

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)

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17th April 2020

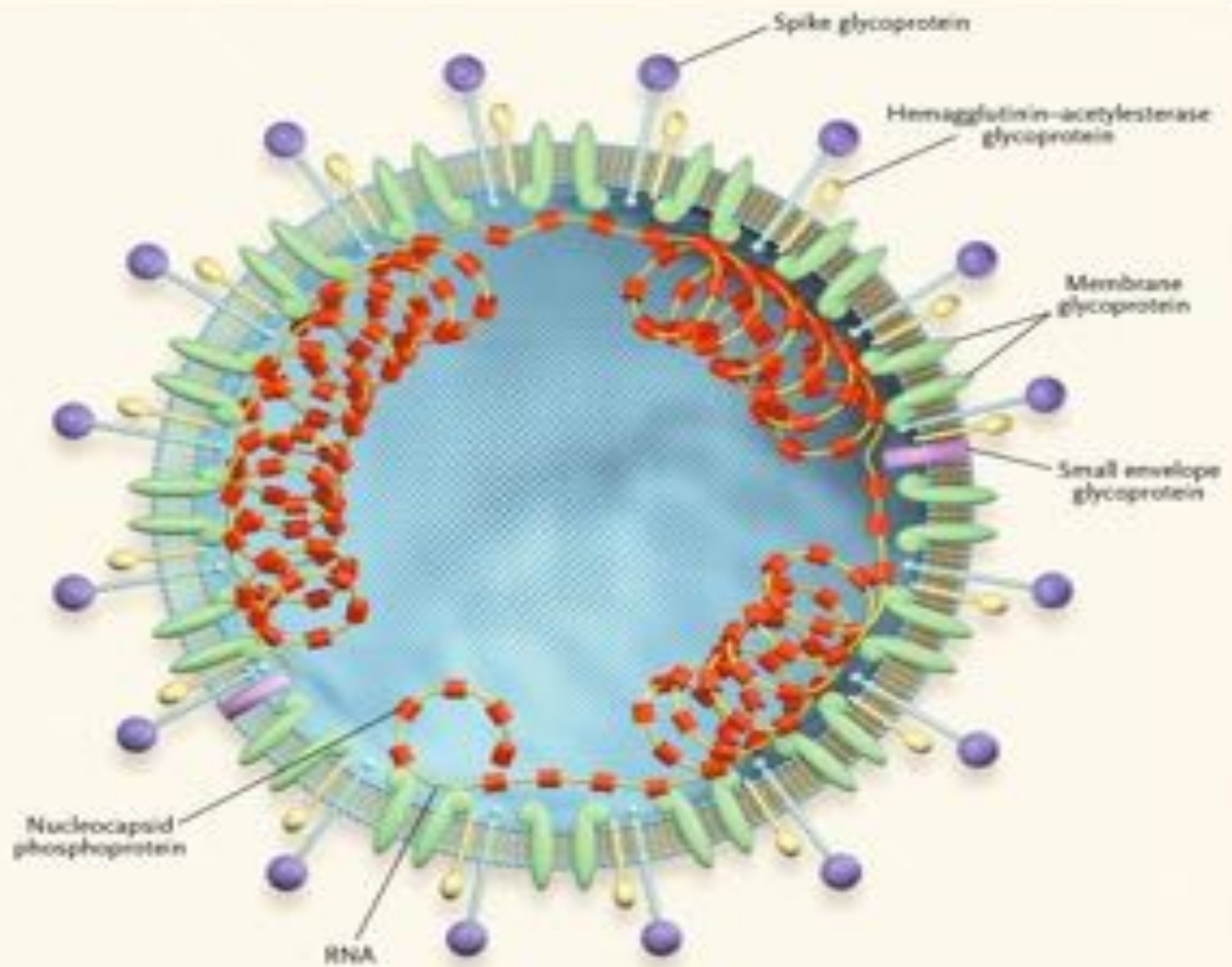
Structure of Presentation

- Virus structure
- Virus replication
- Virus classification
- The emergence of new viruses
- The host response
- Diagnostic testing

1976	Started working as a trainee Biomedical Scientist (BMS) at North Manchester Hospitals, after rotating through all the disciplines in Pathology I chose to specialise in Microbiology
1981 -1984	I began my career in Virology at North Manchester Regional Virus Laboratory
1984 - 1986	Worked at Sheffield Public Health Laboratory
1986 - 1990	Worked in the Virology Laboratory at Riyadh Al Kharj Hospital in Saudi Arabia
1991 - 1994	Worked in the Virology Laboratory at Taunton Public Health Laboratory
1994 - 2013	Managed the Virology Laboratory at Exeter Public Health Laboratory

Landmarks in Virology during My Career

- 9th December 1979 - the eradication of Smallpox
- 1974 - Acyclovir patented - first used to treat HSV in 1982
- 1976 - Ebola (bats)
- 1982 - HIV (bats)
- 1988 - H5N1 Avian flu (bats)
- 1993 - Sin Nombre (mouse)
- 1999 - Nipah (bats)
- 2002 - SARS (bats)
- 2009 - H1N1 (pigs)
- 2012 - MERS (bats)
- 2013 - H7N9 (birds)
- 2019 - SARS CoV2 (bats)

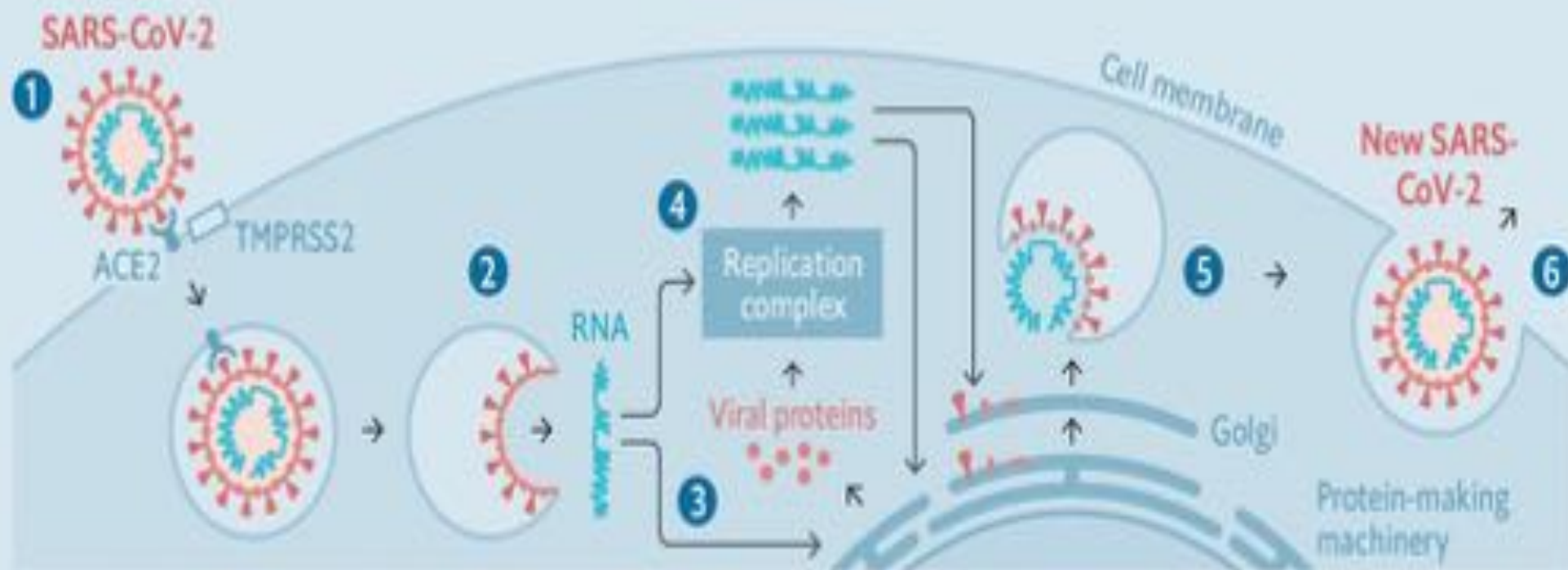


Virus Replication

- Attachment to the cell
- Entry into the cell
- Replication of the genome
- Virus assembly
- Cell death and release of virus particles

Hijack

How SARS-CoV-2 replicates itself in the cells of those infected



1 Spike protein on the virion binds to ACE2, a cell-surface protein. TMPRSS2, an enzyme, helps the virion enter **2** The virion releases its RNA **3** Some RNA is translated into proteins by the cell's machinery **4** Some of these proteins form a replication complex to make more RNA **5** Proteins and RNA are assembled into a new virion in the Golgi and **6** released

Sources: Song et al, *Viruses*, 2019; Jiang et al, *Emerging Microbes and Infections*, 2012; *The Economist*

International Committee on Taxonomy of Viruses (ICTV)

- In July 2013, the ICTV definition of species changed to state: "A species is a monophyletic group of viruses whose properties can be distinguished from those of other species by multiple criteria."

Viral classification starts at the level of order and continues as follows, with the taxon suffixes given in italics:

- Order (-*virales*)
- Family (-*viridae*)
- Subfamily (-*virinae*)
- Genus (-*virus*)
- Species

Species names generally take the form of [*Disease*] *virus*.

* *Of, pertaining to, or affecting a single phylum (or other taxon) of organisms.

Classification SARS CoV 2

- Order **Nidovirales**
- Family **Coronaviridae**
- Genus **Betacoronavirus**
- Species **Severe Acute respiratory syndrome related coronavirus**

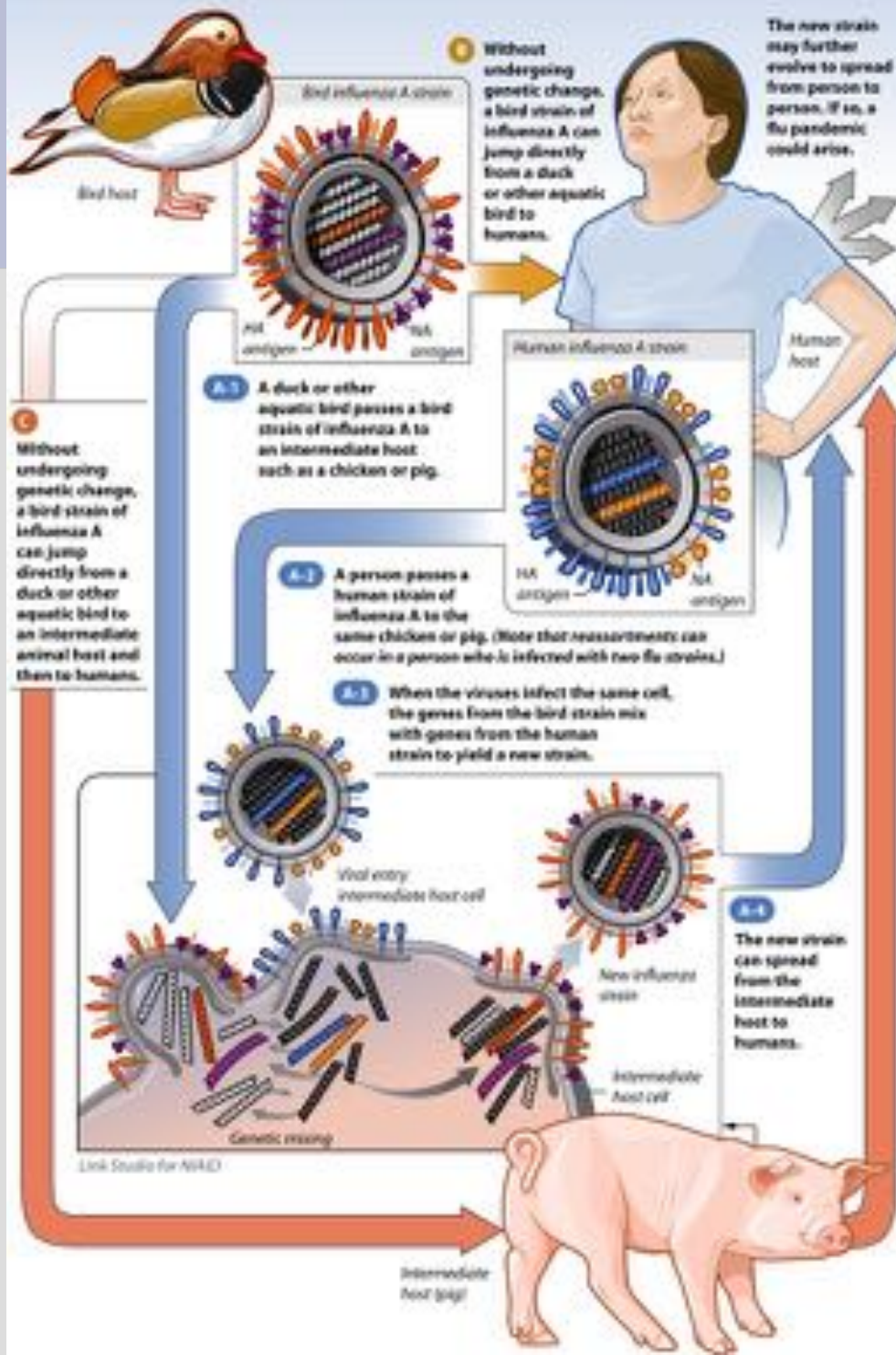
The Naming of Coronaviruses



Genus	Varieties causing human disease
Alphacoronaviruses	Human coronavirus 229E (HCoV-229E)
Betacoronaviruses	<ul style="list-style-type: none"> ● Human coronavirus HKU1 ● Human coronavirus NL63 (HCoV-NL63, New Haven coronavirus) ● Human coronavirus OC43 (HCoV-OC43) ● Middle East respiratory syndrome-related coronavirus (MERS-CoV or HCoV-EMC; the cause of MERS) ● Severe acute respiratory syndrome coronavirus (SARS-CoV-1, the cause of SARS) ● Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 or 2019-nCoV, the cause of COVID-19)

Animal	Variety of coronavirus
Cattle	Bovine coronavirus (BCV)—severe enteritis in calves
Cats	Feline coronavirus (FCoV)—mild enteritis in cats and severe feline infectious peritonitis
Dogs	Canine coronaviruses (CCoV)—enteritis and respiratory diseases
Ferrets	Ferret enteric coronavirus—epizootic catarrhal enteritis; Ferret systemic coronavirus—a syndrome similar to feline infectious peritonitis
Hedgehogs	Hedgehog coronavirus 1
Mink	Mink coronavirus 1
Pigs	Porcine coronavirus HKU15—gastroenteritis; Porcine epidemic diarrhea virus (PED or PEDV)
Rabbits	Rabbit enteric coronavirus—acute gastrointestinal disease and diarrhea in young European rabbits
Rats	Lucheng Rn rat coronavirus
Whales	Beluga whale coronavirus SW1

The genetic change that enables a flu strain to jump from one animal species to another, including humans, is called "ANTIGENIC SHIFT."
Antigenic shift can happen in three ways:



Systemic Disorders

Fever, Cough, Fatigue,
Sputum Production,
Headache

Haemoptysis,

Acute Cardiac Injury

Hypoxemia

Dyspnoea,
Lymphopenia

Diarrhoea

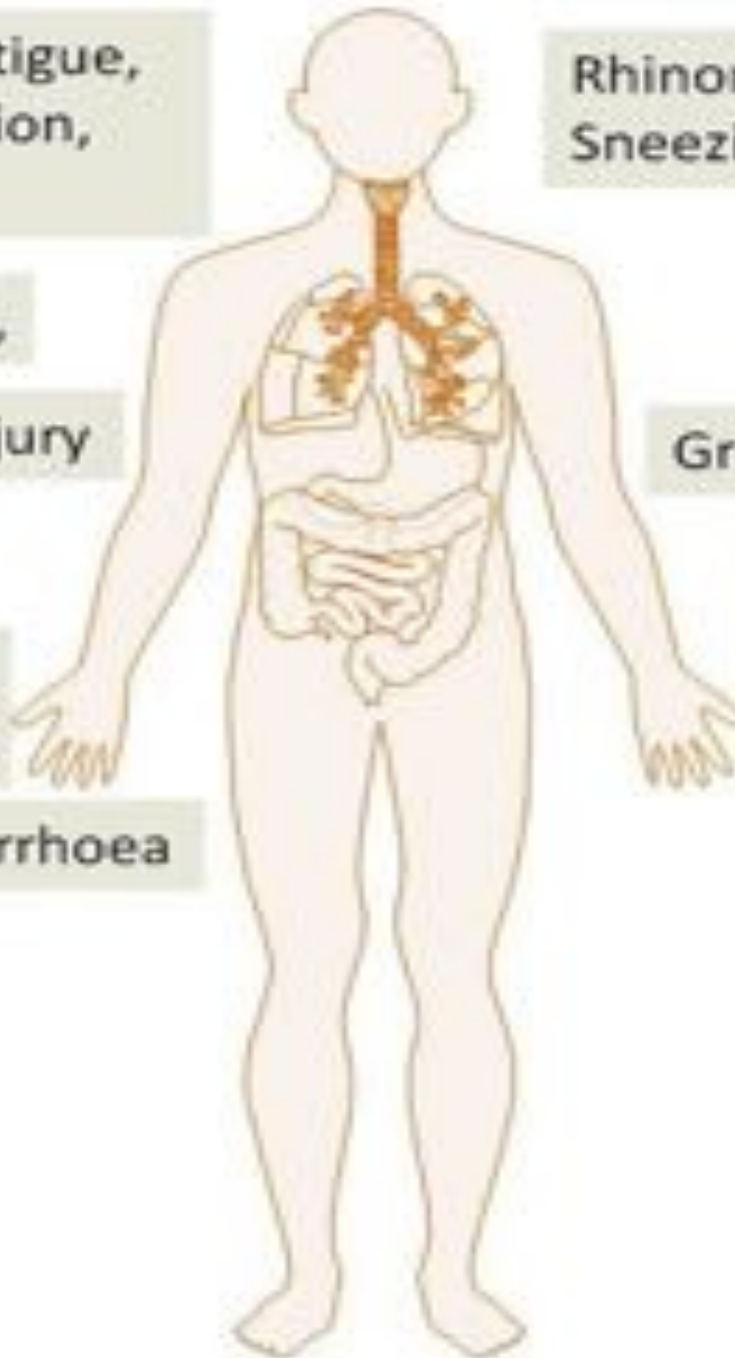
Respiratory Disorders

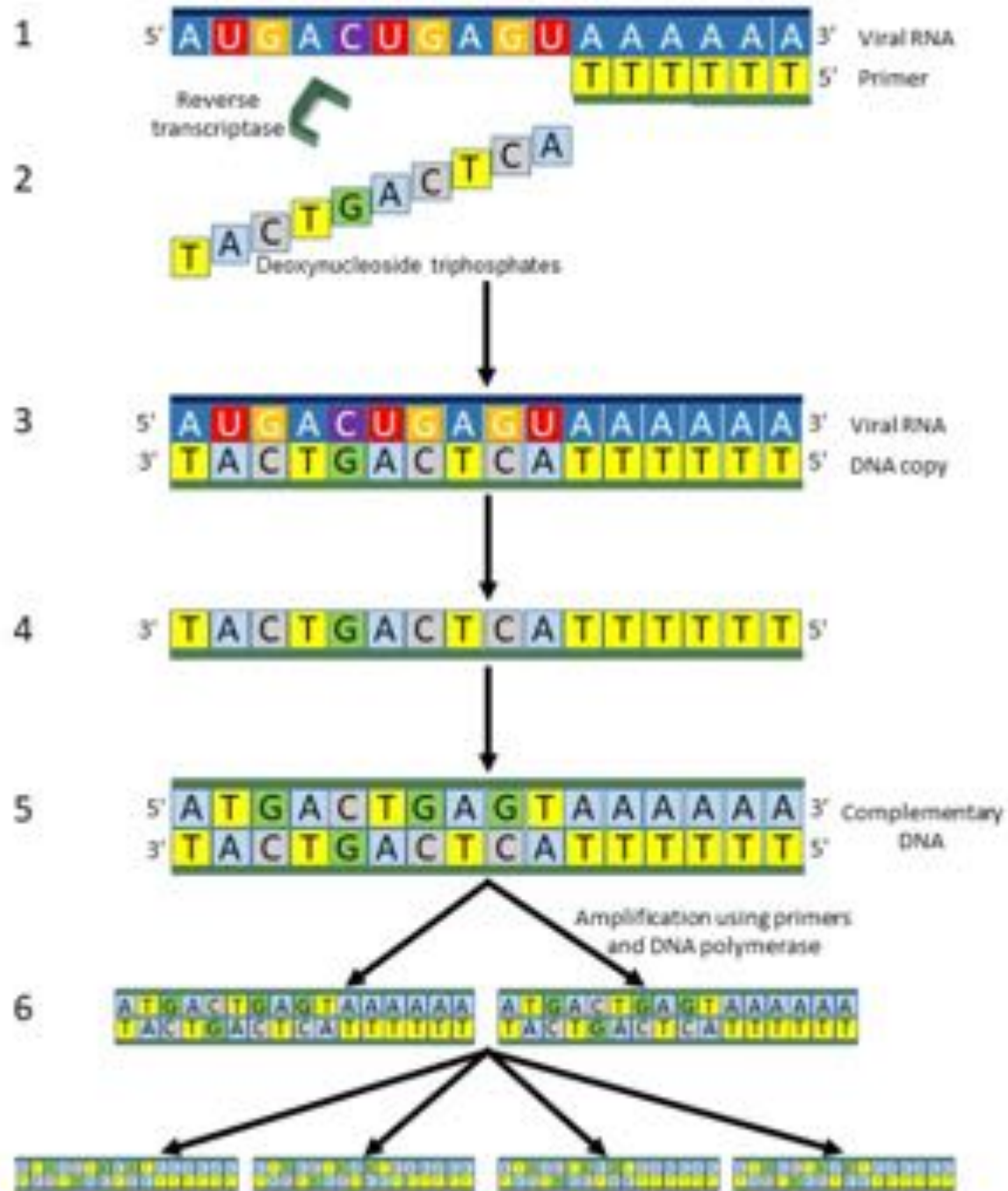
Rhinorrhoea,
Sneezing, Sore Throat

Pneumonia

Ground-glass Opacities

RNAemia, Acute
Respiratory Distress
Syndrome





Sensitivity of the test



Ability to **rule OUT** disease
(if the test is negative)

Specificity of the test



Ability to **rule IN** disease
(if the test is positive)