Influenza 101: The Virus and its Epidemiology in Swine

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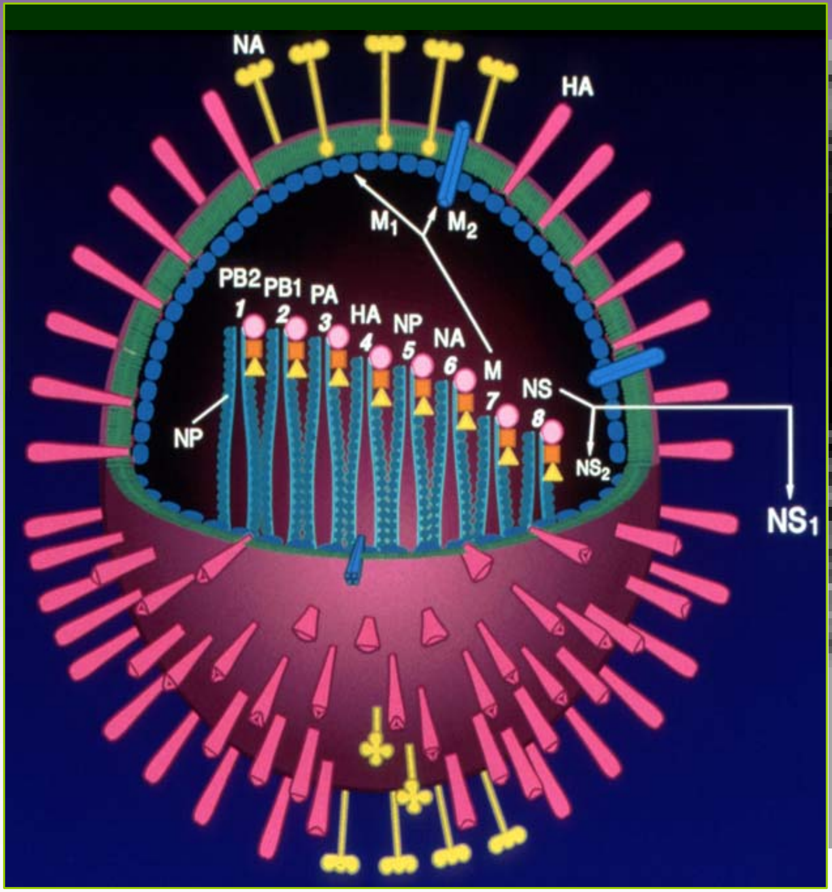
Swine Influenza Viruses

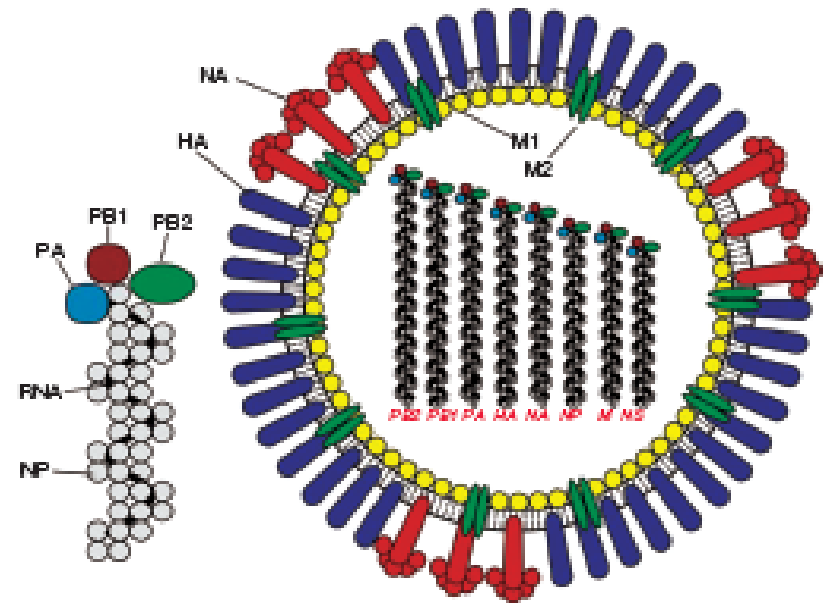


Family *Orthomyxoviridae*

- Genera: Influenza <u>A</u>, B, C *et al.*
- enveloped, negative-sense single-stranded RNA virus
- 8 gene segments, 10/11 gene products
- Typical zoonotic agents

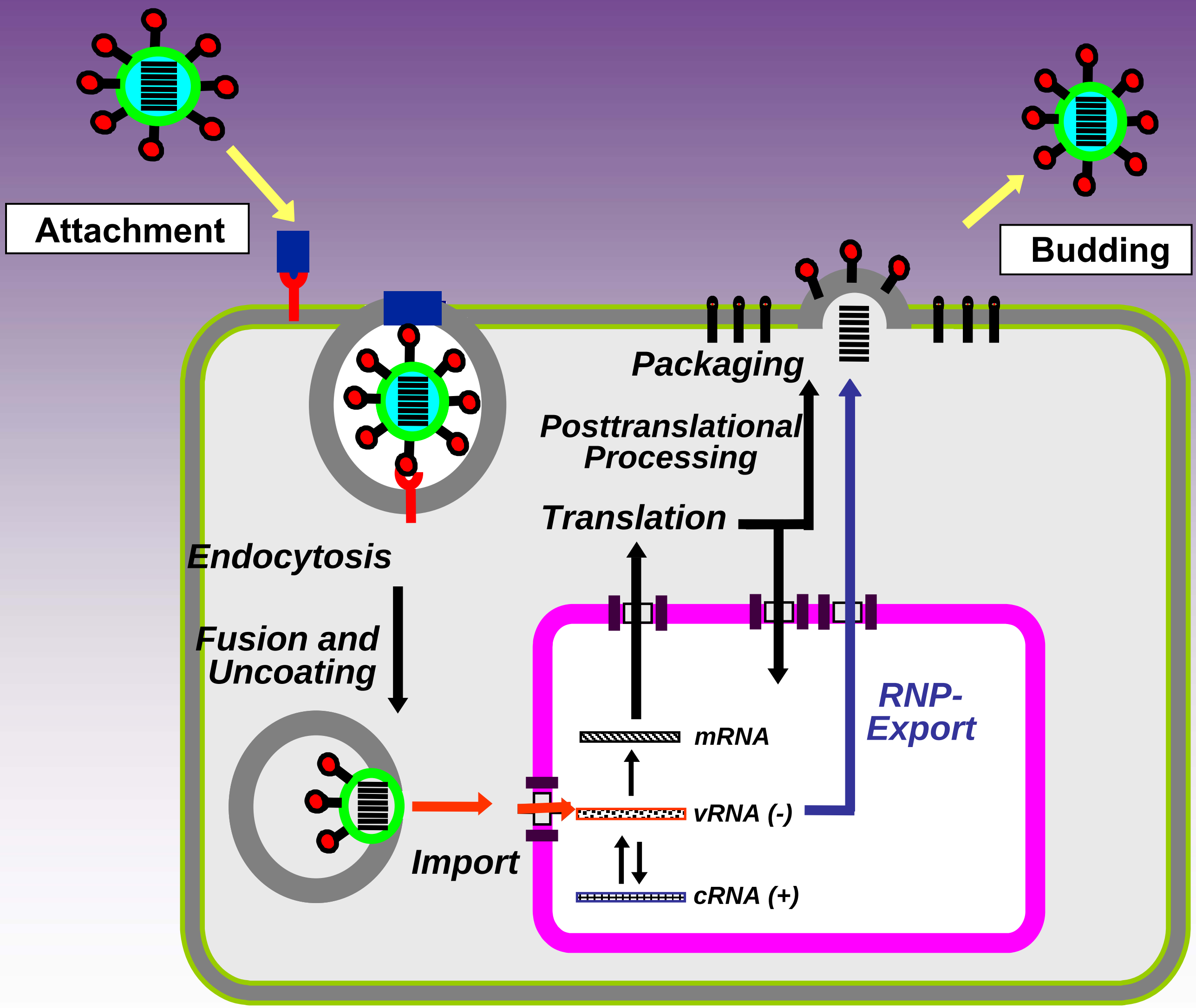
Influenza A Surface Proteins

- HA, NA, and M2 embedded in the envelope
- HA & NA are the major surface glycoproteins
  - Virulence
  - Immunity
  - Diagnostics
- HA (Trimer) attaches to host receptors
  - Mediates fusion of virus to endosomal membrane
- NA (tetramer) involved in detachment & budding



Cox RJ, Brokstad KA, Ogra P. Scand J Immunol 2004;59(1):1-15.

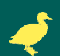
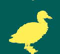
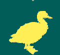
Influenza A Virus Replication Cycle



Influenza A Viruses

- Antigenic serotypes (subtypes) based on surface glycoproteins HA & NA:
  - 16 HA
  - 9 NA
  - e.g. H1N1, H3N2, H5N1, etc.
- Swine influenza – 3 primary subtypes circulating in North America
  - H1N1
  - H1N2
  - H3N2

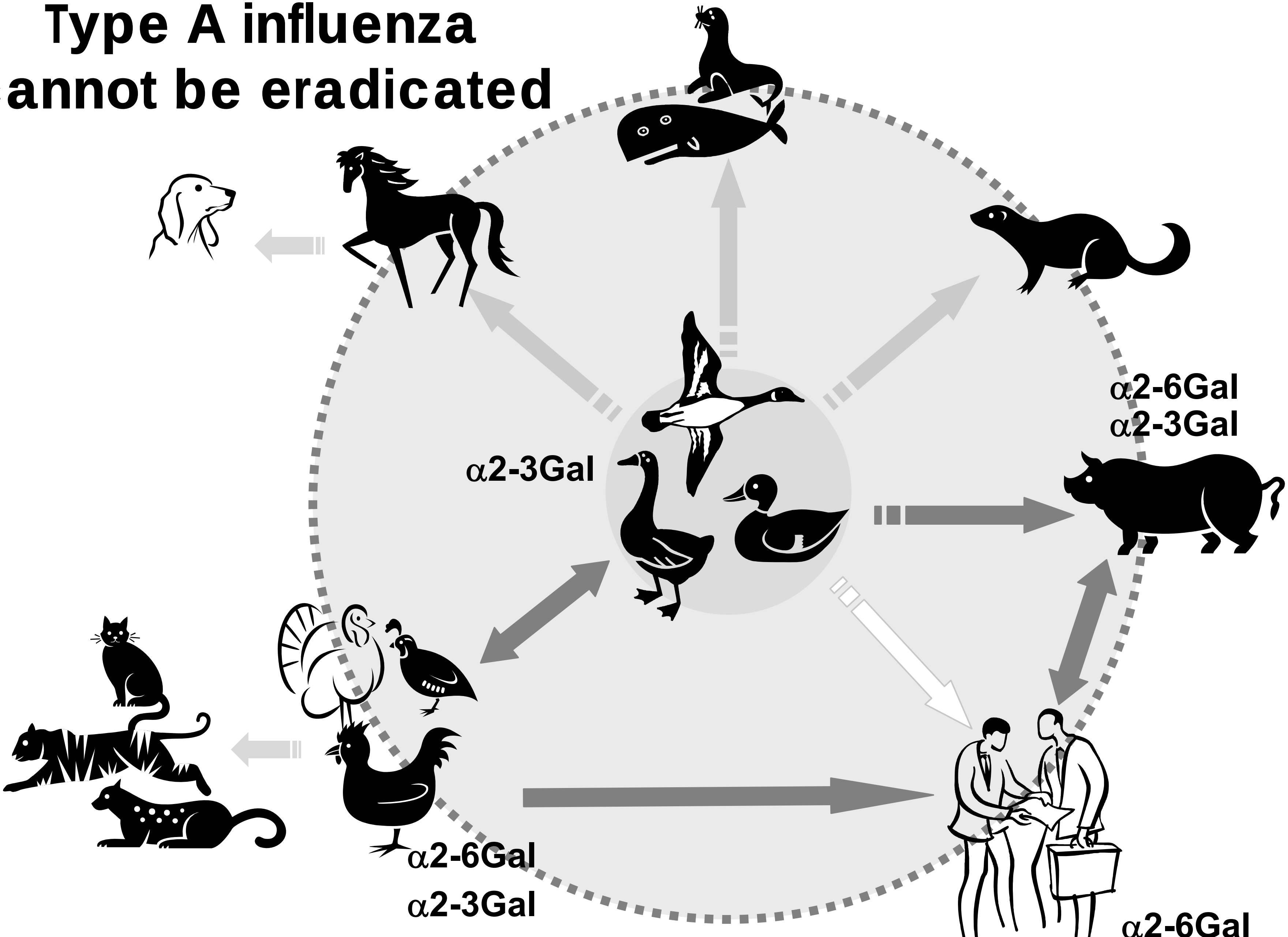
Influenza A: 16 Hemagglutinin subtypes

Subtype	Human	Swine	Horse	Bird
H1				
H2				
H3				
H4				
H5				
H6				
H7				
H8				
H9				
H10				
H11				
H12				
H13				
H14				
H15				
H16				

Host Specificity of Influenza A

- HA binds to sialic acid linked to galactose as its receptor
  - Human/mammalian viruses prefer α-2,6 linkage on respiratory epithelium
  - Avian viruses prefer α-2,3 linkage on G.I. epithelium
  - Pig tracheal epithelium express both receptor linkages on respiratory cells
    - "Mixing vessel" for avian-human reassortant viruses with pandemic potential

Type A influenza cannot be eradicated



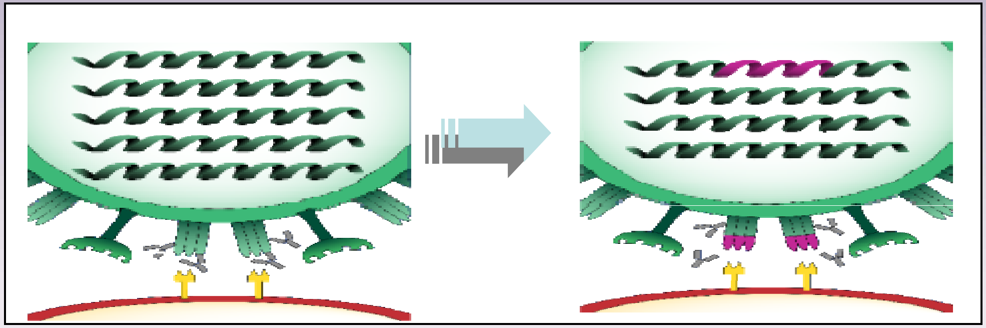
Mechanisms of molecular evolution

- A constantly evolving virus

- Rapid evolution result of two major properties

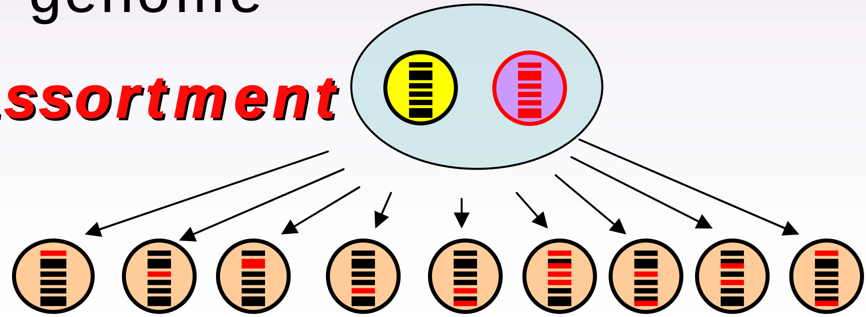
    1) infidelity of viral RNA polymerase

    - Antigenic Drift



    2) segmented nature of genome

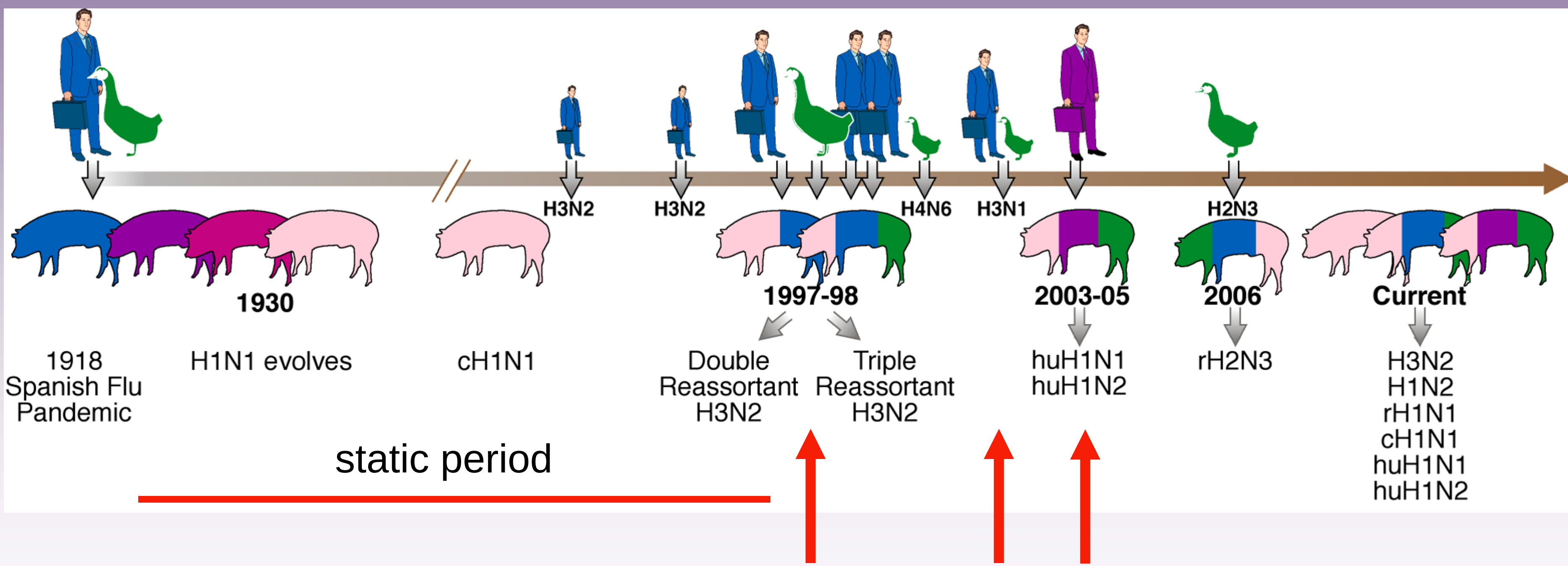
    - Antigenic Shift/Reassortment



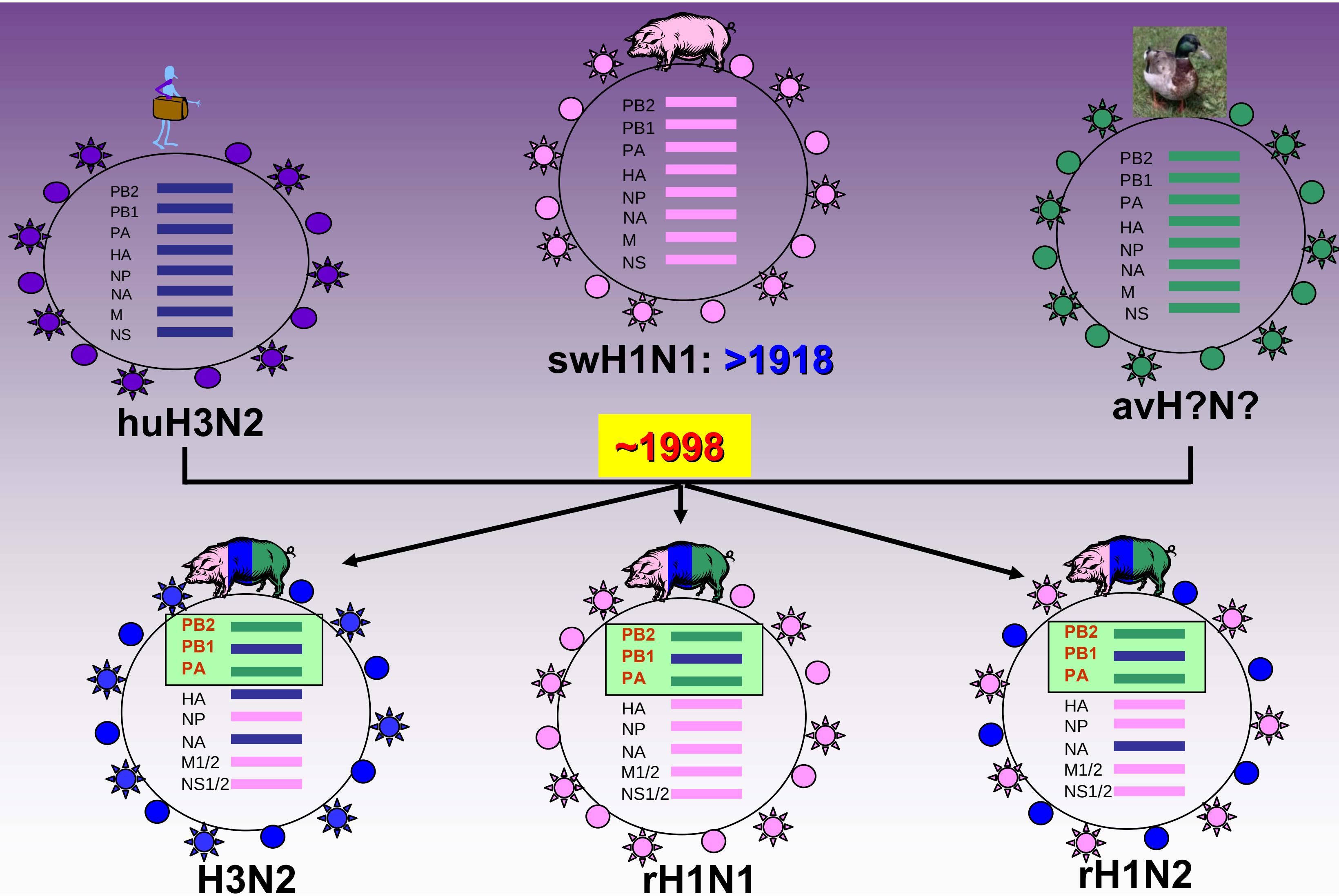
Swine as a host of Influenza Viruses

- Swine influenza is a worldwide endemic respiratory disease of pigs (except Australia?, Norway?)
- SIV first isolated in 1930 by Dr. R. Shope (Sw/IA/1930)
- Swine are uniquely susceptible to avian and mammalian viruses ("mixing vessel" for human/avian/swine influenza viruses)
- Influenza in swine similar to influenza in humans (good model - NHP?)
- Viruses sporadically pass between humans and swine

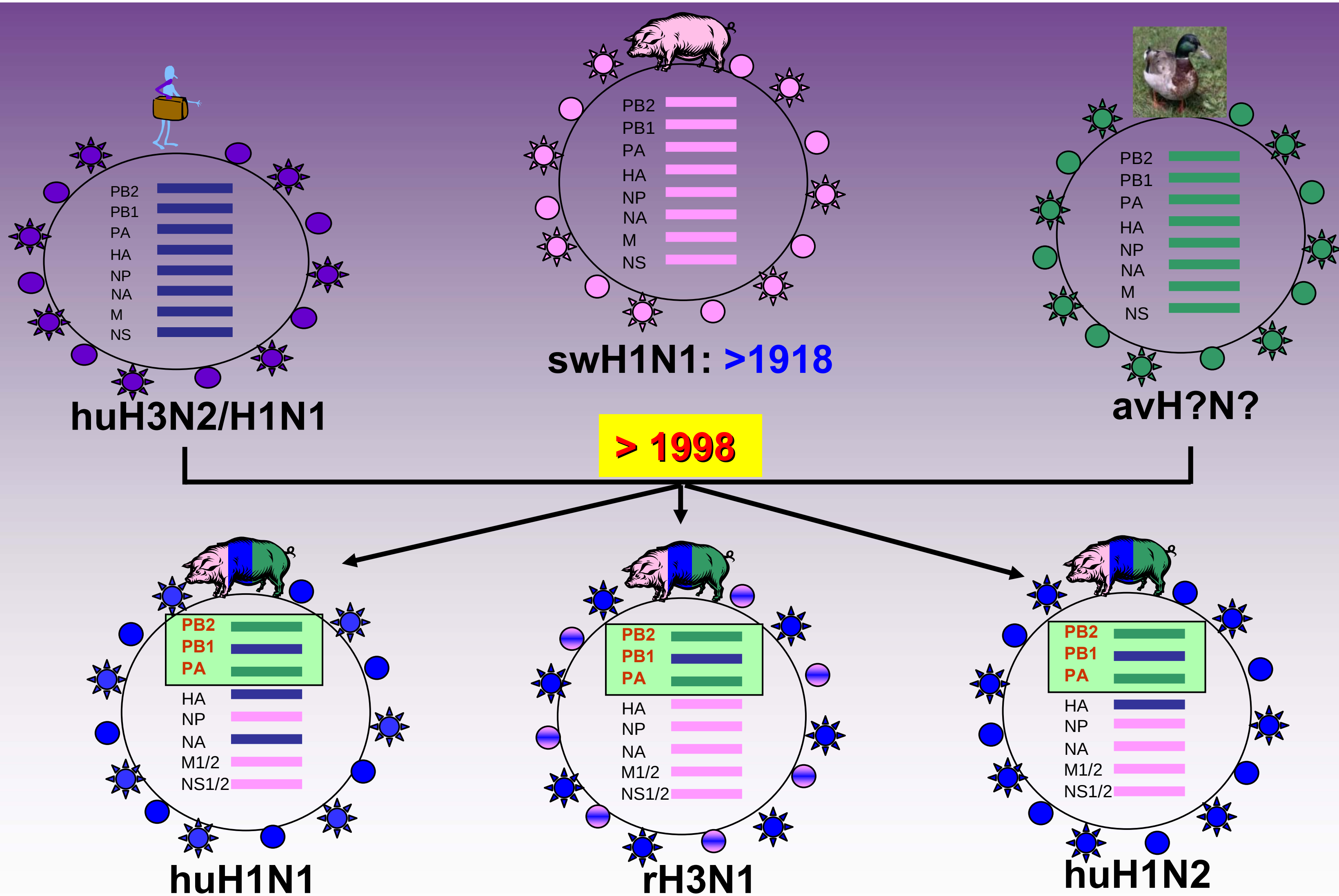
Epidemiology of North American SIVs



Reassortment Events in Swine Flu

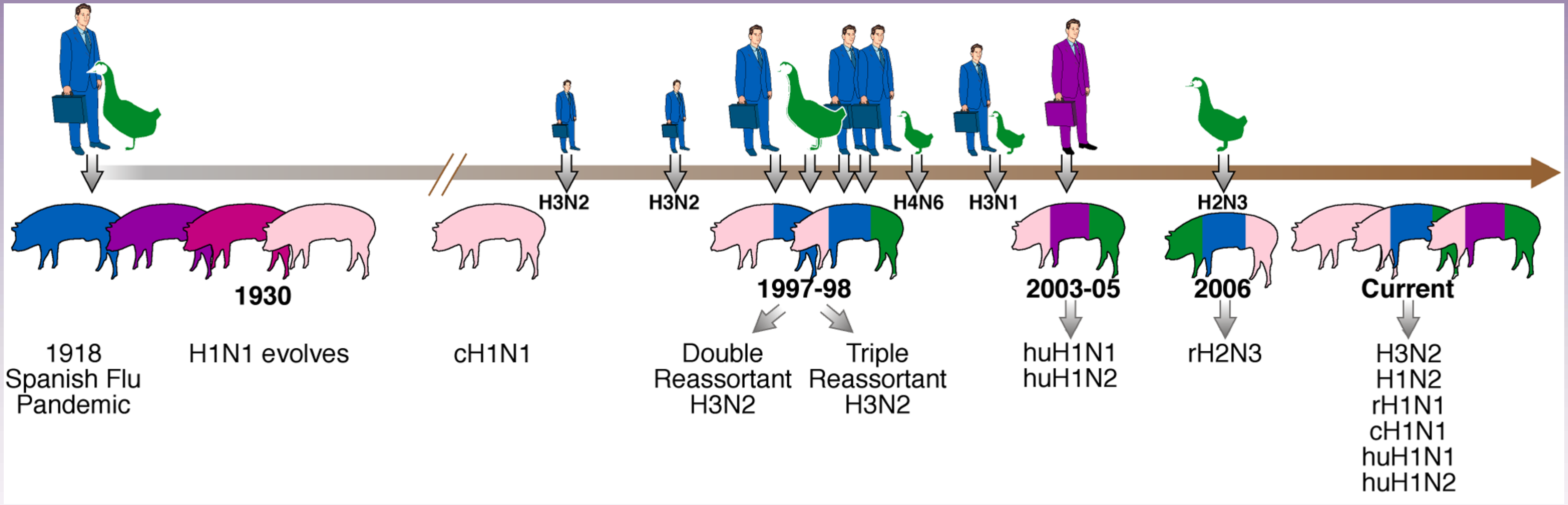


Reassortment Events in Swine Flu

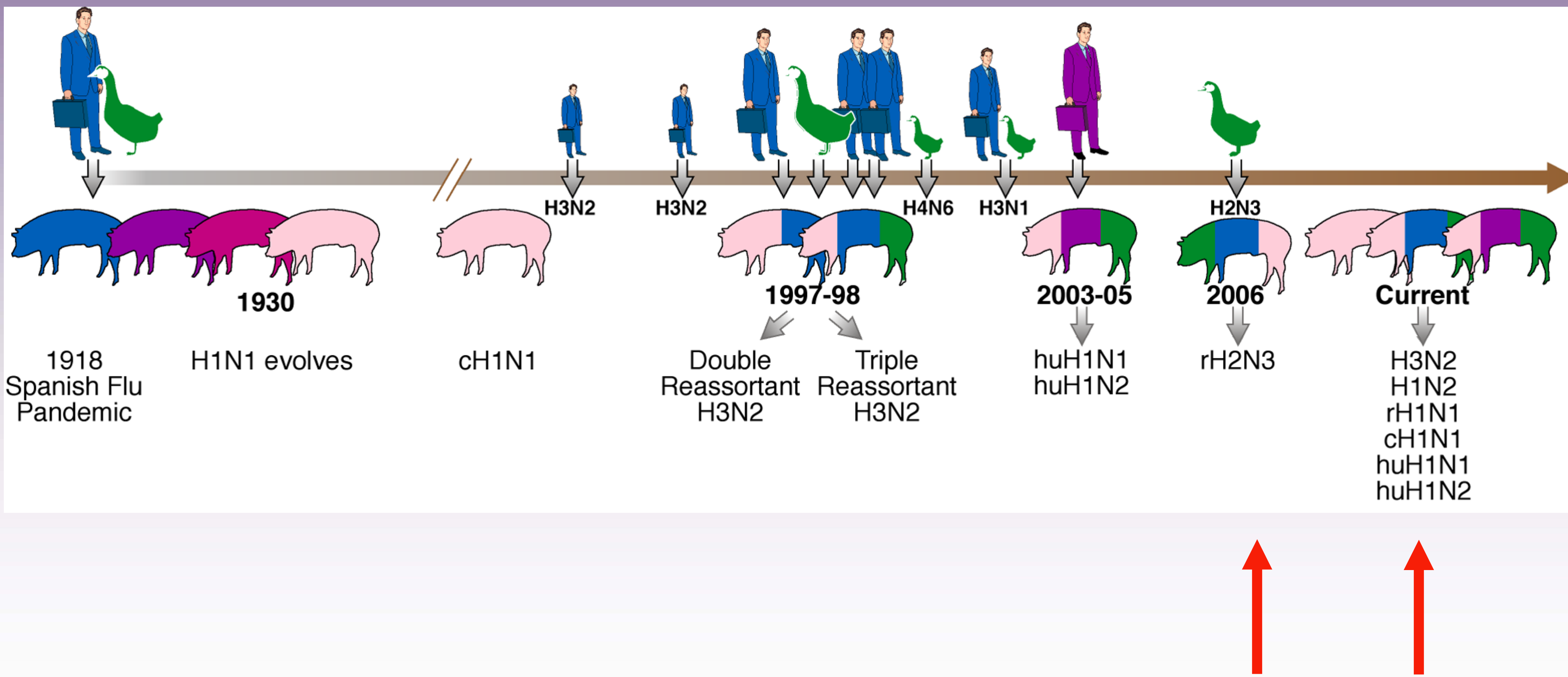


Avian/human polymerase complex plus swine genes: TRIG cassette

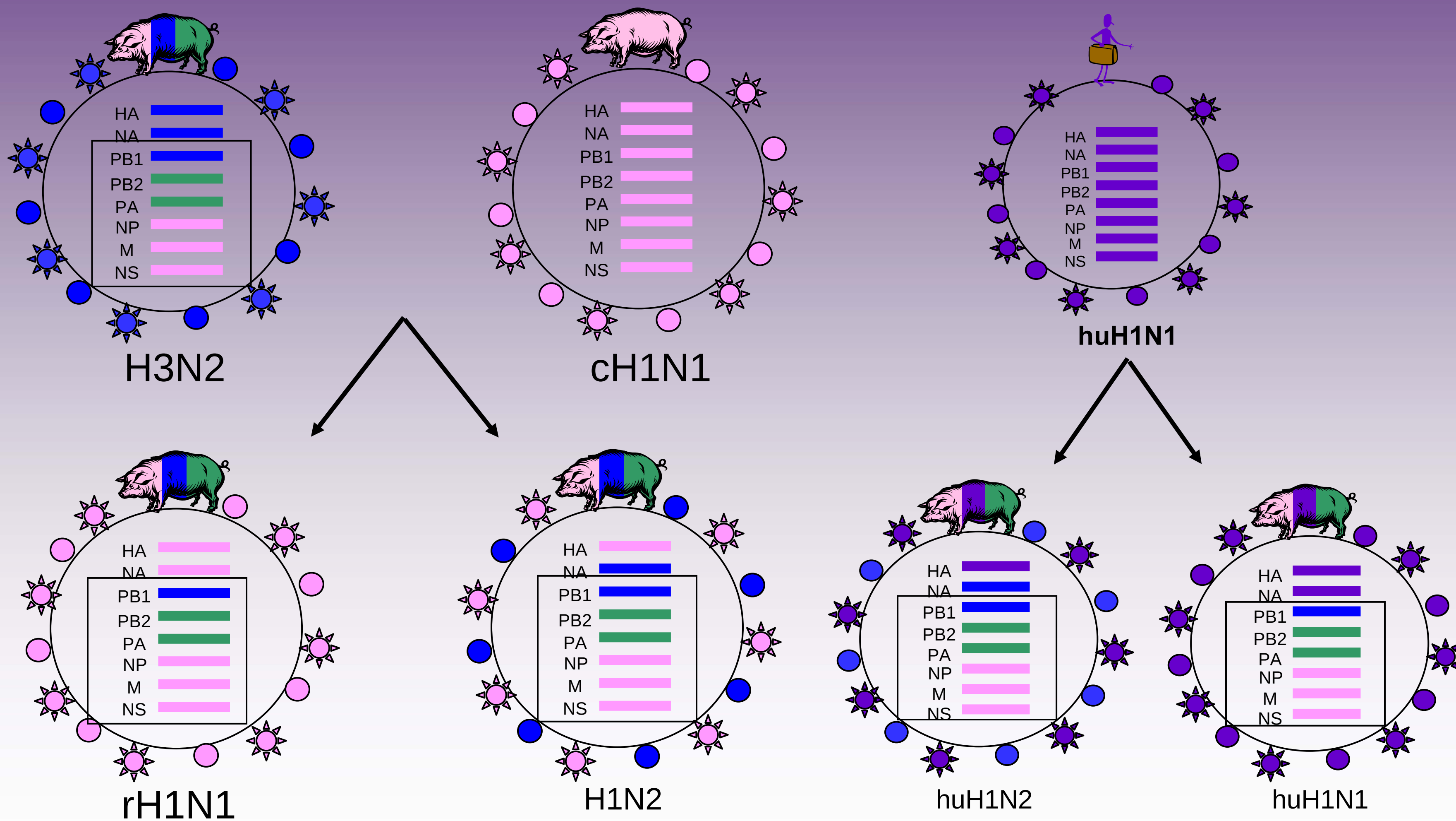
Epidemiology of North American SIVs



Epidemiology of North American SIVs

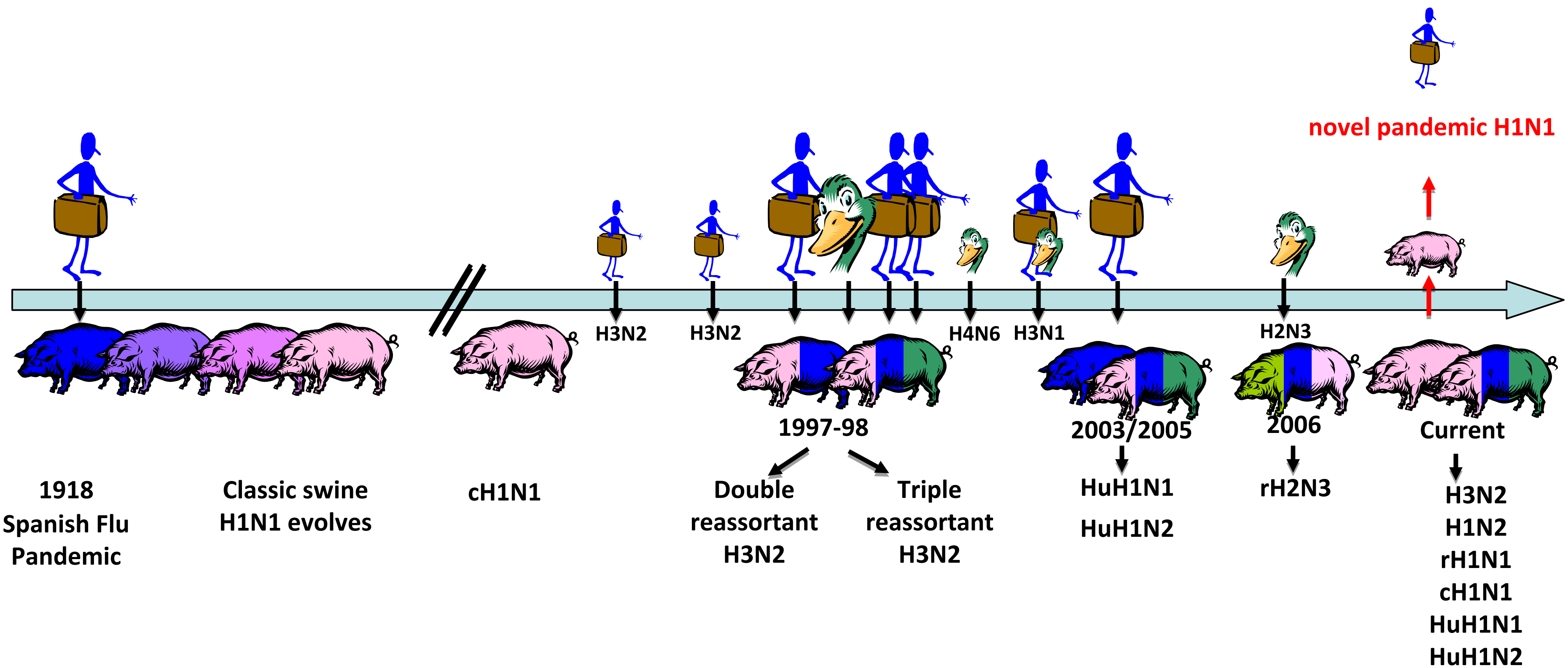


Circulating swine influenza viruses in the U.S.: mainly H1N1, H1N2 and H3N2

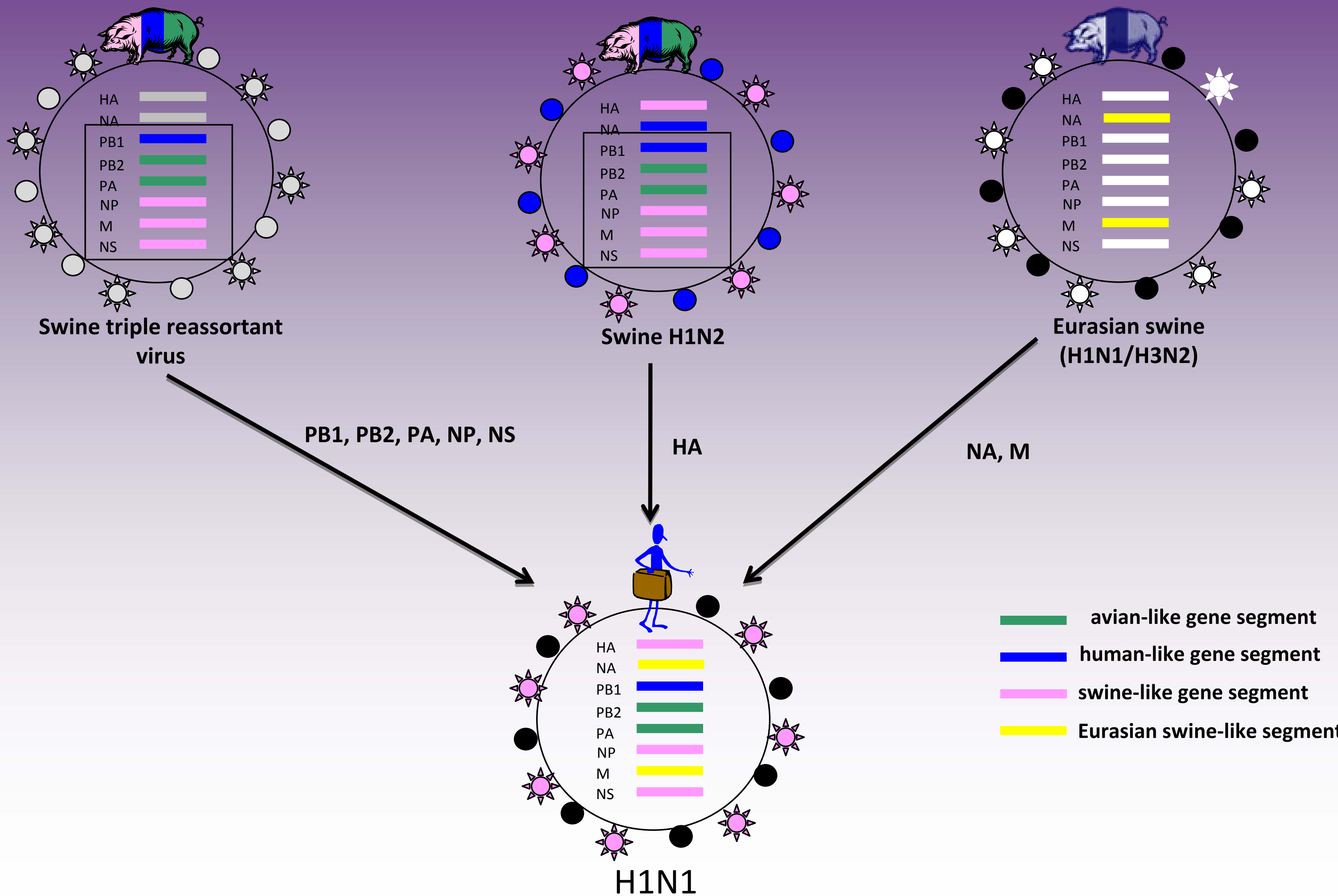


= triple reassortant viruses with avian/human polymerase genes

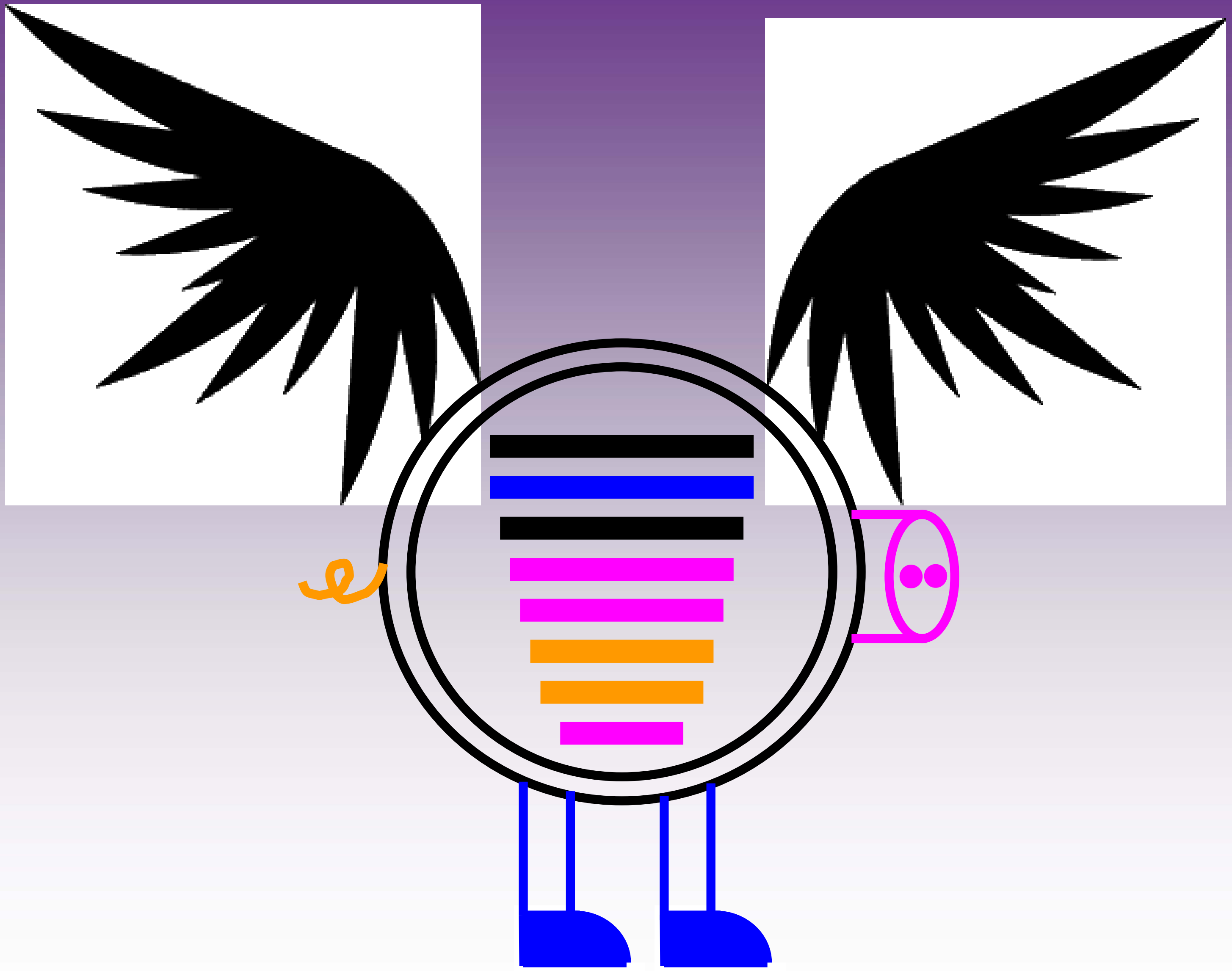
Swine Influenza in the U.S. in 2009



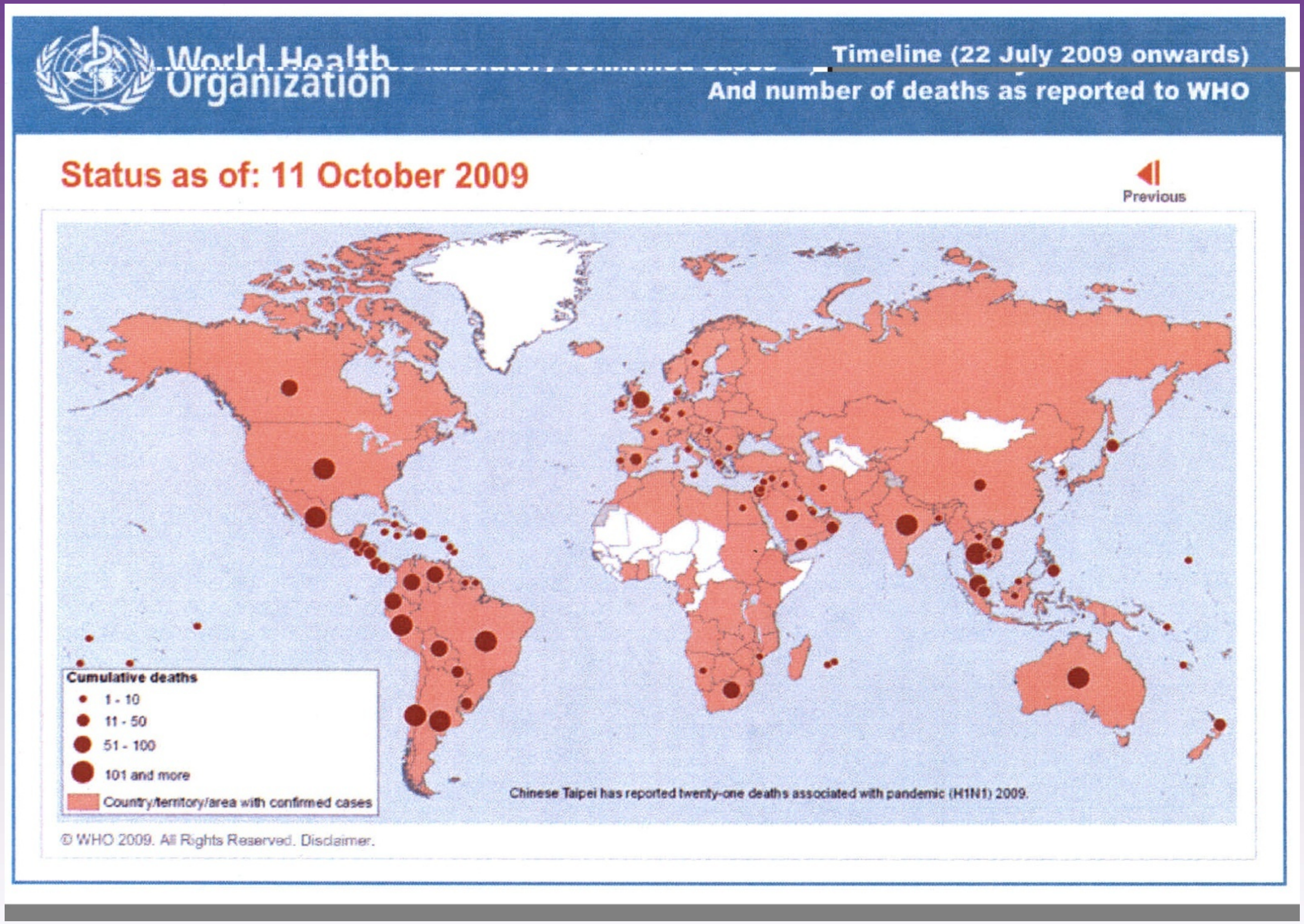
Genetic composition of novel pandemic H1N1



Swine origin flu



Current situation of pandemic H1N1 influenza worldwide



As of October 11. 2009, there have been more than 399,000 laboratory confirmed cases of pandemic influenza H1N1 worldwide and over 4,735 deaths reported to WHO.

Pandemic H1N1 virus isolated from non-human species

Human-animal Transmissions:
Pigs: Canada, Argentina, Australia, Singapore, Ireland, Norway, USA, Japan
Turkeys: Chile, Canada
Ferrets: USA

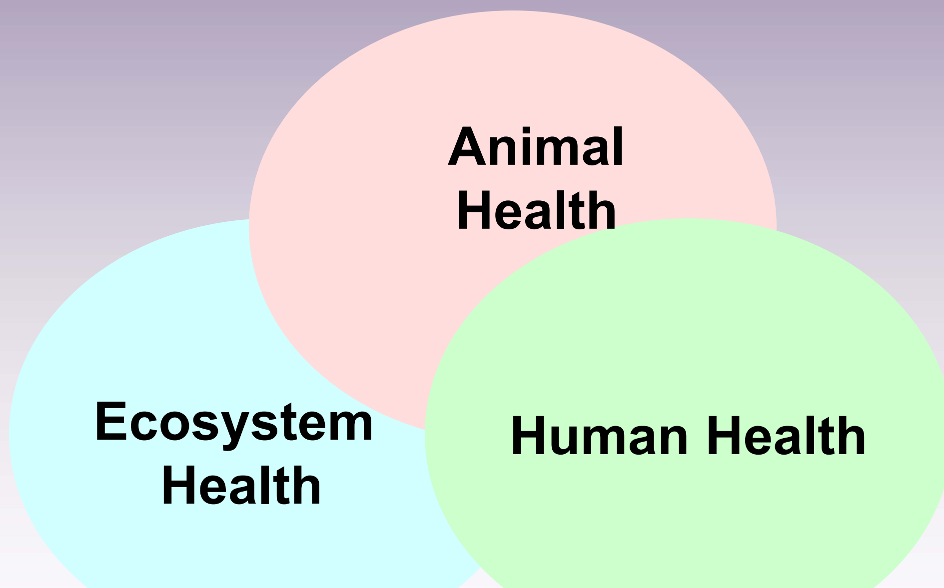
Experimental Infections: Ferrets, Mice, Monkeys, Pigs, Turkeys

Pandemic H1N1 virus:
- is able to infect and transmit among pigs
- potential of introduction and maintenance in swine herds is high

One Health, One Medicine, One World

Fact:

- ~60% of EID are zoonotic (majority wildlife origins)
- Effective surveillance and control requires **integration of human and animal populations worldwide**



Integration of human medicine and veterinary medicine improves the lives of all species - human and animal.

The veterinarian is the only health care professional likely to see both people and their animals.


Thank you!