Virus detection methods, vaccines, and therapeutics

Erin DiCaprio, M.S., Ph.D.
Assistant Specialist in Cooperative Extension

Department of Food Science and Technology
University of California, Davis
University of California Division of Agriculture and Natural Resources

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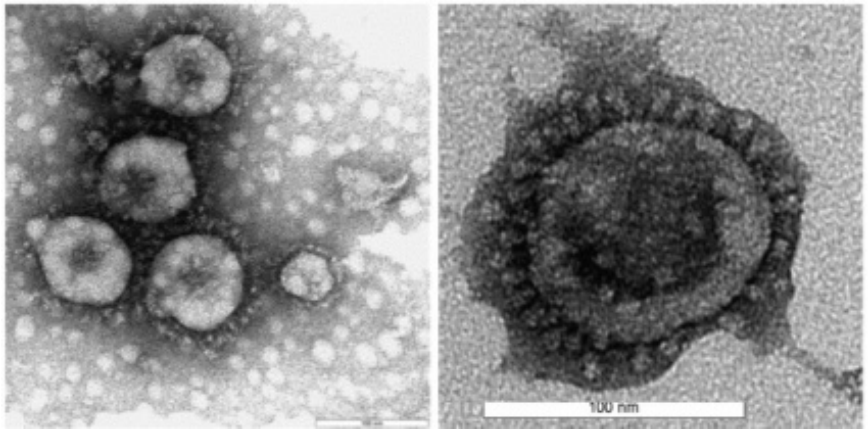
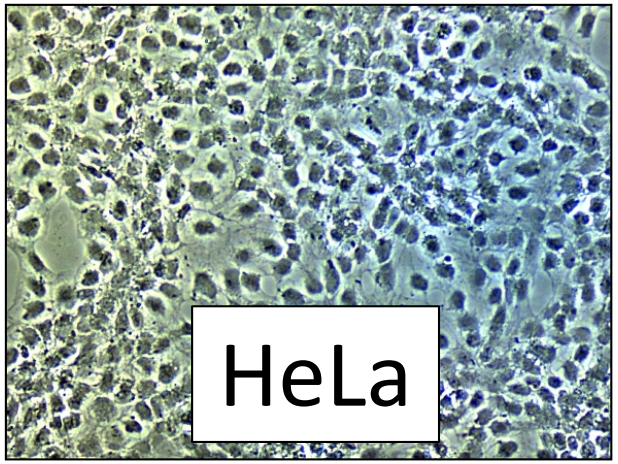
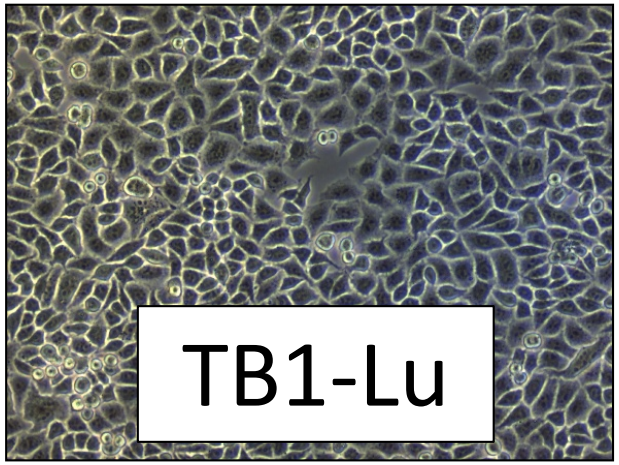
Virus cultivation under laboratory conditions

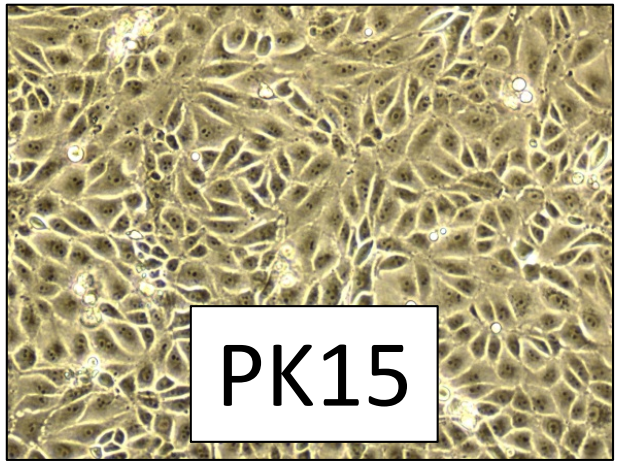


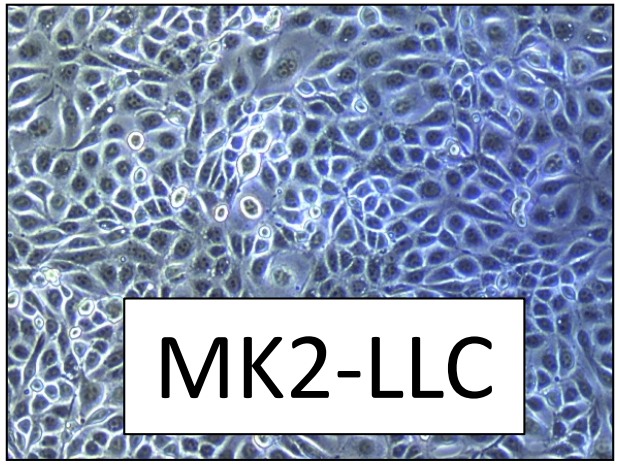
Virus cultivation in the laboratory requires a susceptible cell type

Immortalized cell lines

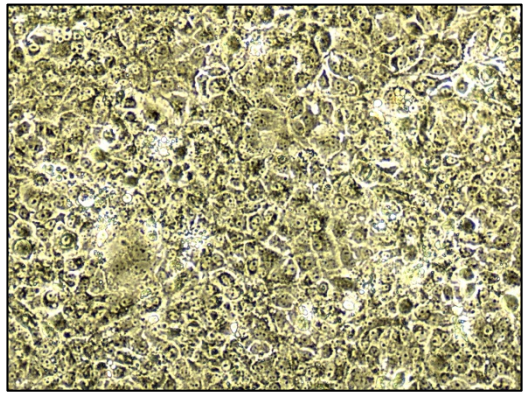




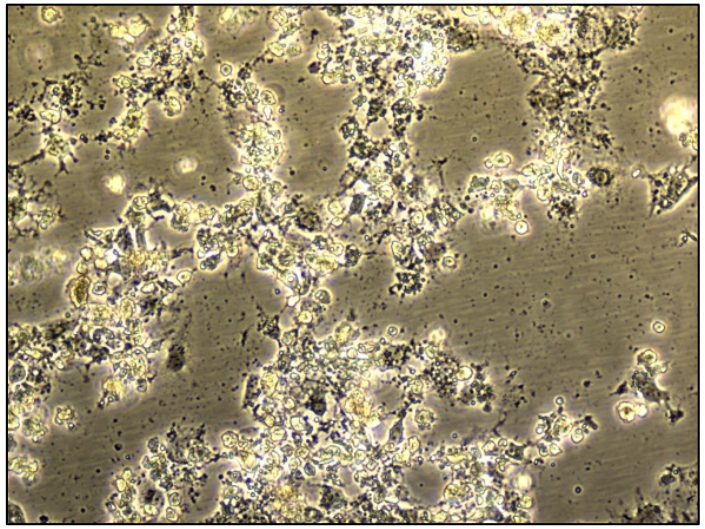




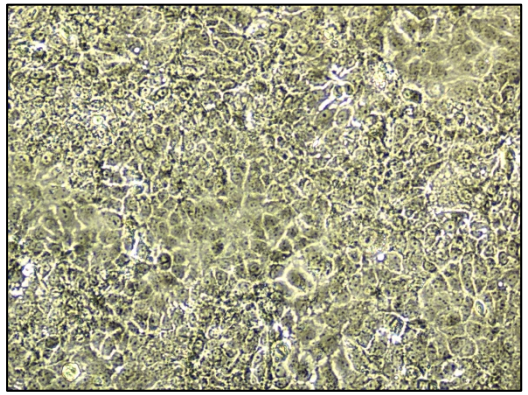
Virus replication in cell culture



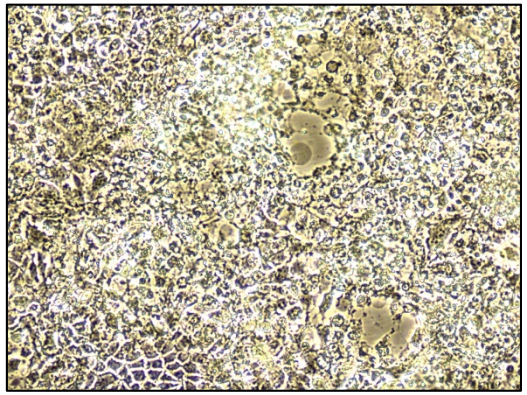
Virus infected Day 0



Virus infected 3 days later



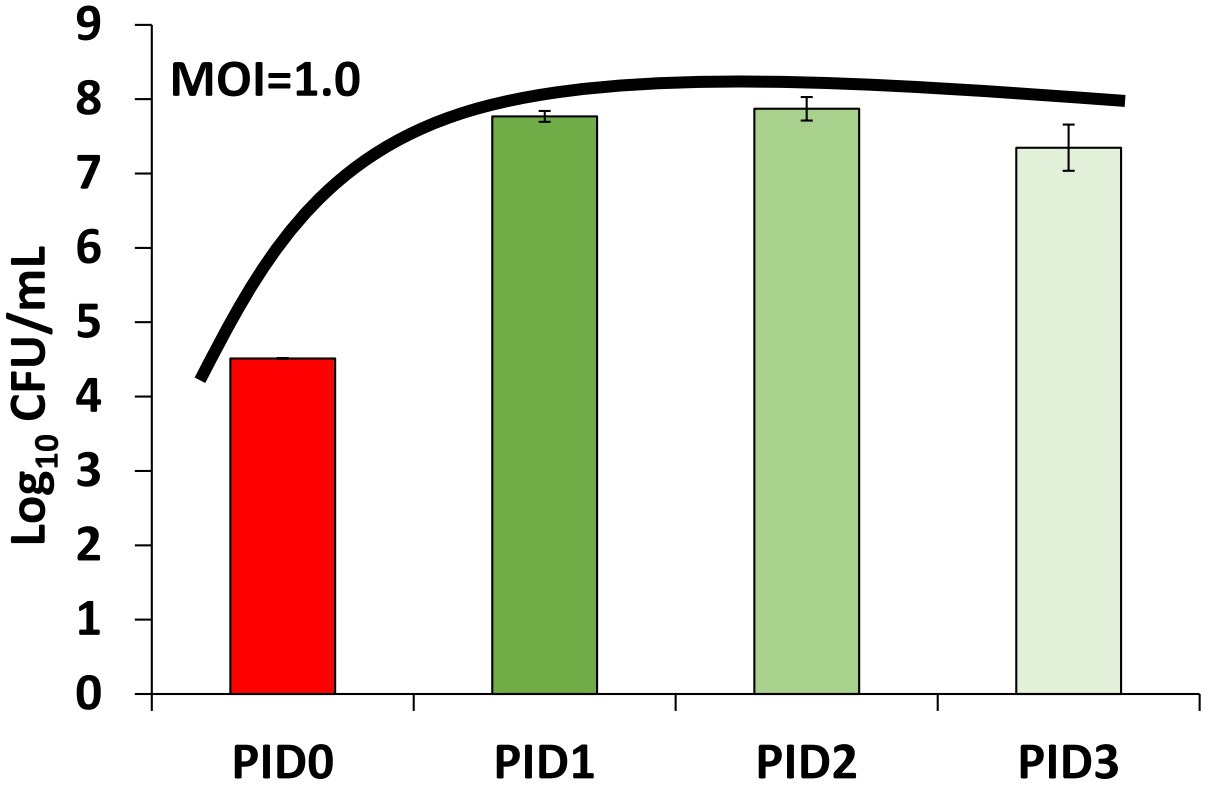
Non-infected (control) Day 0



Control 3 days later

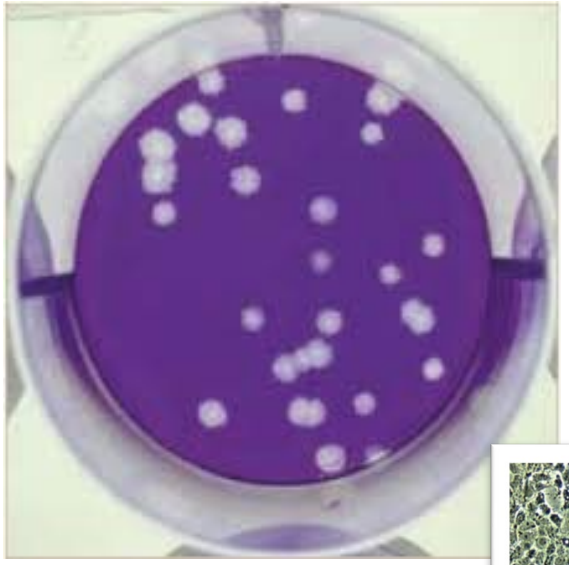
Cytopathic effect (CPE)

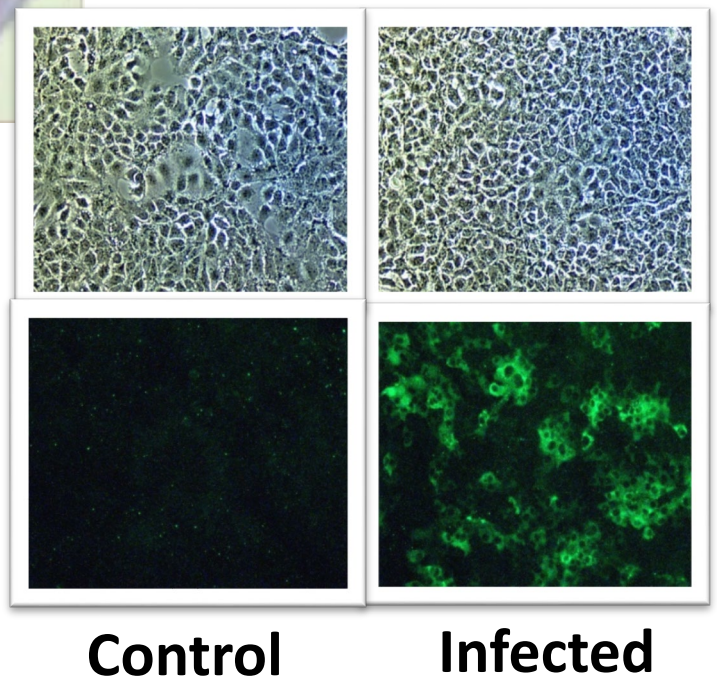
- Cell rounding
- Detachment
- Death



Cell culture based detection methods for viruses

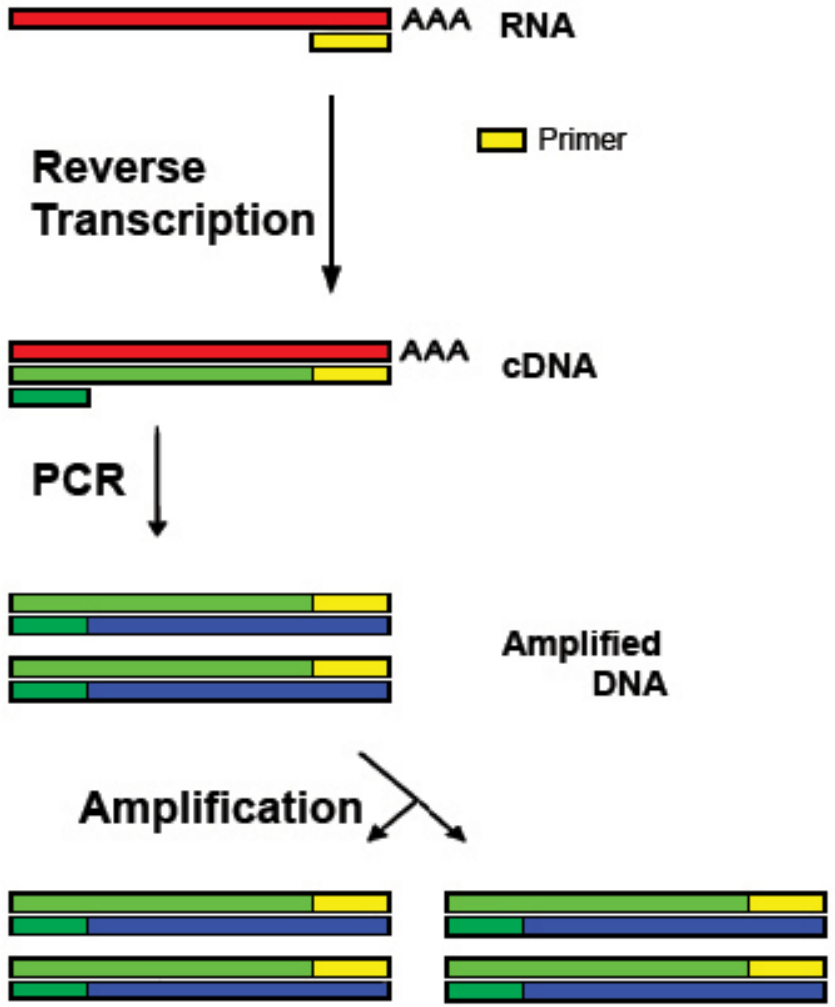
- Cell culture based assays
  - Plaque assay
  - Tissue culture infectious dose$_{50}$ assay (TCID$_{50}$)
  - Focus forming assay
  - Viral protein expression





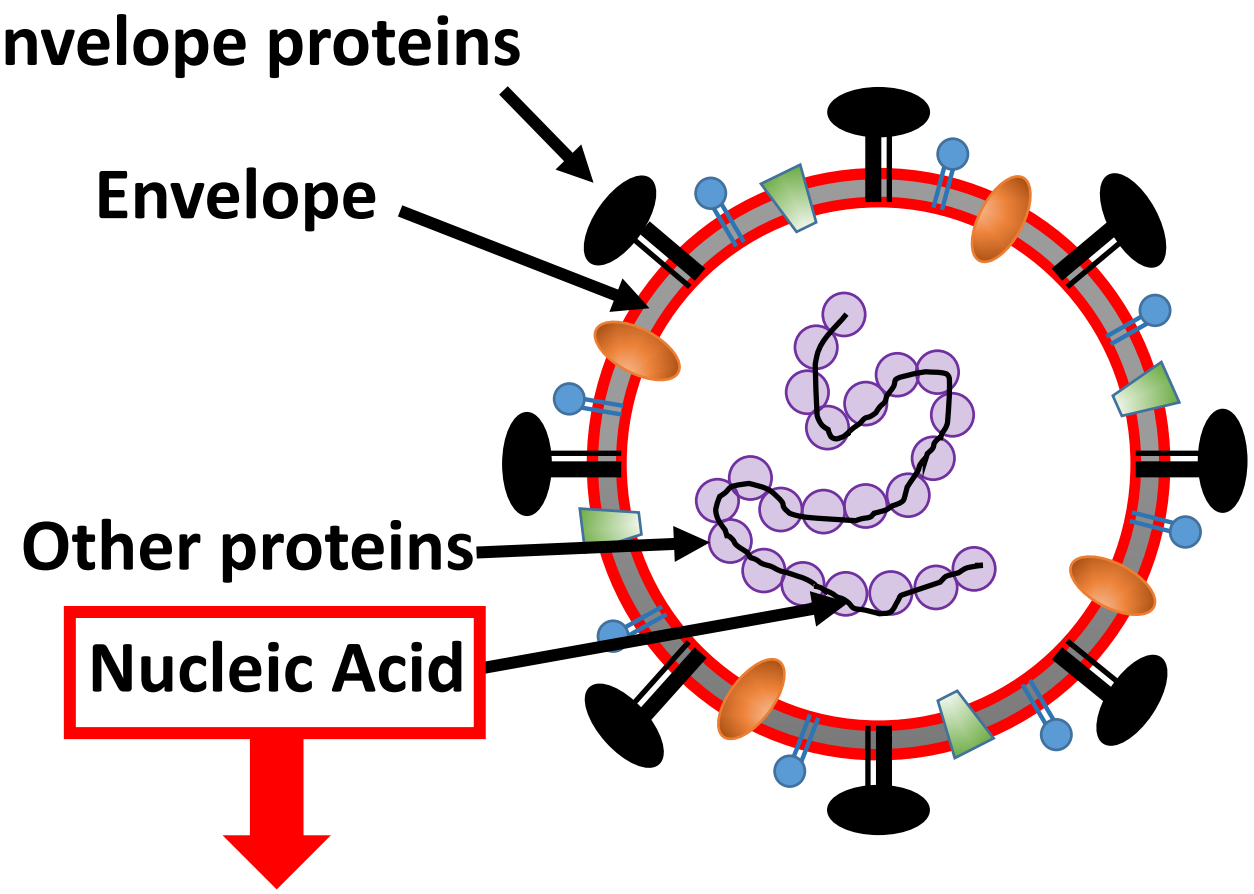
Nucleic acid detection methods for viruses

- Many viruses grow poorly or not at all under laboratory conditions
- Detection of viruses relies heavily on PCR and reverse transcriptase (RT) PCR
  - PCR for DNA viruses
  - RT-PCR for RNA viruses



Nucleic acid detection vs. infectivity

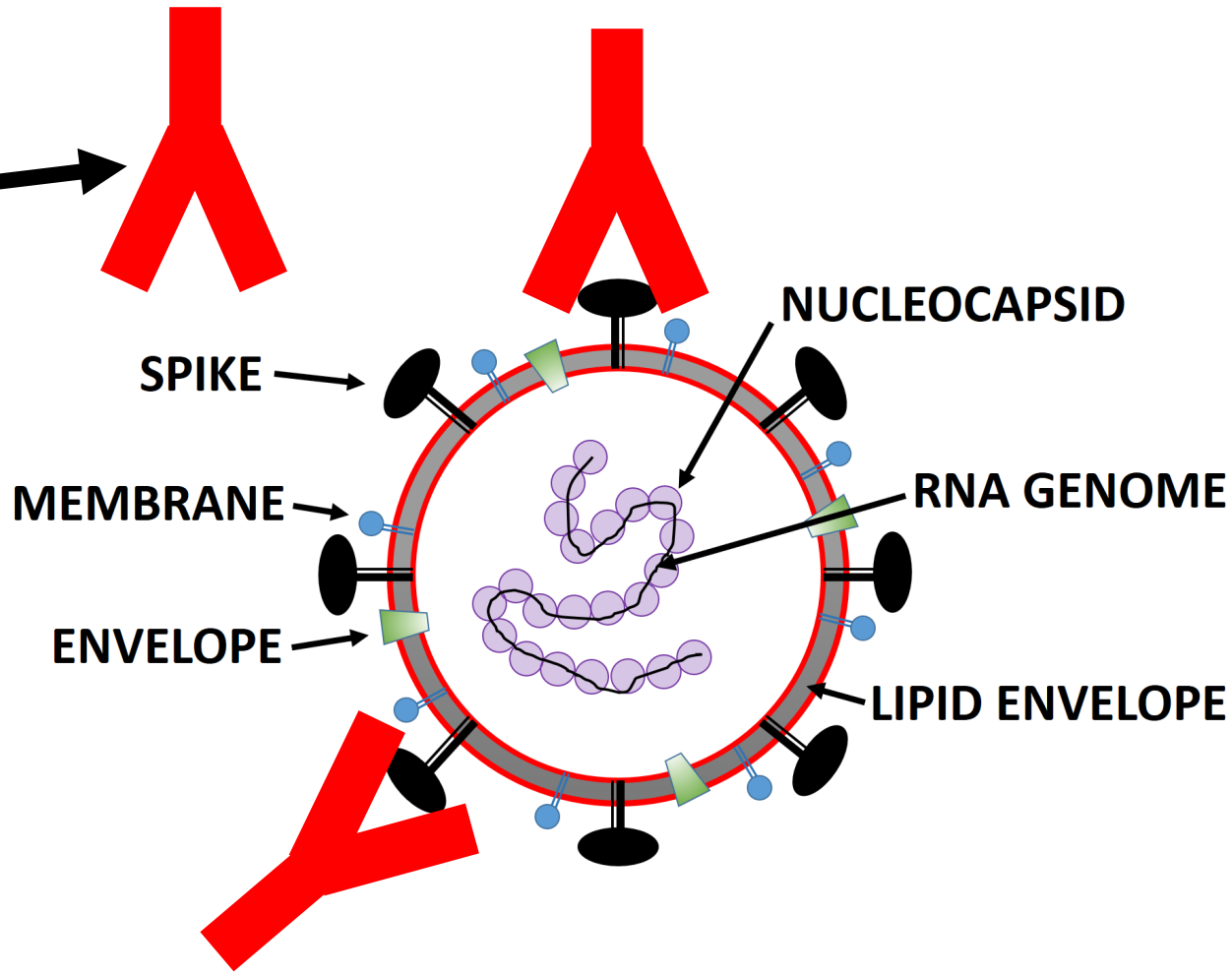
- Nucleic acid detection alone is **not** indicative of infectious virus
  - Inactivated, incomplete, or lethally mutated viruses that still have targeted RNA
  - Exogenous viral genetic material (laboratory contamination)



One piece of an infectious viral particle

Antibody tests

- Antibodies (Ab) develop after infection with pathogen
- Ab specific to protein on the virus surface (Spike protein)
- We can test for the presence of these virus specific Abs in serum
- Indicative a person has been infected by SARS-CoV-2



Vaccine development

Types of vaccines:

- **Inactivated vaccines**
- **Attenuated vaccines**
- **Subunit, recombinant, polysaccharide, and conjugate vaccines**
- **Toxoid vaccines**

Best protection

Require booster
Adjuvants

- CanSino Biologics Inc.
  - Adenovirus 5 vectored vaccine
  - Expressed SARS-CoV-2 protein
  - Phase II
- Moderna, Inc
  - mRNA based vaccines
  - Expression of SARS-CoV-2 S protein
  - Phase I

Anti-viral therapies

- **Passive immunization**
- **Target:**
  - **Viral enzymes**
  - **Suppress immune responses**
  - **Block cellular receptor**
  - **Block other processes required for viral replication**

- Convalescent serum
- Remdesivir
  - nucleoside analog
  - acts as an RdRp inhibitor
  - incorporation results in premature termination of RNA synthesis
  - CoV proofreading function?
- Hydroxychloroquine
  - increase pH within intracellular vacuoles
  - antirheumatic properties of these compounds results from their interference with "antigen processing" in macrophages and other antigen-presenting cells

Use caution when interpreting research results

- Look closely at methods, especially controls used, and results
- Best source is the peer-reviewed scientific literature
- Many uncited, unscientific sources of information exist

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Dr. Erin DiCaprio is a virologist and food safety specialist in the Department of Food Science and Technology at UC Davis and the UC Division of Agriculture and Natural Resources.