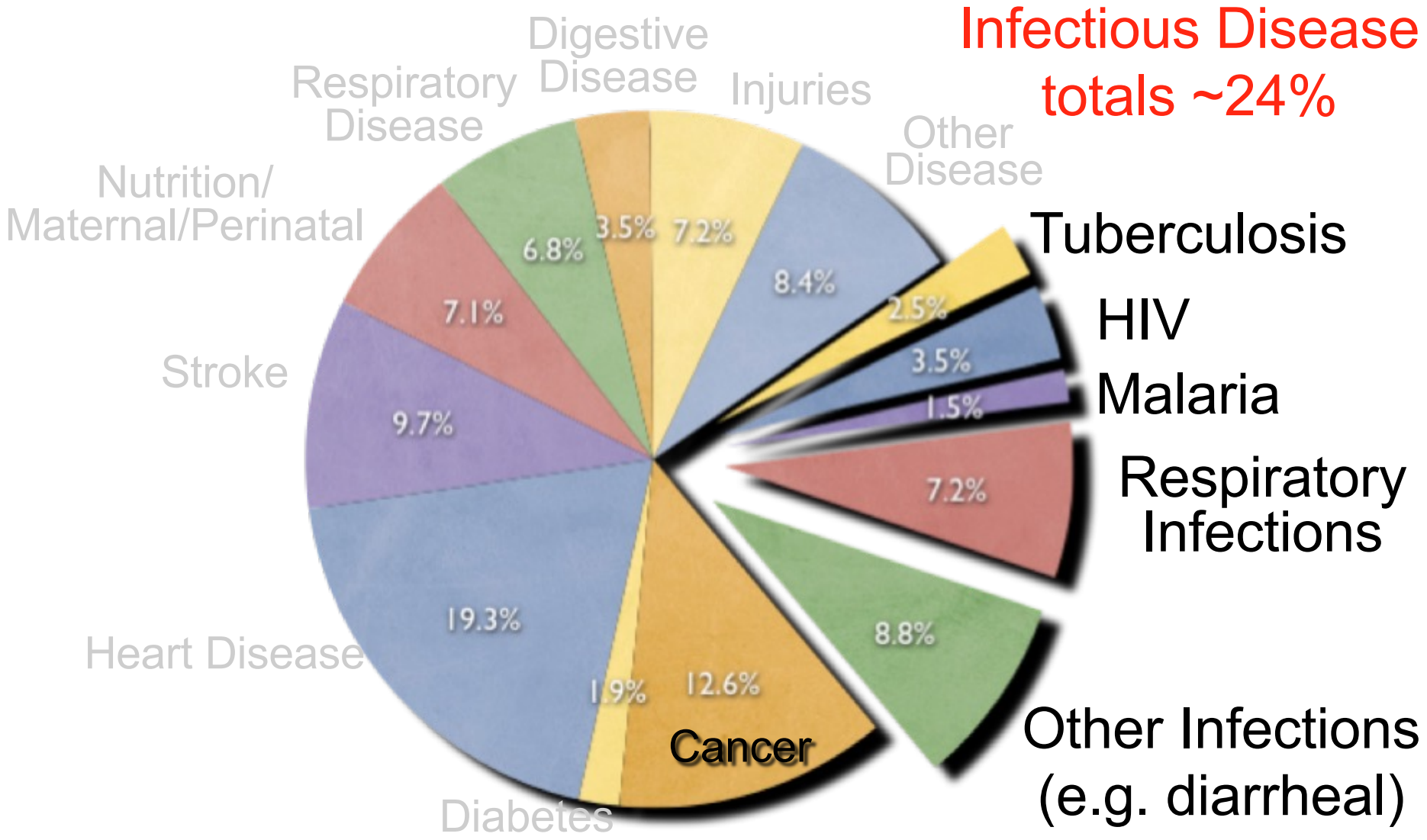
What impact do infectious diseases continue to have?

How did SARS-CoV-2 spread so quickly?

What are all the different SARS-CoV-2 vaccines?

The Global Burden of Infectious Disease

Worldwide causes of death World Health Organization

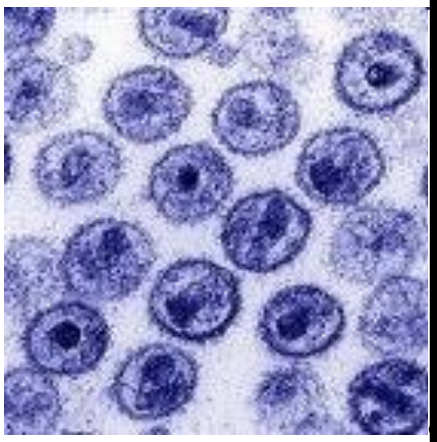
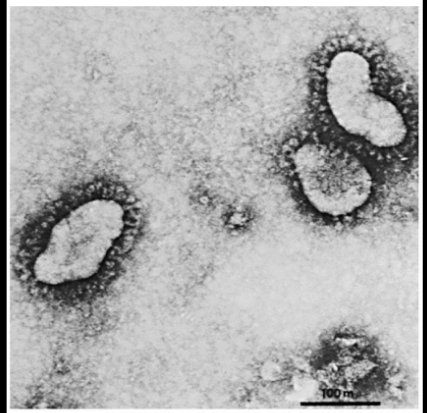
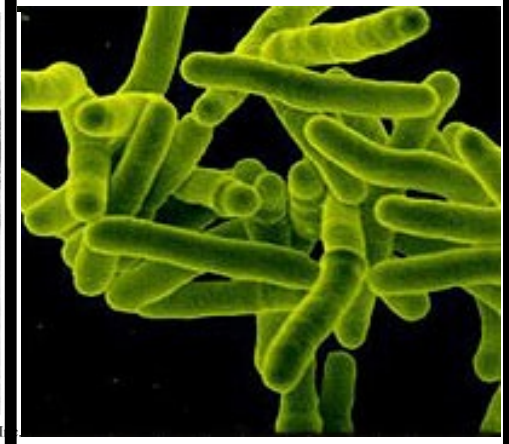
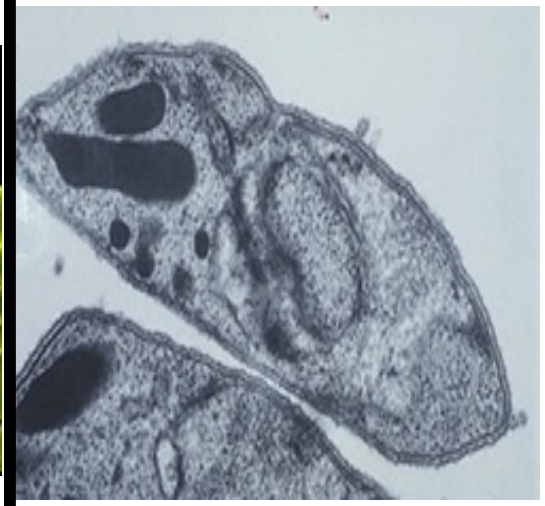


Infectious diseases that have "emerged"

1953: Dengue hemorrhagic fever
1967: Marburg virus
1969: Lassa fever
1970: Toxoplasmosis
1970: Lyme disease
1976: Ebola
1976: Legionnaires' Disease
1980: Toxic shock syndrome
1981: HIV- AIDS
1982: E.coli O157:H7
1993: Hantavirus
2002: SARS CoV-1 / SARS
2009: H1N1 "Swine" Influenza (flu pandemic)
2012: Middle East SARS (MERS)
2013: H7N9 "Avian" Influenza
2015: Zika in Brazil (though discovered in Uganda, 1947)
2019: SARS-CoV-2 / COVID-19

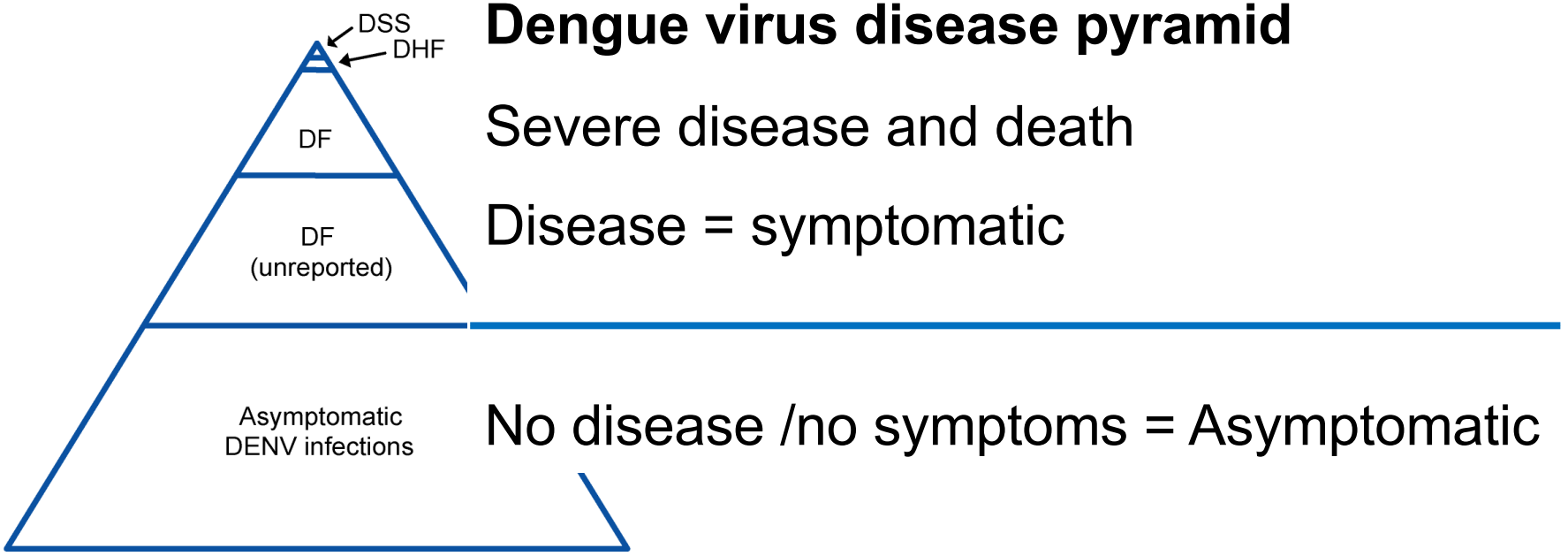
Mostly zoonotic viruses (viruses from animals)

Big Killers
are very different pathogens

HIV-AIDS	SARS COVID 19	Tuberculosis	Malaria
			
Retrovirus	Virus	Bacterium	Protozoan Parasite

Infection versus disease

Most pathogens do not ‘want’ to make us sick; all they ‘want’ is to replicate and move on to the next host. Meaning they do not intend to cause disease but cause disease if it helps for survival, transmission and replication. And some pathogens can cause a high number of asymptomatic infections.



Dengue virus disease pyramid

Severe disease and death

Disease = symptomatic

No disease /no symptoms = Asymptomatic

Epidemiology

Finding the causes of disease
(not just infectious disease)

Epidemiology helped us answer what causes infectious disease and how diseases are spread.

Original IDEA
Miasma theory: bad air causes disease (*mala•aria*)

19th Century
Germ theory: microbes cause disease

Epidemiology terms

Endemic = an infection that is continually present in a population or geographic area

Epidemic = an outbreak of infectious disease above the normal level of infections that then subsides

Pandemic = infections that spread over more than 3 continents.

Immunology

We will learn some basic facts about the human immune system fights infectious diseases

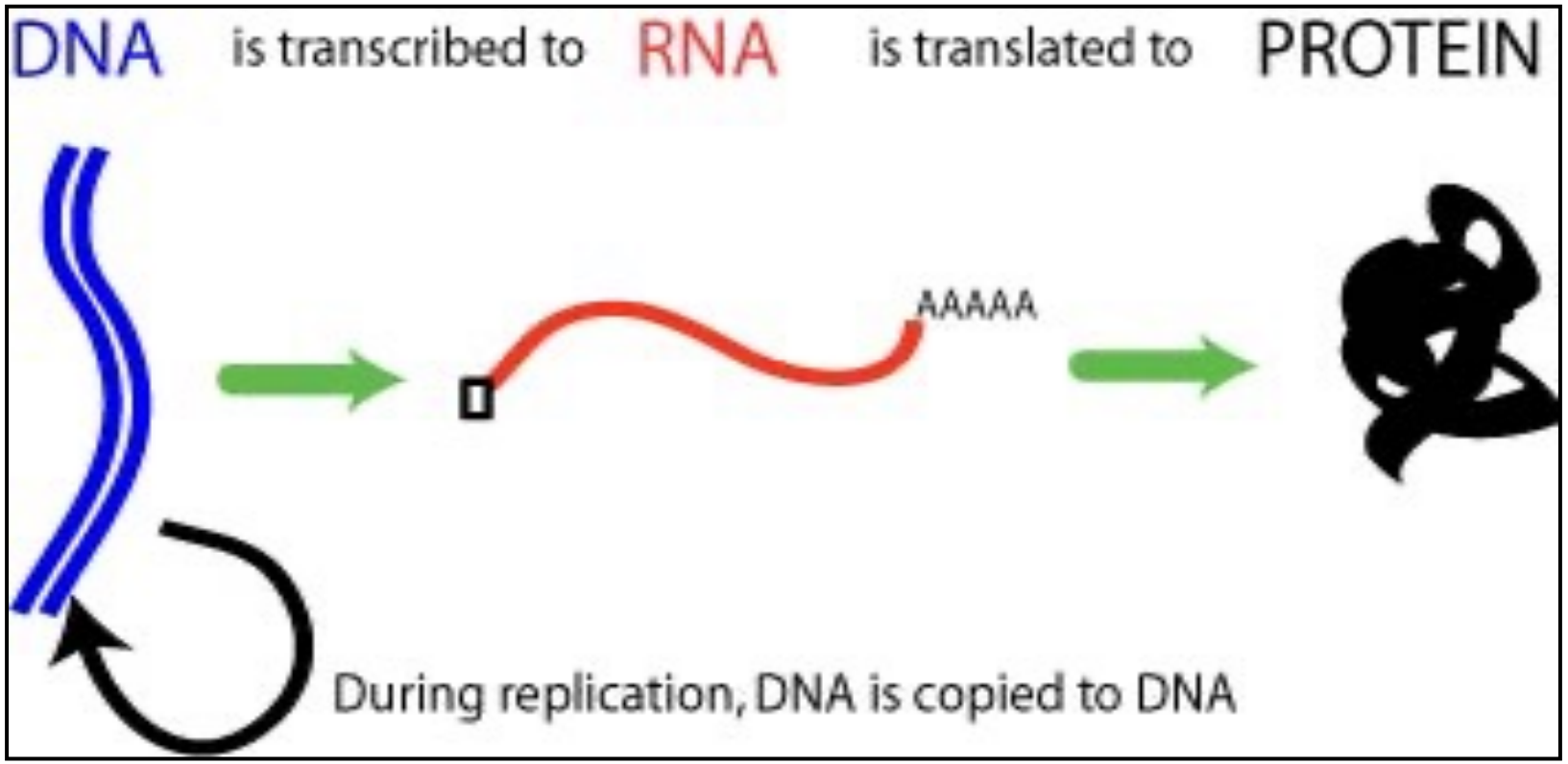
Innate immunity

The innate immune system is critical in limiting the spread of pathogens during the initial infection and then activating the adaptive immune system.

Adaptive Immunity

The adaptive immune system provides the ability to fully eliminate specific pathogens and the memory to be better prepared for a second infection with the same pathogen.

Cell Biology Review

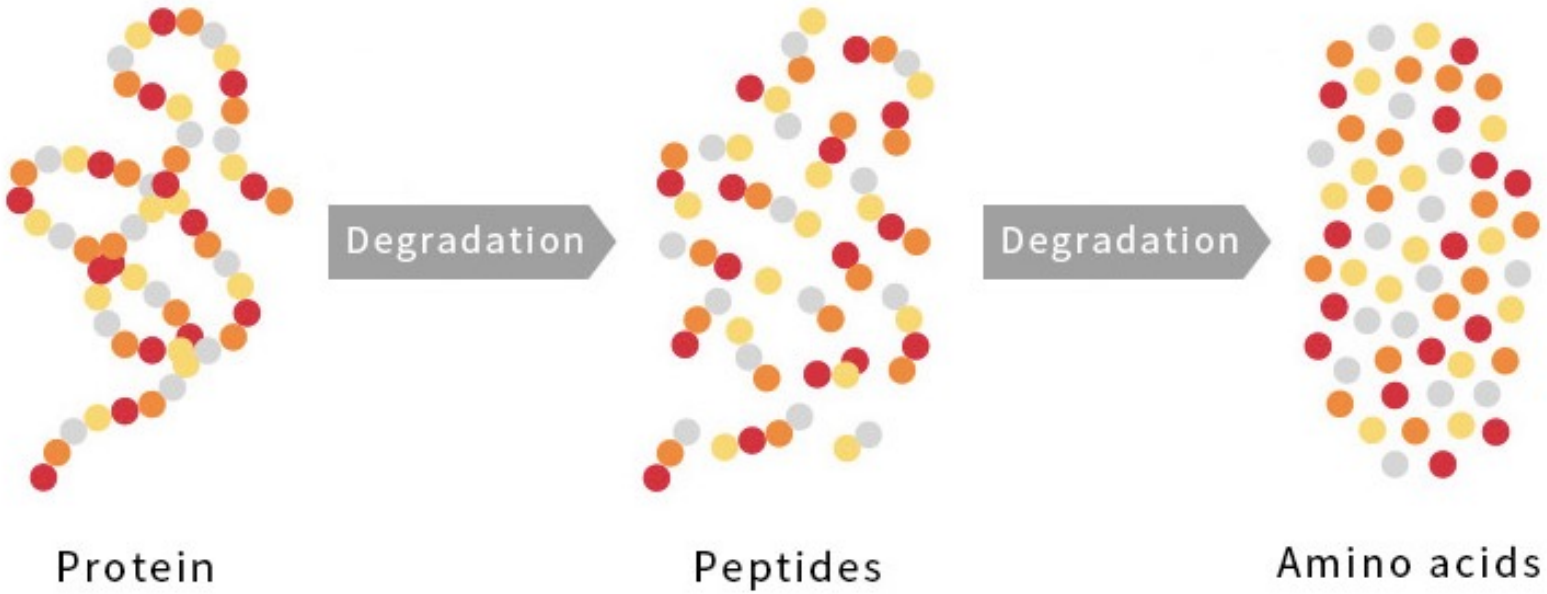


The Central Dogma of Molecular biology

DNA is genetic code for most organisms.

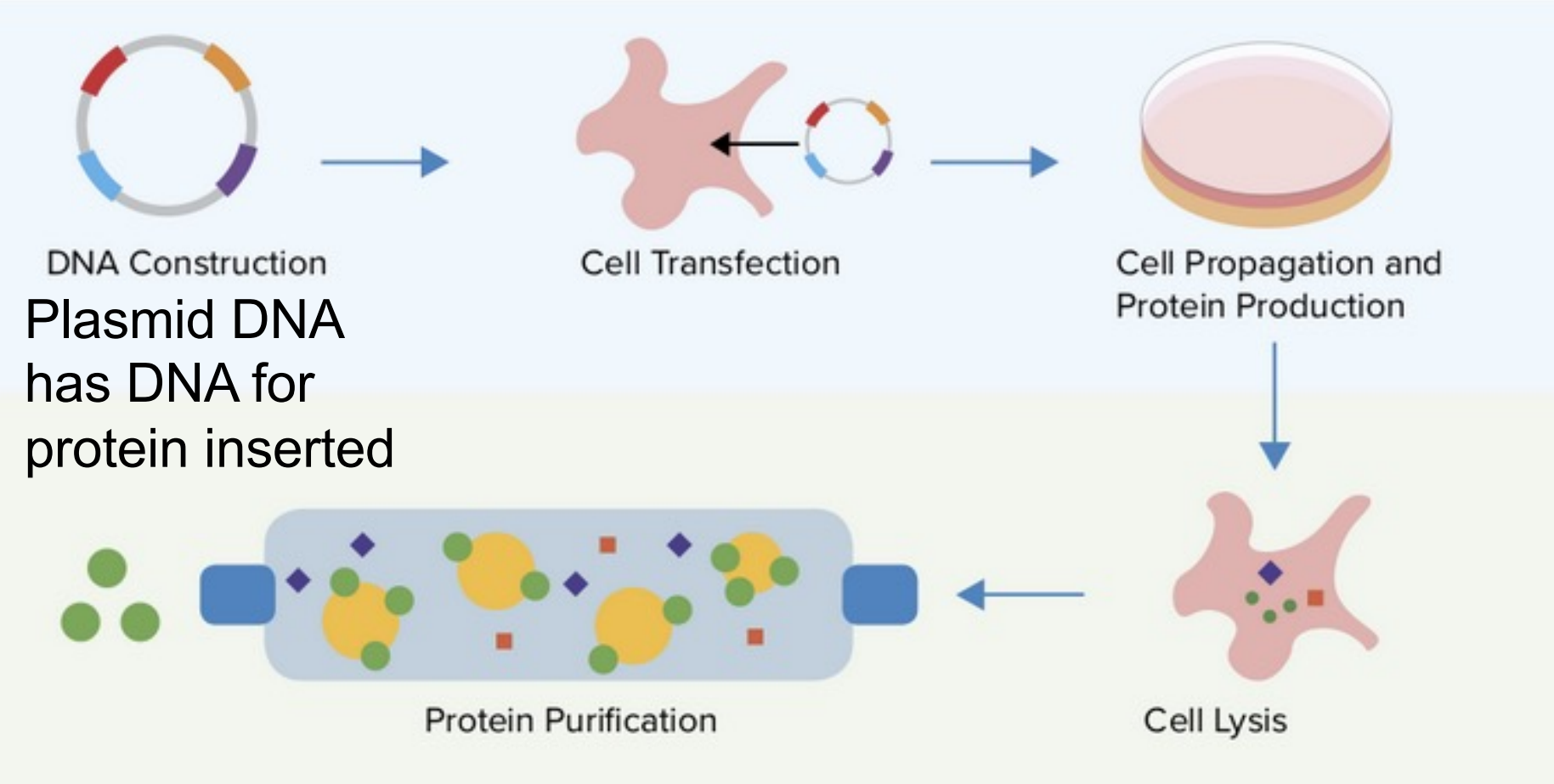
Viruses can use DNA or RNA for their genetic code

Proteins



Degradation is done with proteases (enzymes that degrade proteins). Pathogen proteins are degraded into smaller pieces (peptides) that are used as important signals for the immune response.

DNA recombinant technology

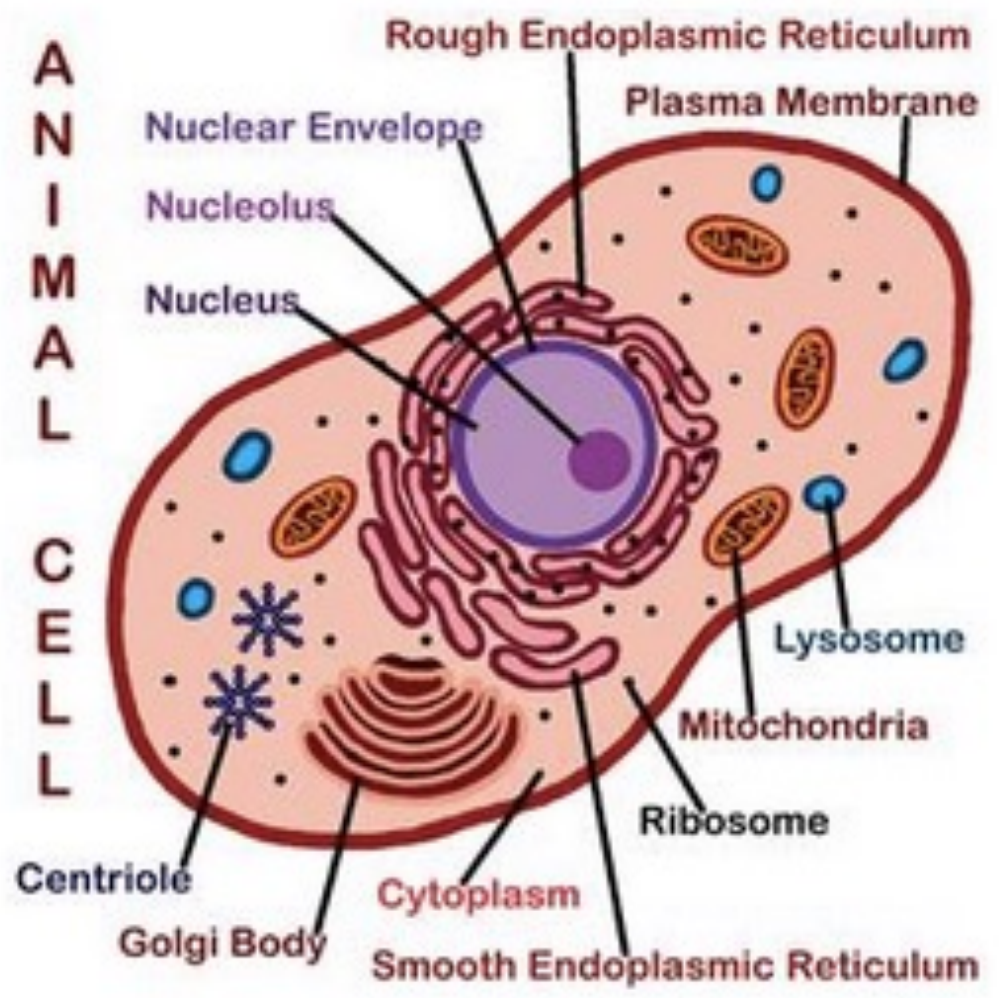


Plasmid DNA has DNA for protein inserted

Synthetic protein production uses recombinant DNA technology and protein expression systems to create millions of copies of proteins for use in research or vaccines.

Animal cell structure

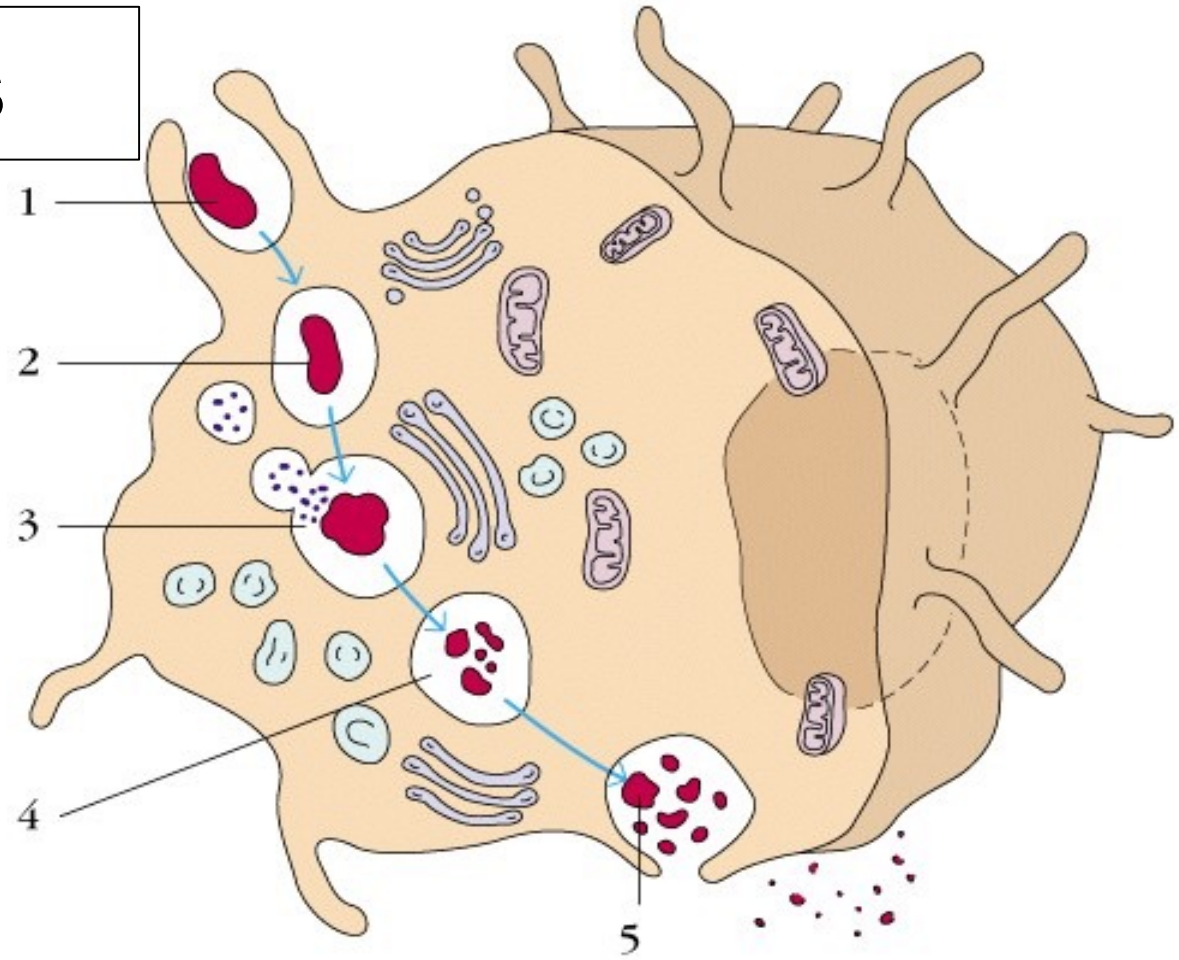
Need to recall basic structure of animal cells with nucleus, cytoplasm and organelles.



Important to understand that membranes keep things separate. The plasma membrane keeps things out of cell, the endosomes including lysosomes keep things inside their membranes for transport or special function. ER and Golgi contain newly synthesized proteins.

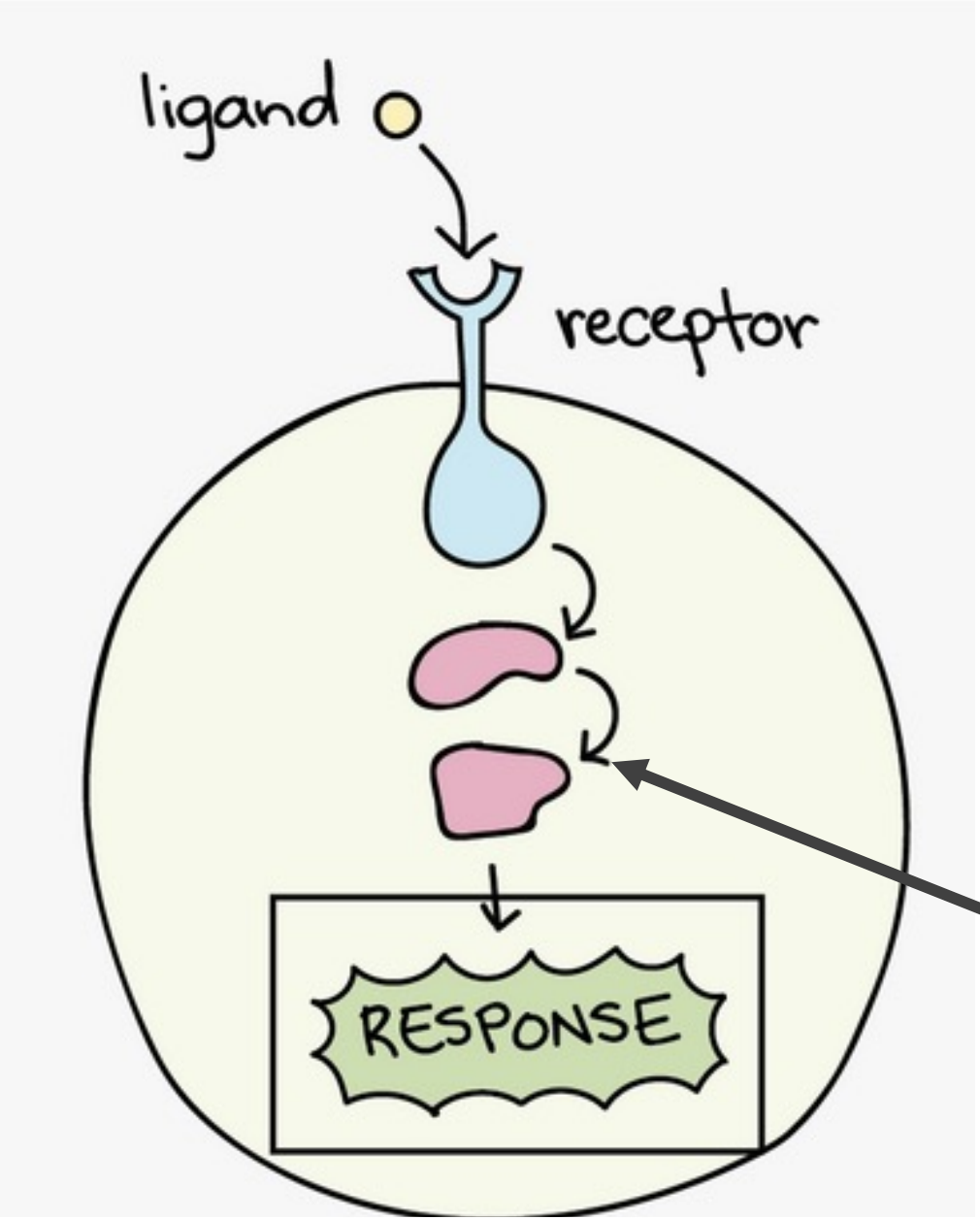
Phagocytosis

In humans, phagocytosis is only carried out by specialized immune cells.
Neutrophils, macrophages, and dendritic cells.



Phagocytosis is a form of endocytosis (1) that uses pseudopodia to engulf particles and results in the formation of phagosomes (2) which can fuse with lysosomes containing enzymes (3) to breakdown into smaller pieces (4).
Label 5 shows expelling waste from degradation.

Receptors and ligands



Receptors are on the surface of cells and bind to soluble ligand or cell surface ligand on another cell to activate an action for the cell.

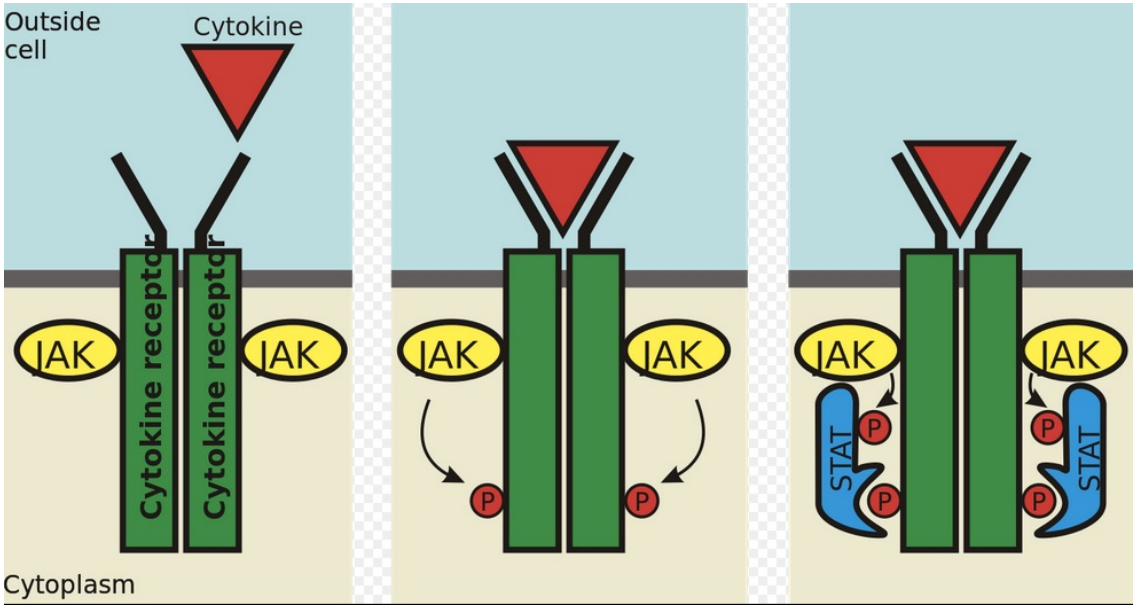
The activation of the receptor by binding its ligand can trigger various signals for the cell.

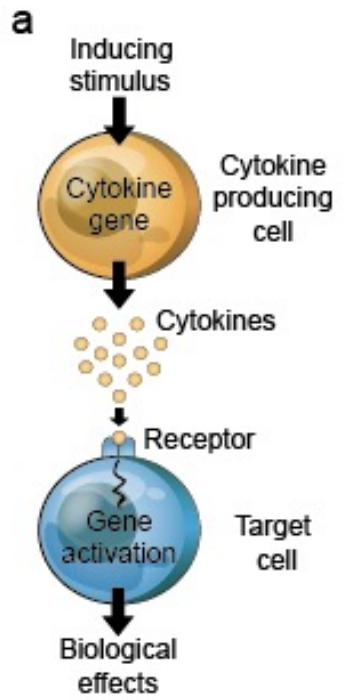
Signal transduction = response and this response is usually new protein production or other change in cell.

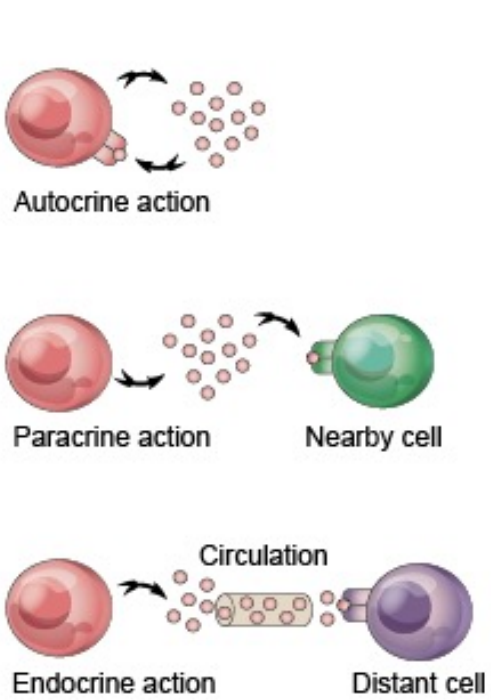
Cytokines

Cytokines are the special molecular messengers (aka "immune hormones") that control and regulate the immune system.
Cytokines are secreted ligands recognized by surface receptors on cell surfaces.

Cytokines are released by one cell to act on a cell nearby or a distant cell.







Quizzes and iClicker points

- There will be 6 quizzes based on readings and in-class material. Quizzes will be done on Gradescope and will be a good check that you are keeping up with course material.

- You are required to participate with the iClicker Cloud using your smartphone, tablet or laptop.
- It is your responsibility to check your iClicker records for discrepancies and inform the instructor within 48 hours.

- MCB55 is set up on the iClicker Cloud website and integrated with bCourses. Please make sure you have an account using CalNet ID and check that you can see MCB55 class.
- First iClicker day for points will be Friday Sept 6!!

Exam structure

True/False and multiple-choice questions will be the majority of the questions.

There will be short answer questions that require scientific analysis.

It will be important to compare and contrast the different pathogens or diseases.

Points in Class

Midterm I	100 pts
Midterm II	100 pts
Quizzes	60 pts
iClickers	40 pts
Final Exam	100 pts

Total = 400 pts

Grades

The median grade is usually a B/B-, with roughly 1/3rd of the class earning grades in the A+/A/A-range, 1/3rd in the B+/B/B-range, and 1/3rd in the C range or below.
There is no **extra credit**.

Attendance

In-person attendance is expected unless excused. For excused absences please contact the instructor BEFORE class.
Attendance will be tracked using iClickers.
You will receive 2 points each day when you answer at least 75% of the class participation questions.

Beatty contact

Please use my email address
prbeatty@berkeley.edu
And please check YOUR berkeley.edu email for announcements-this is my ONLY way to communicate with you

Open Discussion Hours

Beatty
Fridays 10-11 am
176 Weill Hall