Microbiology

Subject :

Lec no : 23

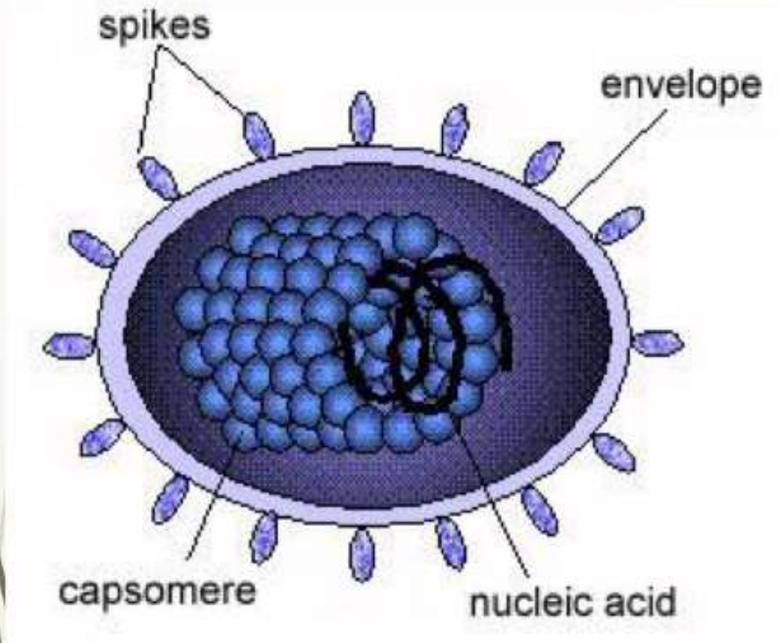
Done By : Tabark Aldaboubi

وقل رب زدني علما

28

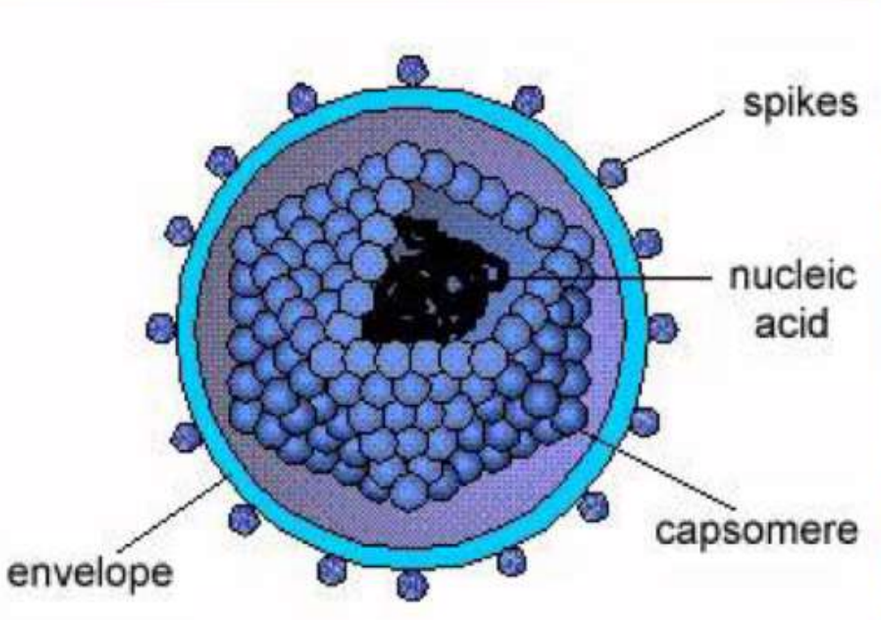
Enveloped helical virus

RNA



Enveloped icosahedral virus

RNA or DNA



Helical

(helical كونه RNA لحاد) helical امثلة ع ال

? California Encephalitis Virus
Coronavirus
Hantavirus
Influenza Virus (Flu Virus)
Measles Virus (Rubeola)
Mumps Virus
Para influenza Virus
Rabies Virus
Respiratory Syncytial Virus(RSV)

الاشي المشترك بينهم انه كلهم enveloped

Icosahedral

ليش الفيروس اللي بأثر على GIT بنفصل naked بيكون !!

Lipid bilayer بكون envelop ال

Acid اللي فيه GIT بالتالي اذا دخل على

وبرجع الفيروس يحطموا

naked ال

loss of envelop for envelop viruses

going to non infection virus

Spike فيها envelop ال انه حكينا *

Target cell على receptor ب اللي برتبطوا

protien وجود ال envelop ال مع

infected virus لل وهم جزء

(more resistance) naked ال *

heat من ناحية ال

(RNA or DNA ممكن تكون) Icosahedral

اقل ال

naked وبعضهم enveloped بعضهم

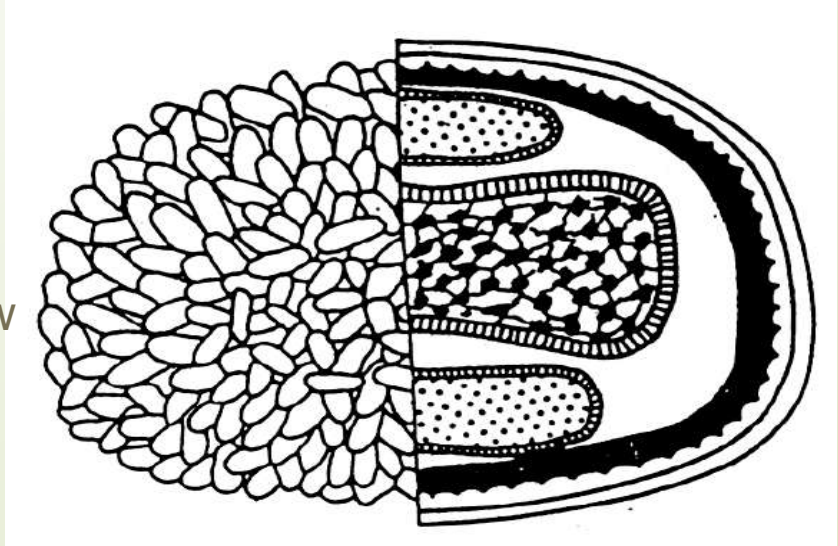
? Adeno-associated Virus (AAV)
2 Adenovirus
3 B19
4 Coxsackievirus - A
5 Coxsackievirus - B
6 Cytomegalovirus (CMV)
7 Eastern Equine
8 Encephalitis Virus (EEEV)
9 Echovirus
10 Epstein-Barr Virus (EBV)
11 Hepatitis A Virus (HAV)
12 Hepatitis B Virus (HBV)
13 Hepatitis C Virus (HCV)
14 Hepatitis Delta Virus (HDV)
15 Hepatitis E Virus (HEV)

? 16 Herpes Simplex Virus 1 (HHV1)
17 Herpes Simplex Virus 2 (HHV2)
18 Human Immunodeficiency Virus (HIV)
19 Human T-
20 lymphotrophic Virus (HTLV)
21 Norwalk Virus
22 Papilloma Virus (HPV)
23 Polio virus
24 Rhinovirus
25 Rubella Virus
26 Saint Louis
27 Encephalitis Virus
28 Varicella-Zoster Virus (HHV3)
29 Western Equine
30 Encephalitis Virus (WEEV)
31 Yellow Fever Virus

Complex viruses

- Have additional or special structures
- Examples:
- Poxviruses – lack normal capsid – instead, layers of lipoprotiens and fibrils on surface

Complex بشوف الـ
بس بهاي الحالة



surface view

cross section

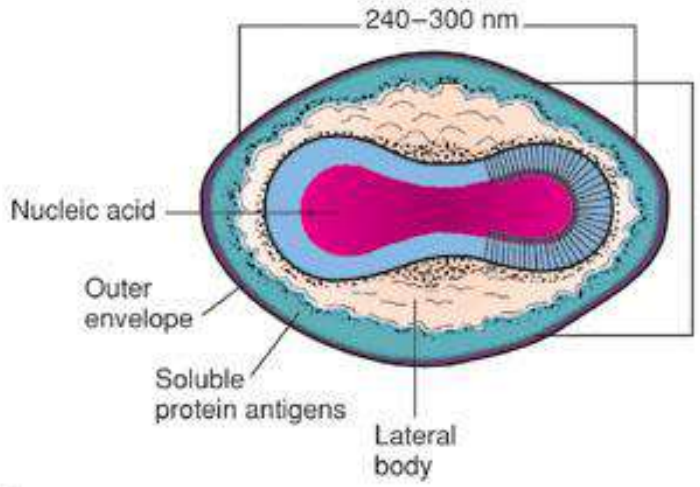
A bacteriophage

* Virus that infect bacteria

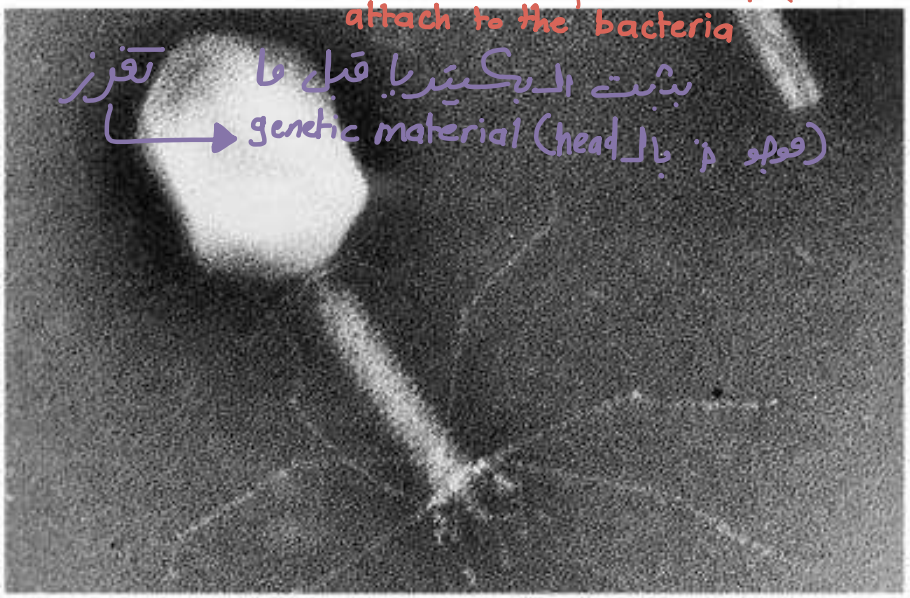
الدكتور * ذكر هاي النقطة بس

? A bacteriophage is any one of a number of viruses that infect bacteria. They do this by injecting genetic material, which they carry enclosed in an outer protein capsid. The genetic material can be ssRNA, dsRNA, ssDNA, or dsDNA ('ss-' or 'ds-' prefix denotes single-strand or double-strand) along with either circular or linear arrangement.

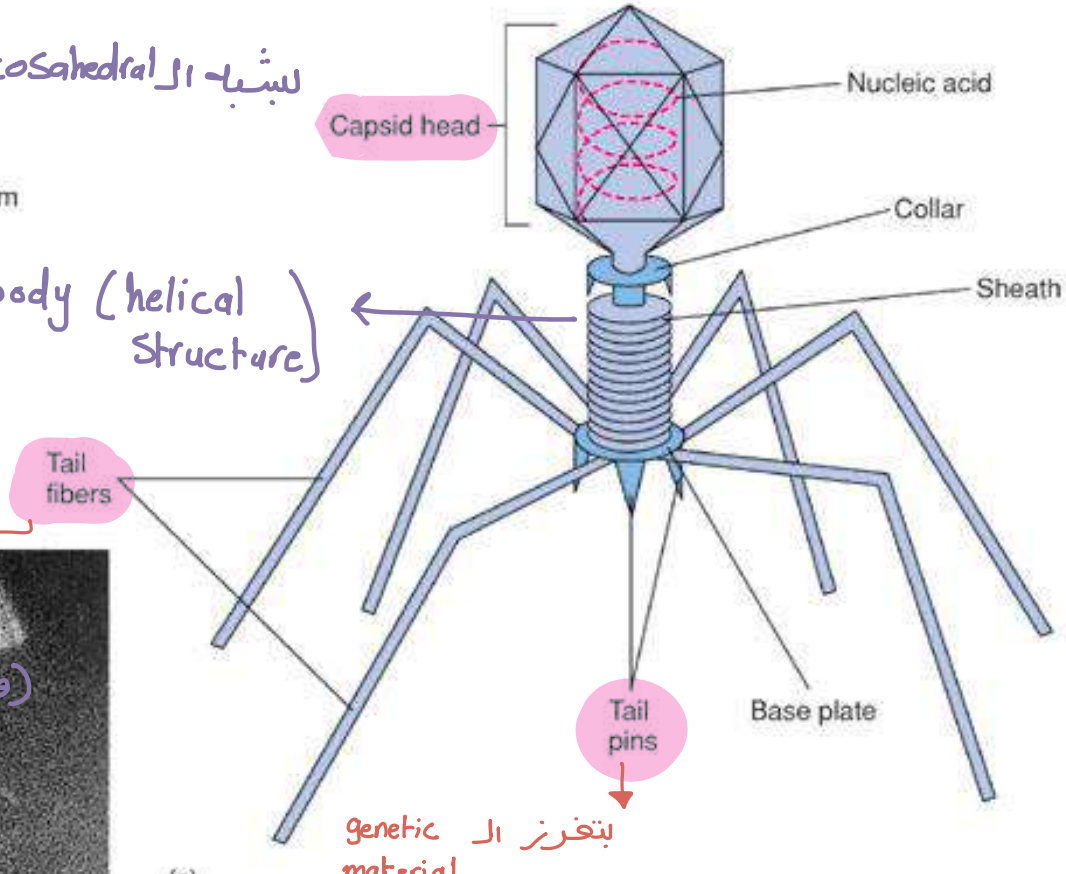
Phage - viruses have a polyhedral head, helical tail and fibers for attachment.



(a)



(b)



(c)

Icosahedral للشبه ال

body (helical structure)

attach to the bacteria ← بتستخدمهم

بثبت البكتيريا قبل ما تفرز genetic material (head موجود في ال)

genetic material بتخزن ال

تاعتها بالبكتيريا

Classification of viruses

- Nucleic acid DNA / RNA
- Capsid icosahedral / helical / complex
- Presence of envelope naked / enveloped
- Replication strategy

عددها الدكتور 7 لـ

8 diffrent replication strategy:

→ certien replication strategy belong to only one virus
other strategy are share by more than one virus

* ممكن تساعدكم فهم الفكرة من تفريغ برجس

رح نفصل فيهم لقدام ↑

CLASSIFICATION NUCLEIC ACID

- RNA or DNA

genome of the virus has multible piece   قطعة واحدة

- segmented or non-segmented

هل ال genetic material هل قطعة واحدة ام مقطعة اكثر من جزء

Fragmented   one piece

- linear or circular

- single-stranded or double-stranded   كل ال DNA virus عبارة عن double ماعدا Parvo virus → single

- if single-stranded RNA

بس بال RNA نوع واحد. عند ال double هو ال Rota Virus و الباقي single

بنحكيين عنهم لقدام.

+ sens
- sens

• is genome mRNA (+) sense or complementary to mRNA (-) sense

(+) → going to ribosome and synthesis protein

sense → شحنة ال RNA

→ (-) : dosen't have the ability to go directly to the ribosome

Produce the new cell membran

ENVELOPE

بالعادة بيجي من ال Target cell

one virus exit the cell is going to aquir part of the cellular membran exit from the target cell as envelope

OBTAINED BY BUDDING THROUGH A CELLULAR MEMBRANE (except poxviruses)

POSSIBILITY OF EXITING CELL WITHOUT KILLING IT

CONTAINS AT LEAST ONE VIRALLY CODED PROTEIN Spikes or glycoprotein

- ATTACHMENT PROTEIN

LOSS OF ENVELOPE RESULTS IN LOSS OF INFECTIVITY

Like GI tract Acidity

Properties of naked viruses

Stable in hostile environment

Can be damage but can tolerate higher dose of disinfectant

Not damaged by drying, acid, detergent, and heat

Released by lysis of host cells

Lysis بطلع مرة وحدة لما يقل

Can sustain in dry environment

Can infect the GI tract and survive the acid and bile

enveloped بتحلل ال acidity ال

Can spread easily via hands, dust, fomites, etc

naked higher than envelope

Can stay dry and still retain infectivity

Neutralizing mucosal and systemic antibodies are needed to control the establishment of infection

سواء naked or envelop

Antibodies generat against the viral protien

* outer part of the virus: (glycoprotein , spike) → على الانسجال مع Immune system

Antibodies going to bind with glycoprotein (target مفروض يرتبطوا مع حتى يدخل الفيروس جوا الخلية

glyco مع Anti فلما ترتبط ال بتمنع الفيروس يدخل لجوا

route of infection →

Icosahedral

all of these enter through oral

Naked viruses(Non-Enveloped)

? Adeno-associated Virus (AAV)
Adenovirus DNA
B19 DNA
Coxsackievirus - A RNA
Coxsackievirus - B RNA
Echovirus RNA
Hepatitis A Virus (HAV) RNA
Hepatitis E Virus (HEV) RNA
Norwalk Virus RNA

The Baltimore classification system

Based on genetic contents and replication strategies of viruses. According to the Baltimore classification, viruses are divided into the following seven classes:

1. dsDNA viruses ← DNA virus
2. ssDNA viruses ← Bravo virus
3. dsRNA viruses ← Rota
4. (+) sense ssRNA viruses (codes directly for protein)
5. (-) sense ssRNA viruses
6. RNA reverse transcribing viruses ← HIV
7. DNA reverse transcribing viruses ← hepatitis B

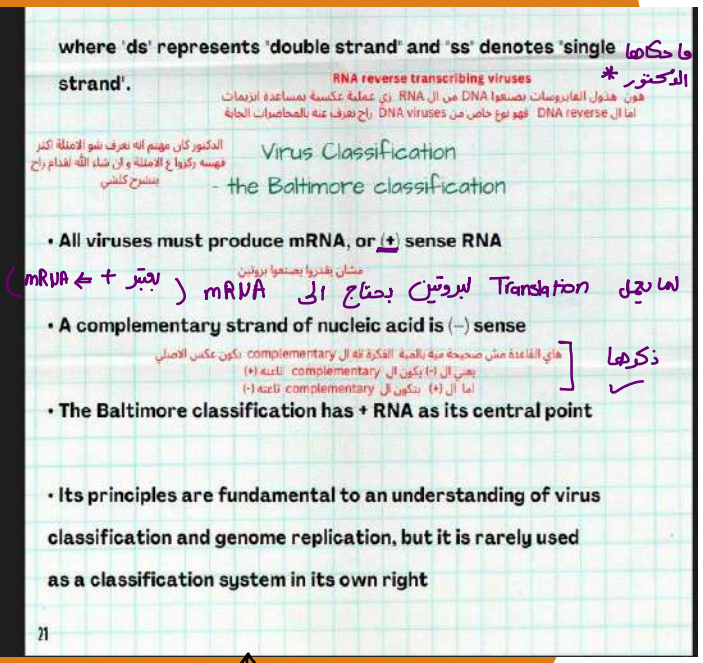
(4,5) → share more than one type of virus

Unique type For one type of virus

↳ Partial double strand DNA virus

where "ds" represents "double strand" and "ss" denotes "single strand".

Virus Classification - the Baltimore classification



- ? All viruses must produce mRNA, or (+) sense RNA
- ? A complementary strand of nucleic acid is (–) sense
- ? The Baltimore classification has + RNA as its central point
- ? Its principles are fundamental to an understanding of virus classification and genome replication, but it is rarely used as a classification system in its own right

herpes
hepatitis B
Papeloma
Pyloma
Pox
parvo

DNA (7) = 2h, 4p, 1a
adeno

Papeloma Pyloma
انقسمت

Viral genome strategies

- ? dsDNA (herpes, papova, adeno, pox)
- ? ssDNA (parvo)
- ? dsRNA (reo, rota)
- ? ssRNA (+) (picorna, toga, flavi, corona)
- ? ssRNA (-) (rhabdo, paramyxo, orthomyxo, bunya, filo)
- × ? ssRNA (+/-) (arena, bunya)
- ? ssRNA (+RTase) (retro, lenti)

فش كلهم حفظ
في شغلات common رح
يتركزوا لقدام

* فارح نحكي عنه . (+) وجزء (-) منه ← نفس الجينوم بكون جزء ampesens

في شغلات مشتركة بينهم وبين الفيروسات
بس هما مش فيروسات

Sub-viral agents

infect the plante

hepatitis B and the certain point of time infected (hepatitis D)

in top of hepa B → super infection

Satellites

- Contain nucleic acid
- Depend on co-infection with a helper virus
- May be encapsidated (satellite virus)
- Mostly in plants, can be human e.g., hepatitis delta virus (delta agent)
- If nucleic acid only = virusoid

Single virus ك ما بتصيب الانسان ممكن تصيبوا virus عن طريق ناقي بنفس الوقت مثل Hepatitis B

Viroids

capsid ما عندها

- Unencapsidated, small circular ssRNA molecules that replicate autonomously
- Only in plants, e.g., potato spindle tuber viroid
- Depend on host cell polII for replication, no protein or mRNA

Prions

- No nucleic acid
- Infectious protein e.g., BSE

protein only infectious agent

Viroids & Prions

Viroids

- ss RNA genome and the smallest known pathogens.
- Affects plants

Prions

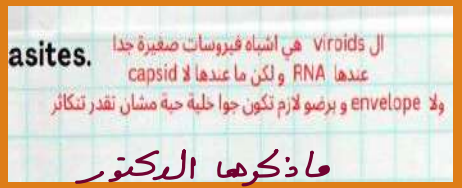
بصيب اكثر من خلية مش بس الاعصاب

- Infectious particles that are entirely protein.
- No nucleic acid
- Highly heat resistant
- Animal disease that affects nervous tissue
- Affects nervous tissue and results in
  - Bovine spongiform encepahltits (BSE) "mad cow disease"
  - scrapie in sheep
  - kuru & Creutzfeld-Jakob Disease (CJD) in humans

معلومة من تقرير برجس (الدكتورة محاها)
اي شخص عنده PRions وبعملوله عملية جراحية لازم يتخلصوا من الادوات بسبب
spongi form Pathology
بقري
جنون البقر
infect CNS
توضيح الفكرة فقط

Viroids

احكينا عنها ما بدنا نحكي اكثر
من هيك !! كلام الدكتور



- Viroids are small (200-400nt), circular RNA molecules with a rod-like secondary structure which possess no capsid or envelope which are associated with certain plant diseases. Their replication strategy like that of viruses - they are obligate intracellular parasites.
- Viroids do not encode any proteins and unlike satellites they are not dependent on the presence of another virus

ماذكرها الدكتور
(بتساعدكم بتوضيح الفكرة)

Viroid replication

- Viroids utilize cellular RNA polymerases for their replication
- Replication is performed by "rolling circle mechanism"
- The resulting long RNA molecule is cut in pieces and ligated either autocatalytically or by cellular factors (depending on a viroid)
- So in a sense, at least some viroids are ribozymes...

- Examples of plants, infected with various viroids

Hepatitis δ virus – a chimeric molecule, half viroid, half satellite

? Viroid like properties

- Rod-like RNA molecule
- Rolling circle replication
- Self-cleaving activty

? Satellite like properties

- Encodes a protein, which is necessary both for encapsidation and replication
- Dependent on presence another virus – HBV
- Genome larger than for viroids (1640 nt)

It is abnormal protein or infection ⇒ True

Prions

وبكن هي موجودة بشكل طبيعي بالجسم

بين Normal on or body ← بختلفو بالstructure

infectious agent ← اللي تعتبر

? Prions are rather ill-defined infectious agents believed to consist of a single type of protein molecule with no nucleic acid component. Confusion arises from the fact that the prion protein & the gene which encodes it are also found in normal 'uninfected' cells. These agents are associated with diseases such as Creutzfeldt-Jakob disease in humans, scrapie in sheep & bovine spongiform encephalopathy (BSE) in cattle.

- **Prions**

- Prions are proteinaceous transmissible pathogens responsible for a series of fatal neurodegenerative diseases (in humans, Creutzfeld-Jakob disease and kuru, in animals, bovine spongioform encephalopathy)

- A prion (**pro**teinaceous **in**fectious particle, analogy for virion) is a type of infectious agent that does not carry the genetic information in nucleid acid!

- Prions are proteins with the pathological conformation that are believed to infect and propagate the conformational changes of the native proteins into the the abnormally srtructured form

تلخيص انه كيف abnormal بقلب infectious disease !!

* عن طريق direct contact

كيف بيتحول ال normal الى abnormal

Disease name	Natural host	Prion name	PrP isoform
Scrapie	Sheep, goat	Scrapie prion	$OvPrP^{Sc}$
Transmissible mink encephalopathy (TME)	Mink	TME prion	$MkPrP^{Sc}$
Chronic wasting disease (CWD)	Elk, mule deer	CWD prion	$MDePrP^{Sc}$
Bovine spongioform encephalopathy (BSE)	Cattle	BSE prion	$BovPrP^{Sc}$
Feline spongioform encephalopathy (FSE)	Cat	FSE prion	$FePrP^{Sc}$
Exotic unguale encephalopathy (EUE)	Greater kudu, nyala	EUE prion	$NyaPrP^{Sc}$
Kuru	Human	Kuru prion	$HuPrP^{Sc}$
Creutzfeldt-Jakob disease (CJD)	Human	CJD prion	$HuPrP^{Sc}$
Gerstmann-Straussler-Scheinker syndrome (GSS)	Human	GSS prion	$HuPrP^{Sc}$
Fatal familial insomnia (FFI)	Human	FFI prion	$HuPrP^{Sc}$

human الي الهم علاقة بال

هي الي بتهمنا

- **Prion diseases: rare neurodegenerative disorders** (one person per million)

Causes :

- **1. Sporadic** (85 %) spontenous mutation
- In the sixth or seventh decade, rapidly progressive (death in less than a year)
- Creutzfeldt-Jakob disease (CJD)

- **2. Familial** (inherited-15%)
- Mutations in the PrP gene that favour the transition from the cellular form to the pathological form of PrP → اذا متبوع بـ c بكون abnormal // اذا متبوع بـ sc normal
- Gerstmann-Straussler-Scheinker disease (GSS), fatal familial insomnia (FFI)

→ in certain Family

- **3. Transmissible** (rare; a source of great concern)
- Propagation of kuru disease in New Guinea natives (ritualistic cannibalism)
- Recently, it has been discovered that BSE had been transmitted to humans in Europe after consumption of infected beef, producing a variant of the CJD called vCJD

Kuru

* لما يموت الشخص بطلعوا مخه ويعملوا عليه شوربة

هاي الشغلة كانت تسبب مرض kuru

highly resistance بصير ⇐ abnormal الى normal من يتحول بس
to heat and infection

Transmissible spongioform encephalopathy (TSE)=prion disease

A group of progressive conditions that affect the brain and nervous system of humans and animals and are transmitted by prions

spongioform

The pathology: vacuolar degeneration, neuronal loss, astrocytosis and amyloid plaque formation

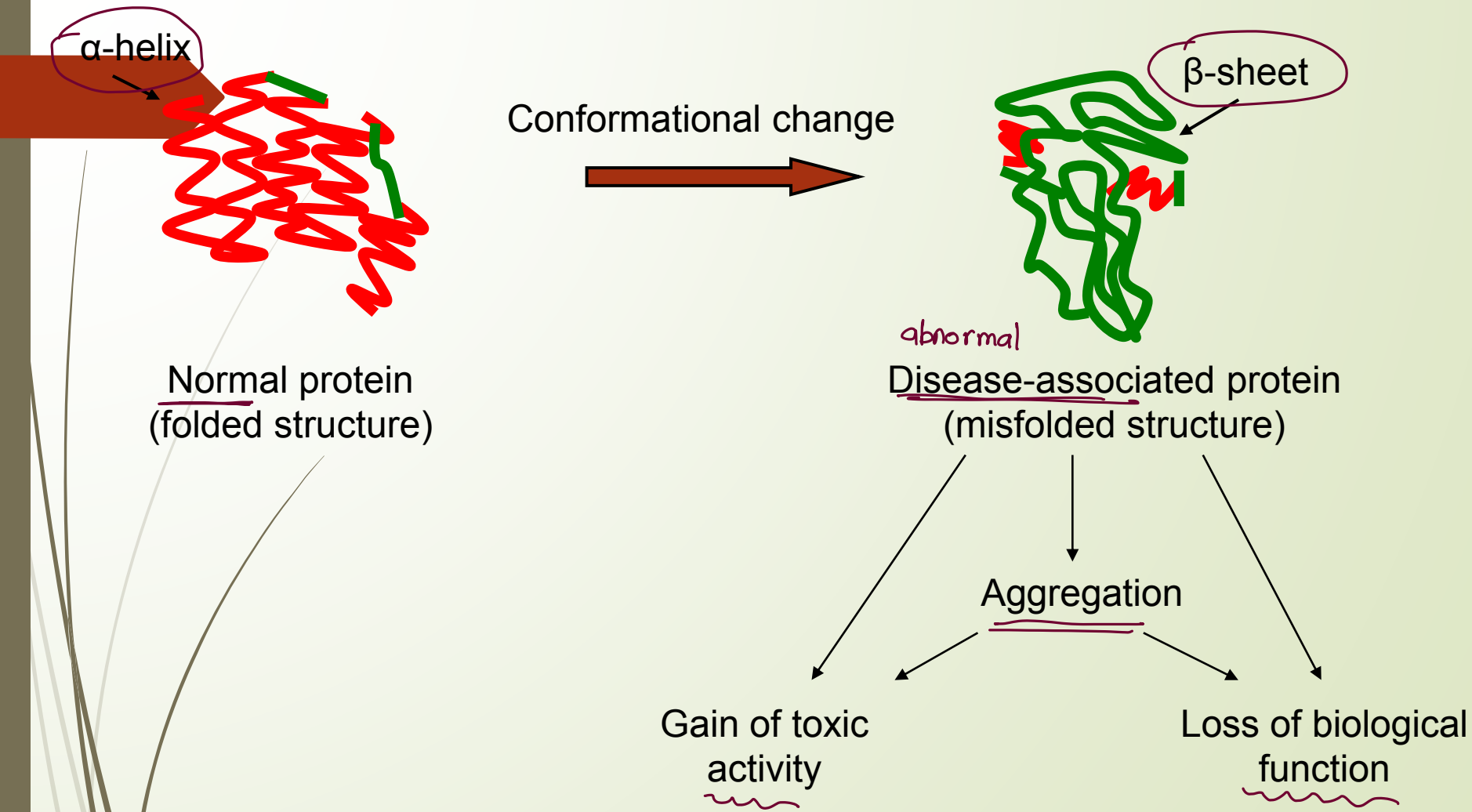
لأنو لها يتحول من abnormal الى normal بحسب وظيفتها
non functional

going to form aggregate (platelet)

The clinical signs: loss of motor functions (lack of coordination, ataxia, involuntary jerking movements), personality changes, depression, insomnia, confusion, memory problems, dementia, progressive tonic paralysis, death

Definitive diagnostic test: biopsy of brain tissue (histopathological examination and immunostaining for PrP^{Sc})

There is no cure جهاز المناعة ما بتعرف عليه ابدا
فما اله علاج


α-helix
Conformational change
β-sheet
abnormal
Normal protein
(folded structure)
Disease-associated protein
(misfolded structure)
Aggregation
Gain of toxic
activity
Loss of biological
function

PrP^{C}	PrP^{Sc}
The normal protein	The abnormal, disease-producing protein
is called PrP^{C} (for cellular)	is called PrP^{Sc} (for scrapie)
is a transmembrane glycoprotein (neurons, lymphocytes); its function is unknown; it binds Cu^{2+} (regulation its homeostasis)	has the same amino acid sequence (primary structure)
has dominant secondary structure α-helix	has dominant secundary structure β-sheets
is easily soluble	is insoluble
is monomeric and easily digested by proteases	is multimeric and resistant to digestion by proteases
is encoded by a gene designated PRNP located on the chromosome 20	When PrP^{Sc} comes in contact with PrP^{C}, it converts the PrP^{C} into more of itself These molecules bind to each other forming aggregates

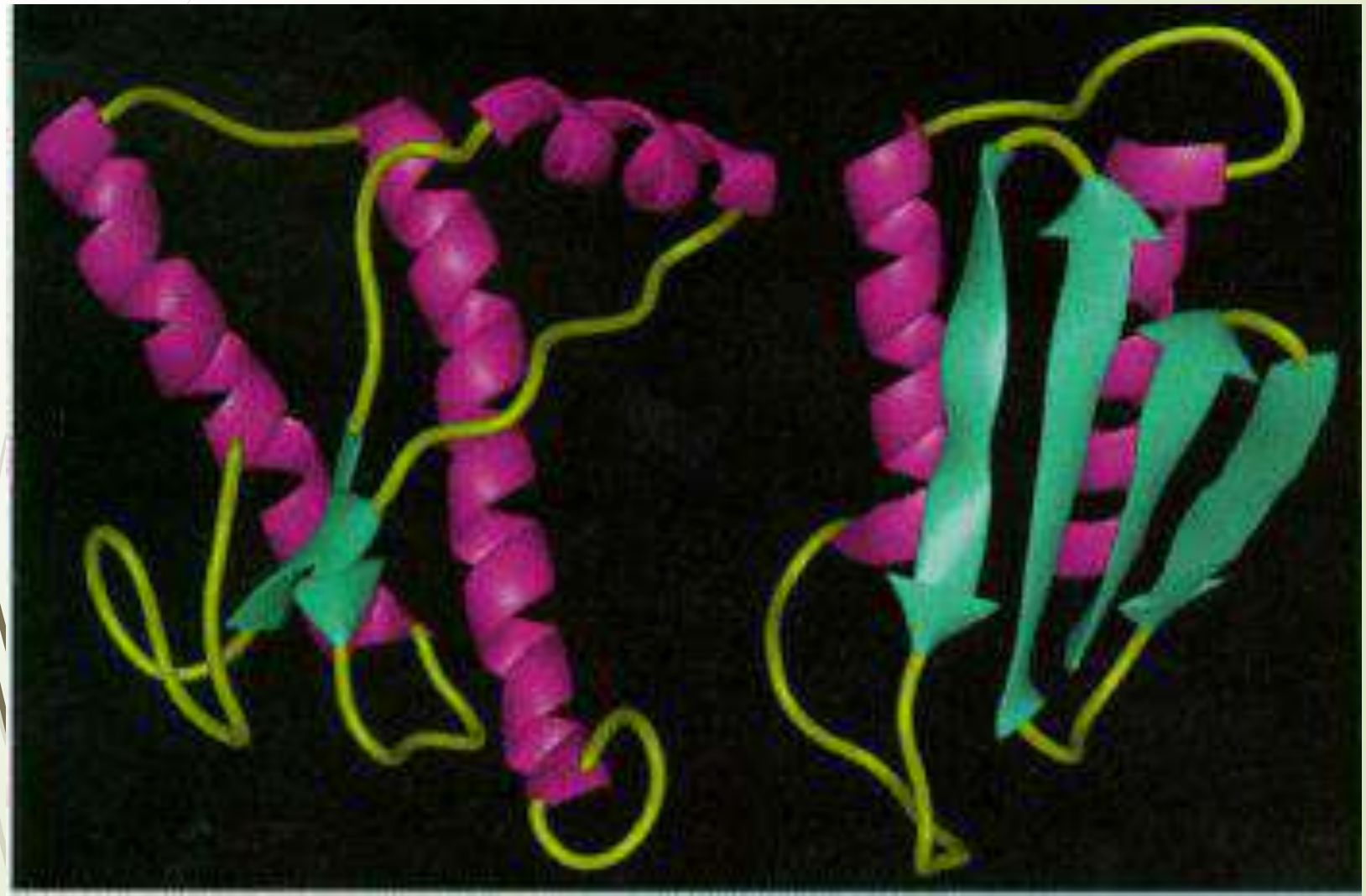
Molecular models of the structure of:

PrP^{C} normal

Predominantly α-helix (3)

abnormal **PrP^{Sc}**

β-sheets (40%), α-helix (30%)

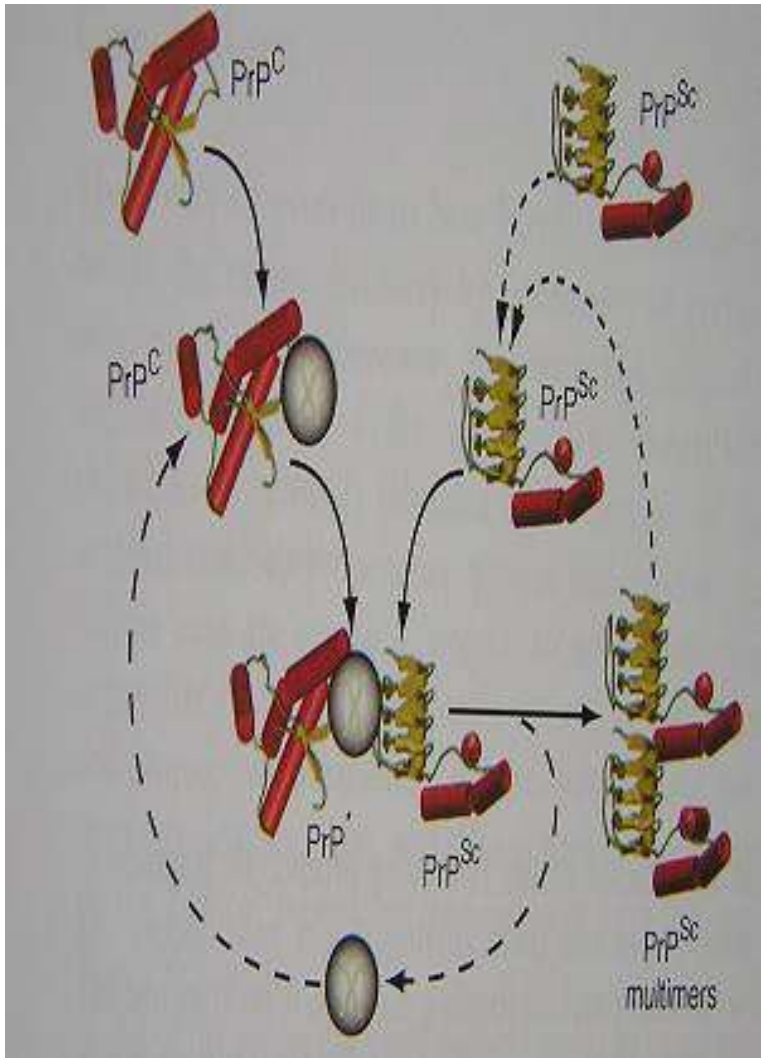


بتحول (α) على (β) Abnormal بس تقرب ال

β ال

- **Replication cycle**

- The presence of an initial PrP^{Sc}: exogenous (infectious forms) or endogenous (inherited or sporadic forms)
- This first prion will initiate PrP^{Sc} accumulation by sequentially converting PrP^{C} molecules into PrP^{Sc} in replication cycle
- PrP^{Sc} molecules aggregate



Summary

The prions are proteins that carry information for self-reproduction (contradict the central dogma of modern biology)

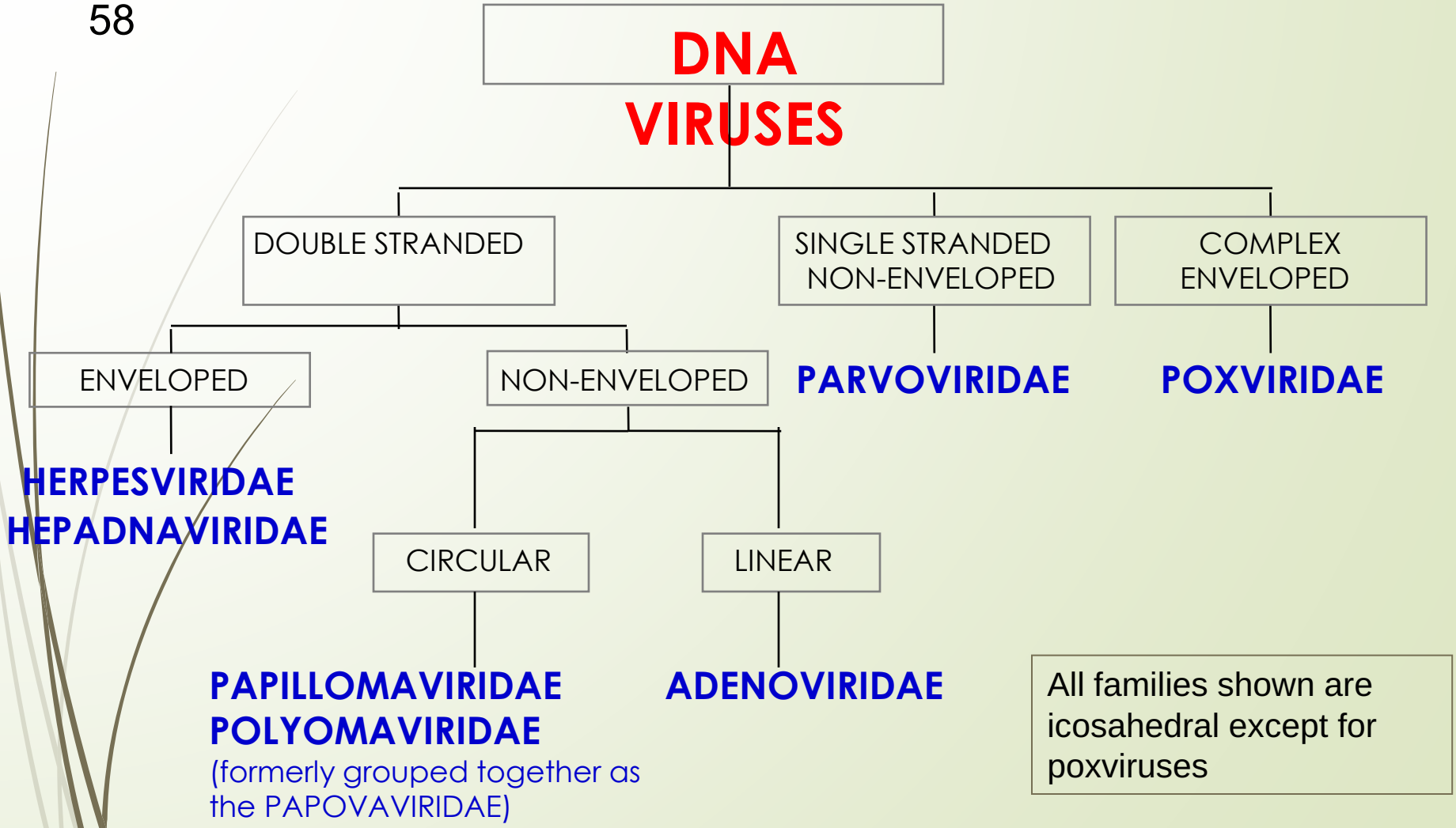
The prions are expressed in cells of healthy humans and animals; their abnormal conformations (PrP^{Sc}) are insoluble, resistent to digestion and aggregate

The PrP^{Sc} attacks the native prion PrP^{C}, changes its conformation into an abnormal form and causes an exponential production of insoluble proteins; they aggregate and form the fibrillar structure

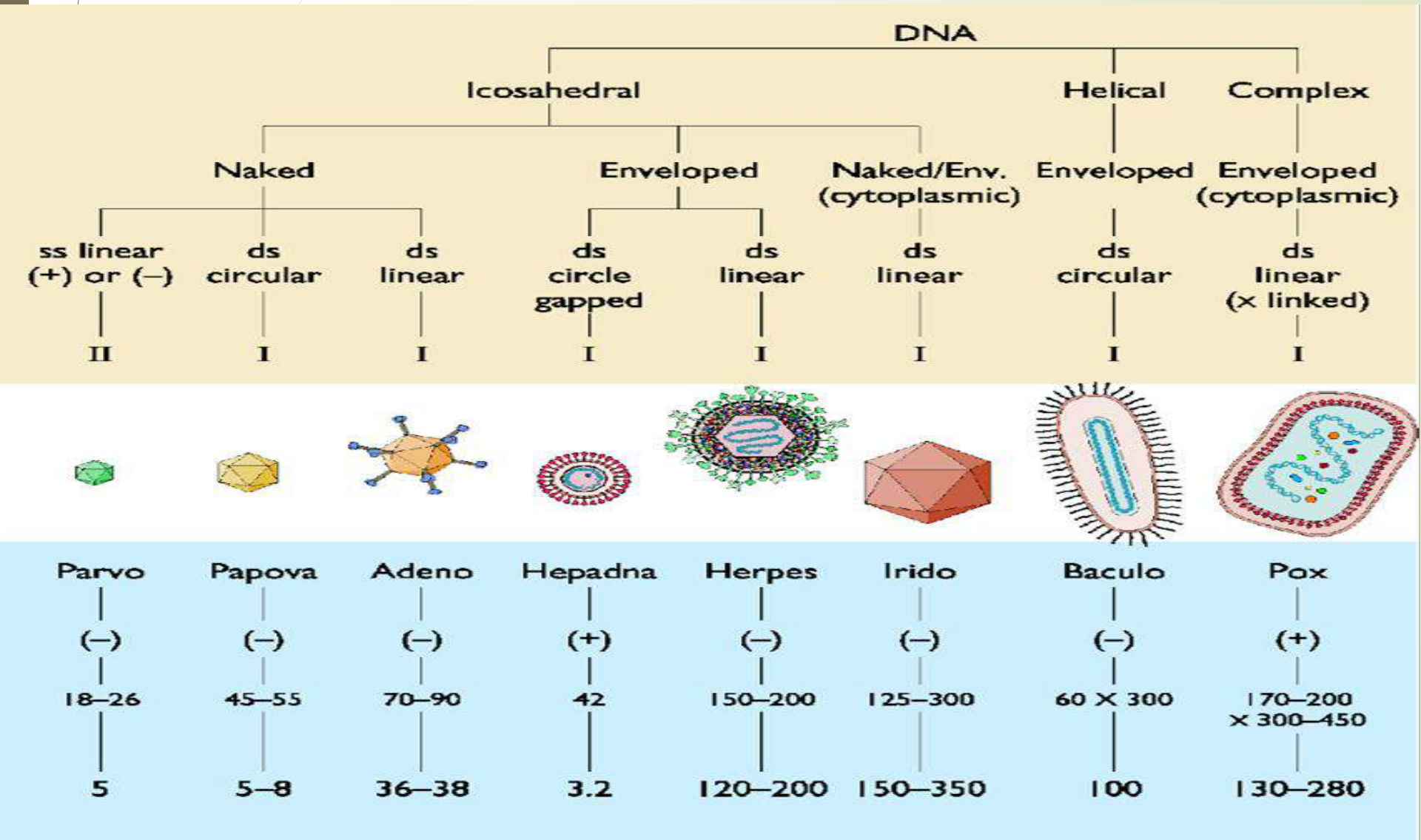
Prion disease are rare fatal degenerative disorders; a portion of them can be transmitted; this mechanism is not clear (e.g. transmision of BSE to human)

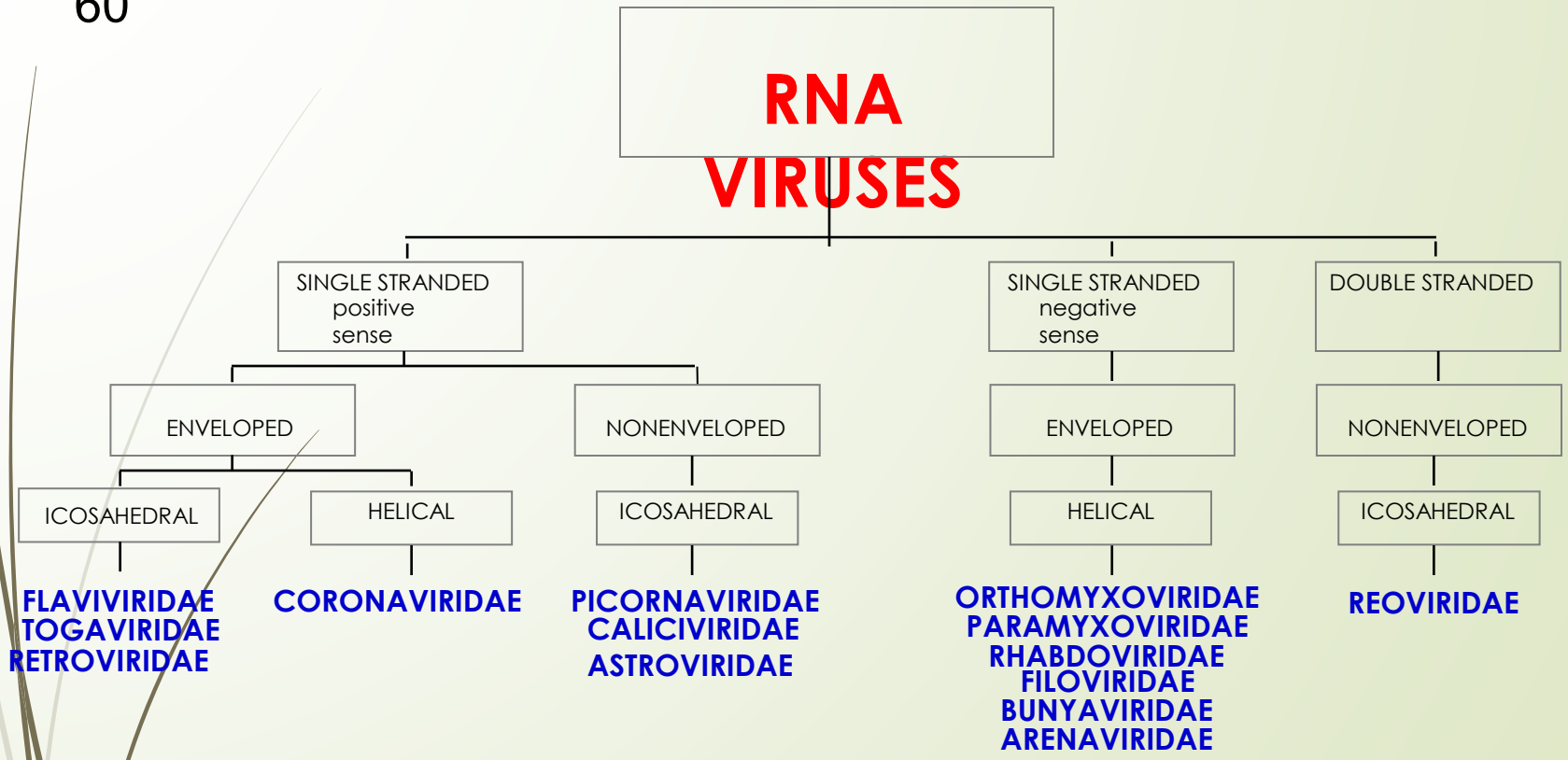
One part of the prion protein can cause apoptosis, or programmed cell death

Prions induce no immune reactions within the human

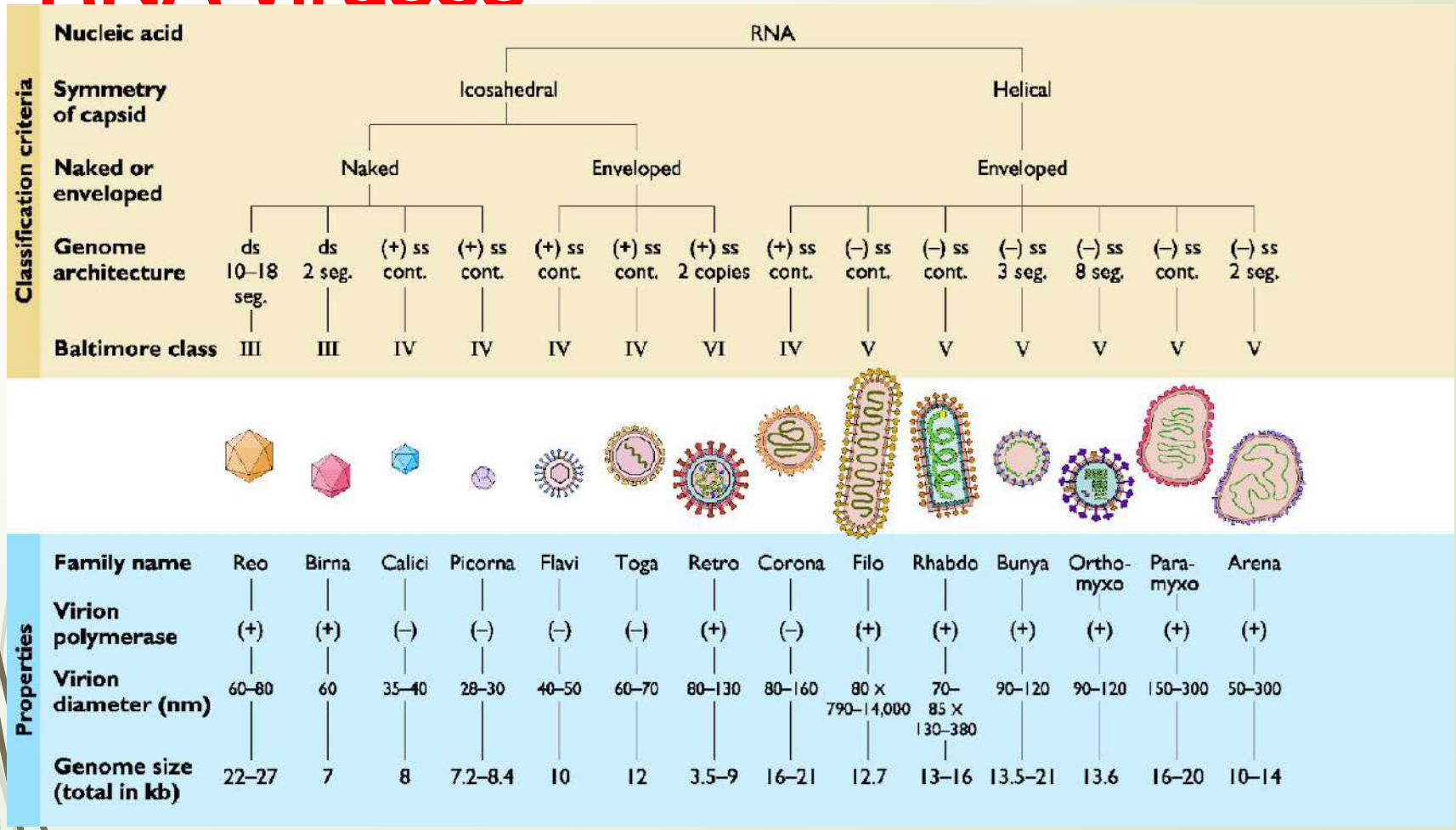

DNA VIRUSES
DOUBLE STRANDED
SINGLE STRANDED NON-ENVELOPED
COMPLEX ENVELOPED
ENVELOPED
NON-ENVELOPED
PARVOVIRIDAE
POXVIRIDAE
HERPESVIRIDAE
HEPADNAVIRIDAE
CIRCULAR
LINEAR
PAPILLOMAVIRIDAE
POLYOMAVIRIDAE
(formerly grouped together as the PAPOVAVIRIDAE)
ADENOVIRIDAE
All families shown are icosahedral except for poxviruses

DNA viruses

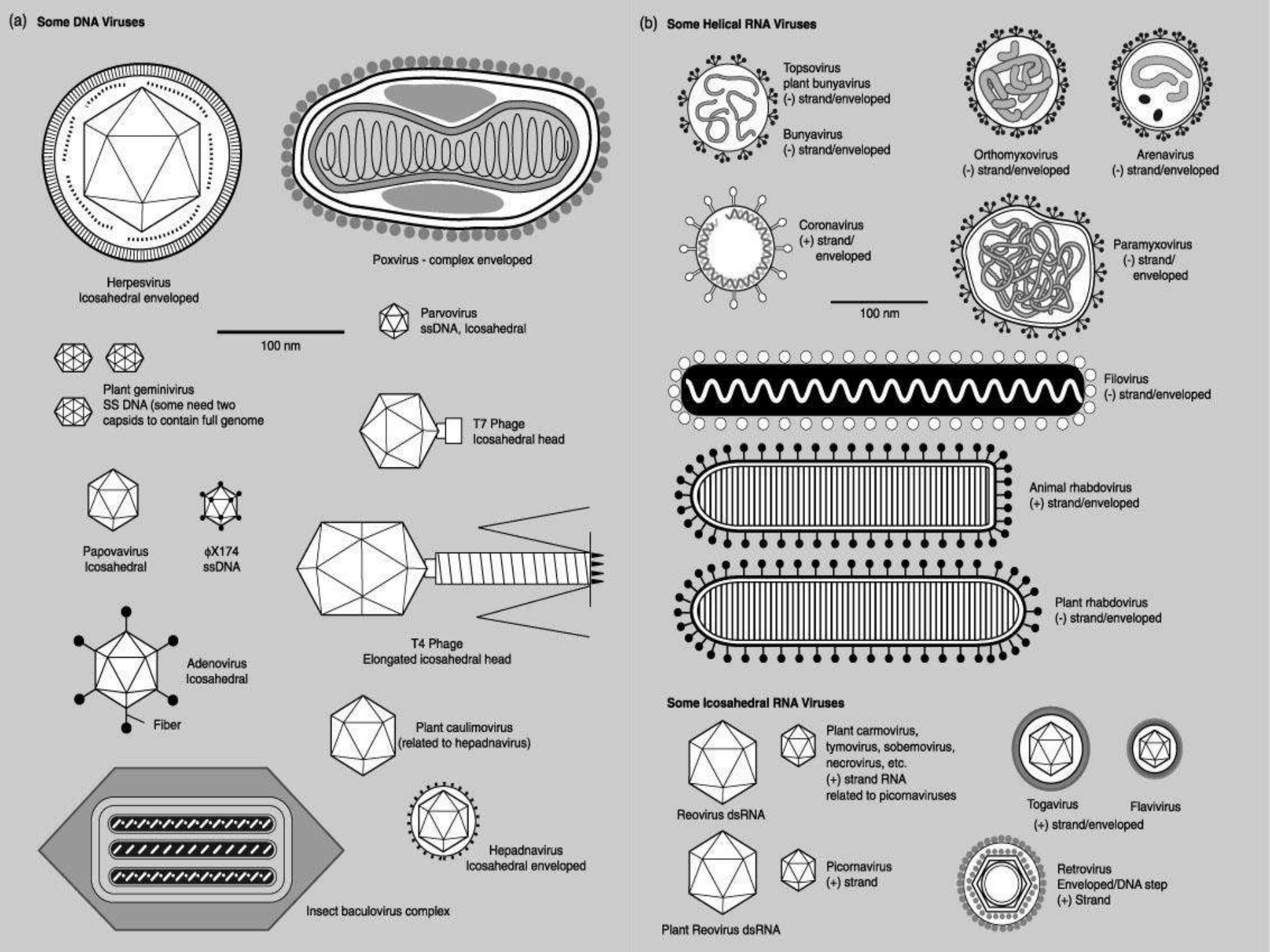

DNA
Icosahedral
Helical
Complex
Naked
Enveloped
Naked/Env. (cytoplasmic)
Enveloped
Enveloped (cytoplasmic)
ss linear (+) or (–)
ds circular
ds linear
ds circle gapped
ds linear
ds linear
ds circular
ds linear (× linked)
II
I
I
I
I
I
I
I
Parvo
Papova
Adeno
Hepadna
Herpes
Irido
Baculo
Pox
(–)
(–)
(–)
(+)
(–)
(–)
(–)
(+)
18–26
45–55
70–90
42
150–200
125–300
60 × 300
170–200 × 300–450
5
5–8
36–38
3.2
120–200
150–350
100
130–280


RNA VIRUSES
SINGLE STRANDED positive sense
SINGLE STRANDED negative sense
DOUBLE STRANDED
ENVELOPED
NONENVELOPED
ENVELOPED
NONENVELOPED
ICOSAHEDRAL
HELICAL
ICOSAHEDRAL
HELICAL
ICOSAHEDRAL
FLAVIVIRIDAE
TOGAVIRIDAE
RETROVIRIDAE
CORONAVIRIDAE
PICORNAVIRIDAE
CALICIVIRIDAE
ASTROVIRIDAE
ORTHOMYXOVIRIDAE
PARAMYXOVIRIDAE
RHABDOVIRIDAE
FILOVIRIDAE
BUNYAVIRIDAE
ARENAVIRIDAE
REOVIRIDAE

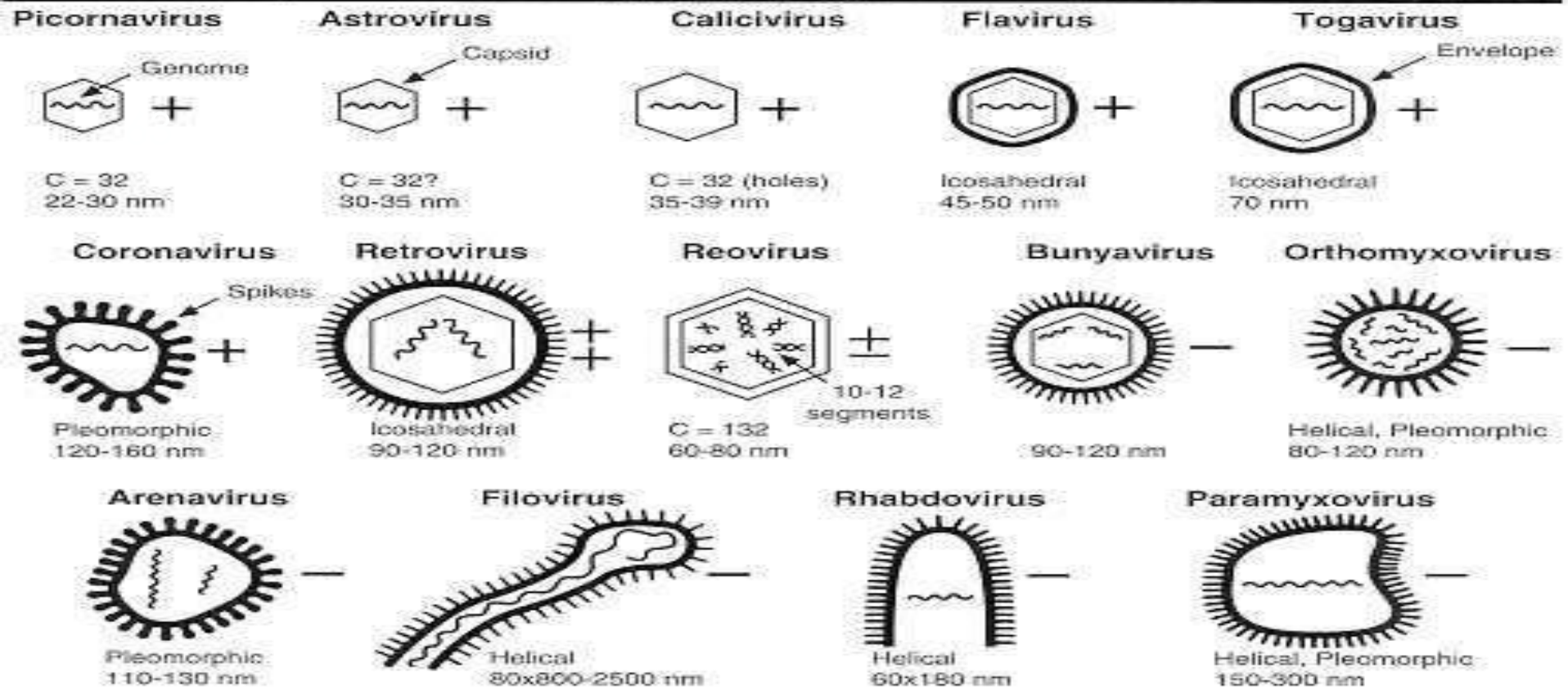
RNA viruses



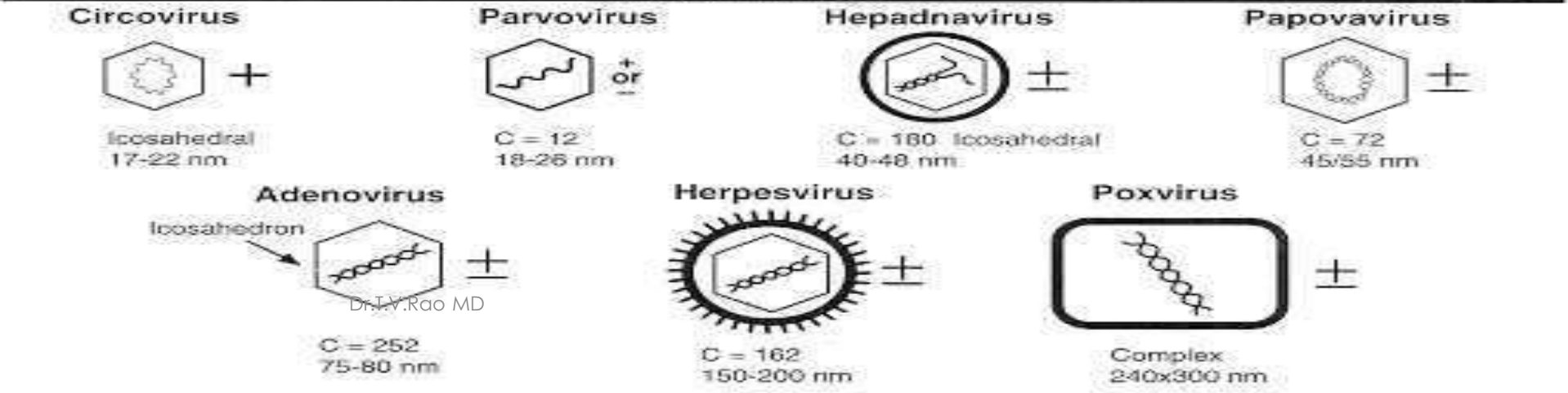
From Principles of Virology Flint et al ASM Press


(a) Some DNA Viruses
Herpesvirus
Icosahedral enveloped
Poxvirus - complex enveloped
Parvovirus
ssDNA, Icosahedral
100 nm
Plant geminivirus
SS DNA (some need two
capsids to contain full genome
T7 Phage
Icosahedral head
Papovavirus
Icosahedral
ϕX174
ssDNA
T4 Phage
Elongated icosahedral head
Adenovirus
Icosahedral
Fiber
Plant caulimovirus
(related to hepadnavirus)
Hepadnavirus
Icosahedral enveloped
Insect baculovirus complex
(b) Some Helical RNA Viruses
Topsovirus
plant bunyavirus
(-) strand/enveloped
Bunyavirus
(-) strand/enveloped
Orthomyxovirus
(-) strand/enveloped
Arenavirus
(-) strand/enveloped
Coronavirus
(+) strand/
enveloped
100 nm
Paramyxovirus
(-) strand/
enveloped
Filovirus
(-) strand/enveloped
Animal rhabdovirus
(+) strand/enveloped
Plant rhabdovirus
(-) strand/enveloped
Some Icosahedral RNA Viruses
Reovirus dsRNA
Plant carmovirus,
tymovirus, sobemovirus,
necrovirus, etc.
(+) strand RNA
related to picornaviruses
Togavirus
Flavivirus
(+) strand/enveloped
Picornavirus
(+) strand
Retrovirus
Enveloped/DNA step
(+) Strand
Plant Reovirus dsRNA

RNA Viruses



DNA Viruses



BASIC STEPS IN VIRAL LIFE CYCLE

- ADSORPTION
- PENETRATION
- UNCOATING AND ECLIPSE
- SYNTHESIS OF VIRAL NUCLEIC ACID AND PROTEIN
- ASSEMBLY
- RELEASE