Types of Vaccines

TRADITIONAL VACCINES

-- Killed vaccines

-- Attenuated vaccines

MODERN VACCINES

-- Recombinant vaccines

-- DNA vaccines

-- Conjugate vaccines

-- Therapeutic vaccines

TRADITIONAL VACCINES

Killed vaccines

-- The pathogen is killed by **heat** or some **chemical treatment**

-- Activate **only humoral response**

-- **Non-specific** immune responses

-- Generally **not as effective** as live vaccines

-- Generally require **3-5 doses**

-- Antibody titer falls **over time**

Examples:

Salk vaccine for polio, whole cell typhoid vaccine, hepatitis A, rabies, plague

Attenuated vaccines

-- **Living** pathogens are **attenuated** (weakened).

-- These attenuated pathogens **must replicate** to be effective.

-- **Pathogenicity is suppressed** but overall structure and antigenicity remain **intact**.

-- These are the **most widely used** and **successful vaccines**.

Advantages

-- Evoke **both** humoral and cellular immunity

-- Immune response **similar to natural infection**

-- Usually effective with **one dose**

Disadvantages

-- **Severe reactions** possible

-- **Interference** from **circulating antibody**

-- **Unstable**

-- **Not all pathogens can grow in culture**

-- Cell culture (for viruses) is **expensive**

-- Yield and rate of production **may be low**

-- **Extensive safety precautions** needed

-- Inactivation/attenuation **must be 100% because** attenuated strains might **revert**

-- **Limited shelf-life** and **stringent** refrigeration requirements

Examples

BCG, oral typhoid, measles, mumps

MODERN VACCINES

RECOMBINANT VACCINES

General approaches

1.Attenuate organism by **specific deletion** of virulence gene

2.Engineer **live, non-pathogenic carrier** to contain antigenic determinant for disease organism

3.If non –culturable, **clone genes**, and **overexpress proteins** to use as vaccines (subunit vaccines)

There are three types:

-- **Subunit** vaccines (include **Peptide** vaccines)

-- **Recombinant attenuated** vaccines

-- **Vector** vaccines

SUBUNIT VACCINES

Vaccines that **use components of a pathogen** rather than the whole organism are called **“subunit”** vaccines

Advantages

-- Using a **purified protein** ensures that the vaccine is **safe and stable.**

Disadvantages

-- Purification may be **costly**

-- Isolated protein **may not have the same conformation** as in the pathogen, so **may not have the same antigenicity**

Examples:

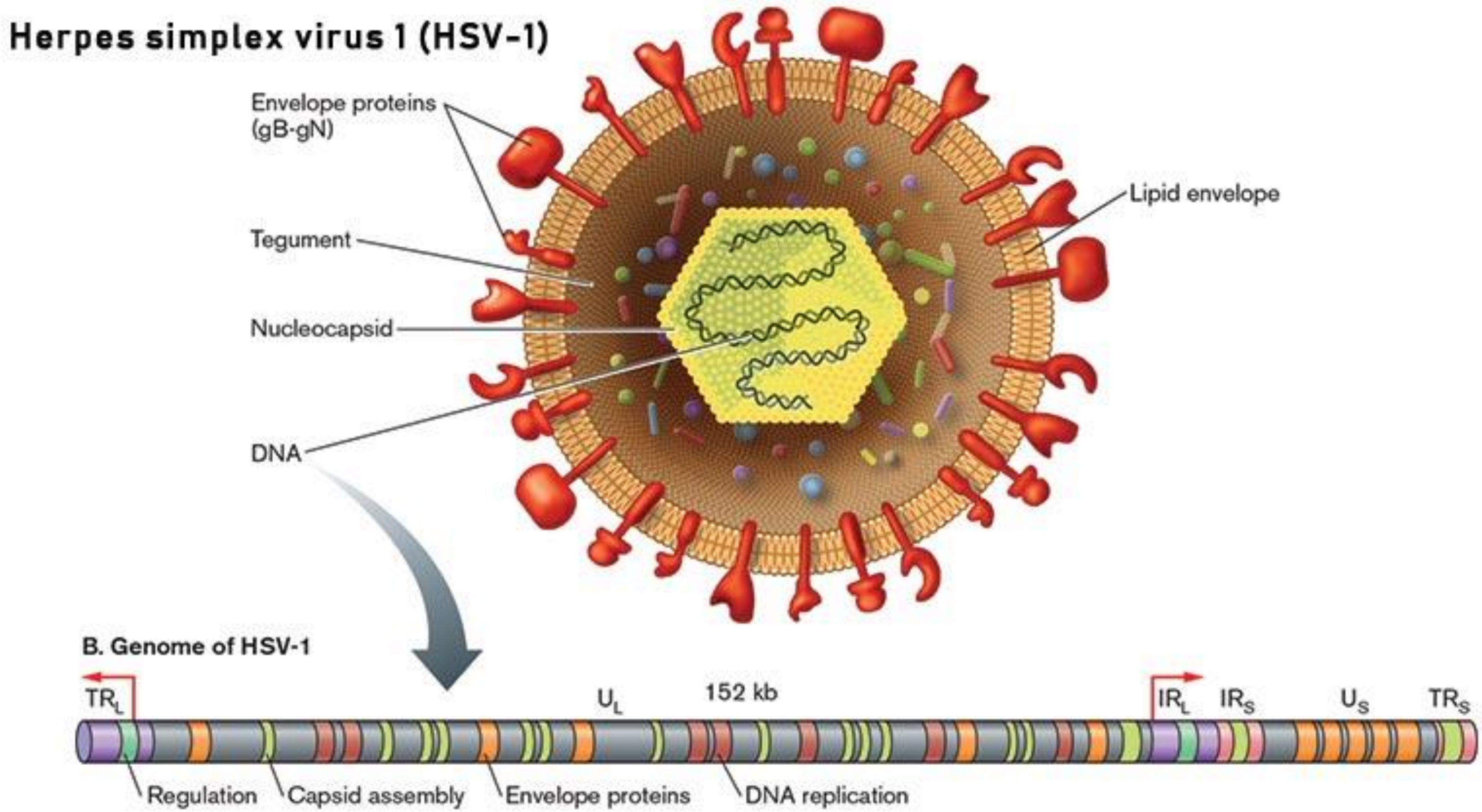
HSV, hepatitis B, influenza, acellular pertussis, typhoid Vi

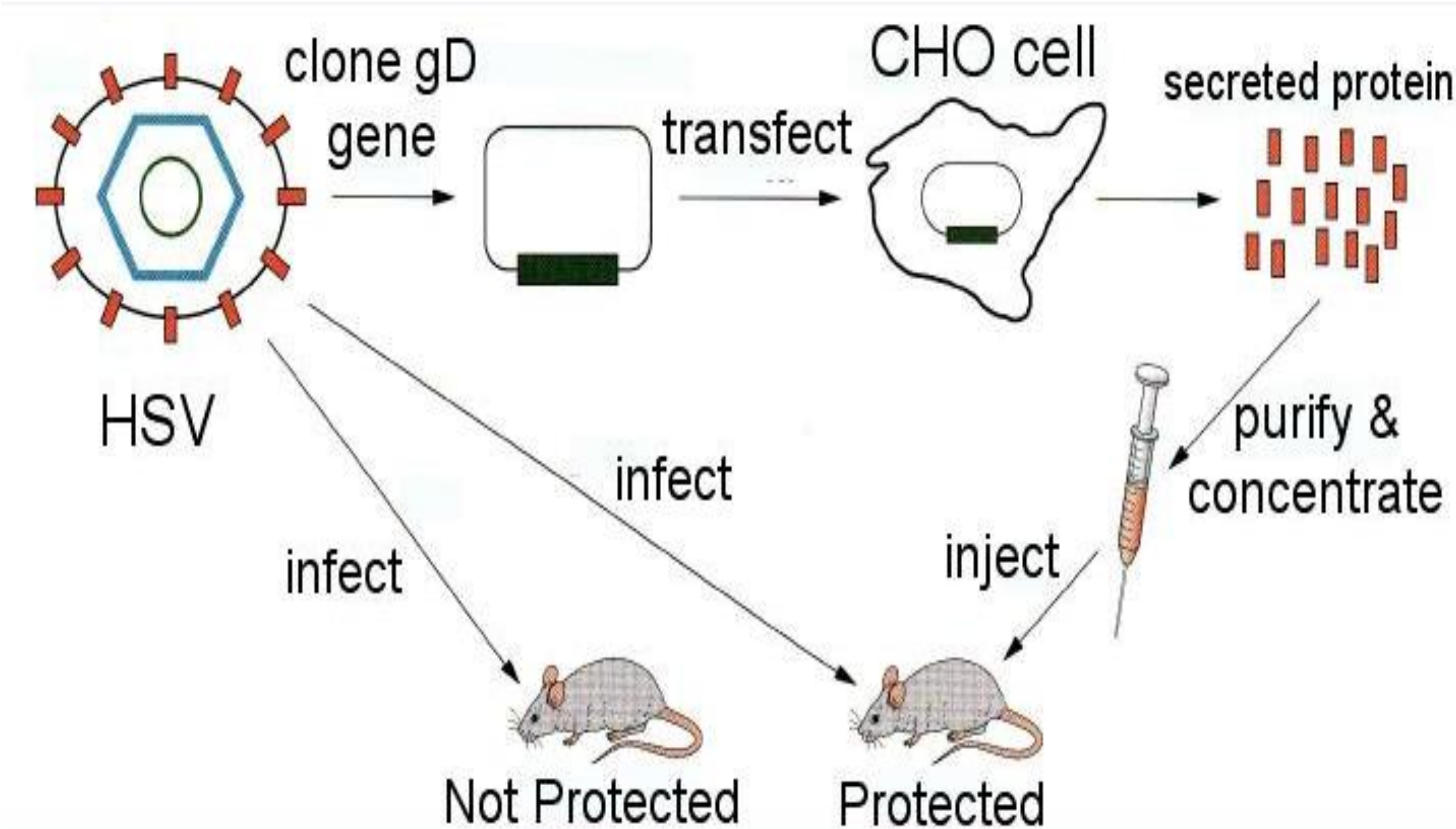
Example: HSV (Herpes Simplex Viruses)

-- HSV may cause **cancer**, **encaphilitis** and **severe eye infections.**

-- For subunit vaccine, the target **antigenic protein** is **HSV viral envelope glycoprotein D.**

-- **Modified HSV glycoprotein D** is effective against **both** HSV-1 and HSV-2.


Herpes simplex virus 1 (HSV-1)
Envelope proteins
(gB-gN)
Tegument
Nucleocapsid
DNA
Lipid envelope
B. Genome of HSV-1
TR$_L$
U$_L$
152 kb
IR$_L$
IR$_S$
U$_S$
TR$_S$
Regulation
Capsid assembly
Envelope proteins
DNA replication



Development of Subunit Vaccine against HSV

PEPTIDE VACCINES

-- Vaccine from a **specific domain** of an antigenic protein

-- **Single epitope** or **antigenic determinant**

-- **Peptides need to be linked** to another molecule to **prevent rapid degradation** due to **small size.**

Common carrier proteins

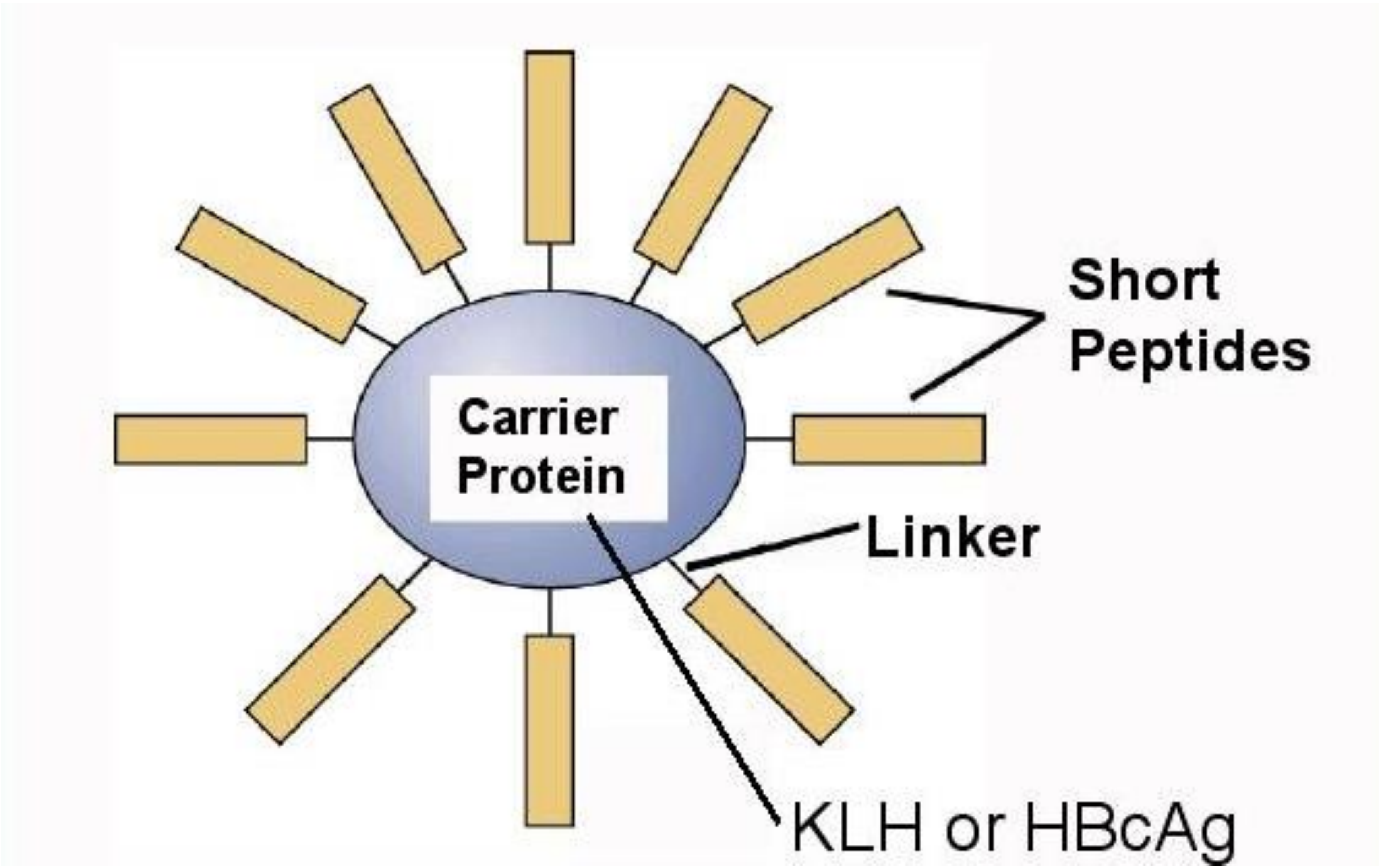
-- **Keyhole limpet hemocyanin --** an inert carrier protein, from a gastropos mollusk (marine animal)

-- **Hepatitis B core protein (HbcAg)** – highly immunogenic carrier protein – self assemble into small particles

Examples:

Melanoma vaccine, *H. influenzae* protein D

STRUCTURE OF A PEPTIDE VACCINE



Limitations:

-- **Epitope** must consist of a **contiguous stretch of amino acids.**

-- **Not all peptides are effective** in eliciting an immune response (may need 2 or more)

-- Peptide must have the **same conformation as in pathogen.**

-- Amount of peptide required to elicit an immune response may be **1000x** more than for inactivated pathogen.

RECOMBINANT ATTENUATED VACCINES

rDNA techniques permit genetic manipulation for generating attenuated vaccines

Methods

-- A pathogenic organism is **engineered** such that the **virulence genes** have been **deleted** or **modified in some cases.**

Benefits

-- **Deletion** of virulence genes **rules out** the likelihood of **reversion** back to virulent form.

-- **Whole pathogen are much more immunogenic** than subunit vaccines

Examples:

Engineered Cholera exotoxin *V. cholerae*

VECTOR VACCINES

Live non-pathogenic viruses are used as **vaccine**.

Advantages

-- Antigen is **authentic**.

-- Virus expresses antigen in the **context** of viral particle. Amount of antigen is **amplified** during replication of the live virus.

Disadvantages

-- Serious viral infection in **immunosuppressed host** – AIDS and transplant patients can occur.

-- Low level of **complications** in healthy persons with frequency of 3×10^{-6} (1 in 333,000).

Example -- Vaccinia virus

-- Live vaccinia virus was used for eradication of **smallpox**

-- Genome is **ds DNA (187 kbp)**

-- Generally **benign**

-- **Broad host range**

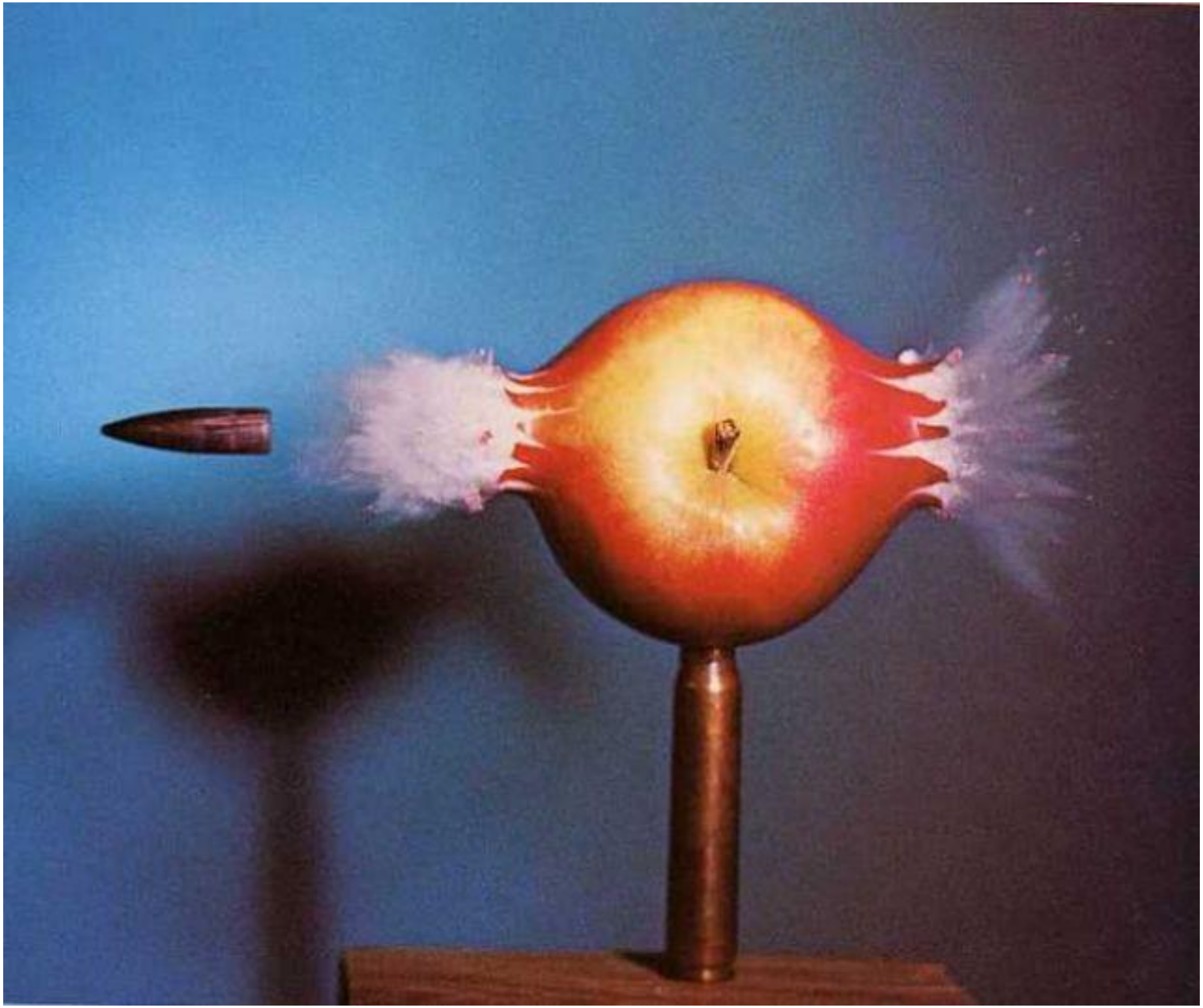
Other potential vectors:

adenovirus, avipox vectors

میں نے پوچھا بابا جی حسد کیا ہے ؟

کہنے لگے رب کی تقسیم سے اختلاف رکھنا !!

اشفاق احمد



Stone Forest in Madagascar


Thank You!