



# DNA VACCINES

# *CONTENTS*

- ❑ Introduction
- ❑ History
- ❑ DNA vaccines Vs Traditional vaccines
- ❑ How DNA vaccine is made
- ❑ Methods of delivery
- ❑ How DNA vaccine works
- ❑ Advantages
- ❑ Disadvantages
- ❑ Current clinical trials
- ❑ Safety issues
- ❑ Future of DNA vaccines
- ❑ Conclusion
- ❑ References

# *INTRODUCTION*

- ❑ DNA vaccine is DNA sequence used as a vaccine.
- ❑ This DNA Sequence code for antigenic protein of pathogen.
- ❑ As this DNA inserted into cells it is translated to form antigenic protein. As this protein is foreign to cells , so immune response raised against this protein.
- ❑ In this way ,DNA vaccine provide immunity against that pathogen.



# *HISTORY*

- ❑ In 1990, University of Wisconsin, Jon Wolff found that injection of DNA plasmids produce a protein response in mice.
- ❑ In 1993, Merck Research Laboratories, Dr. Margaret Liu found that intramuscular injection of DNA from influenzae virus into mice produced complete immune response
- ❑ In 1996, trials involving T-cell lymphoma, influenzae & herpes simplex virus were started

# *DNA vaccines Vs Traditional vaccines*

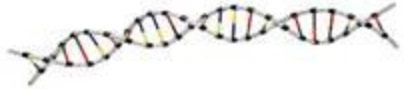
## **DNA vaccines**

- ☐ Uses only the DNA from infectious organisms.
- ☐ Avoid the risk of using actual infectious organism.
- ☐ Provide both Humoral & Cell mediated immunity
- ☐ Refrigeration is not required

## **Traditional vaccines**

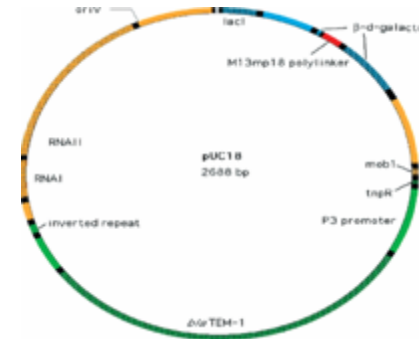
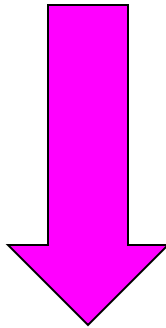
- ☐ Uses weakened or killed form of infectious organism.
- ☐ Create possible risk of the vaccine being fatal.
- ☐ Provide primarily Humoral immunity
- ☐ Usually requires Refrigeration.

# HOW DNA VACCINE IS MADE

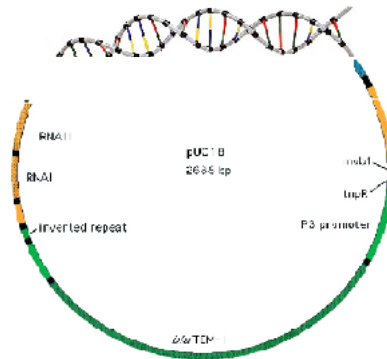


Viral gene

Recombinant DNA  
Technology



Expression  
plasmid



Plasmid with foreign gene

### Granular inclusion

Cell wall / outer membrane (if present)

**Cytoplasmic membrane**

## Capsule

## Pili

### Mesosome

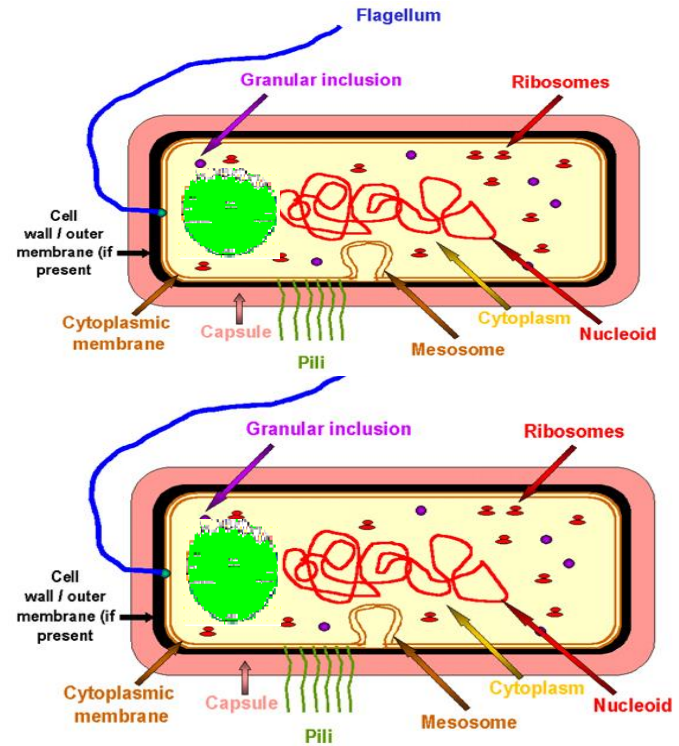
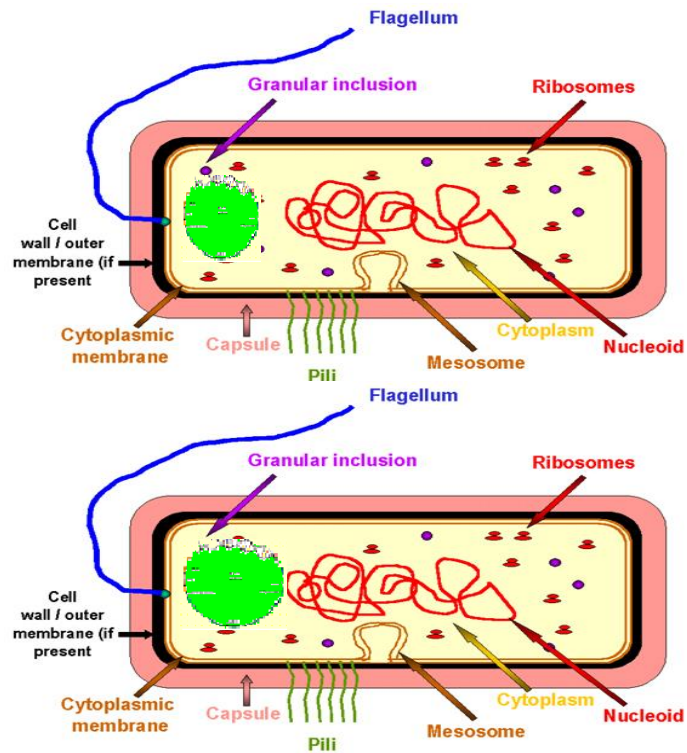
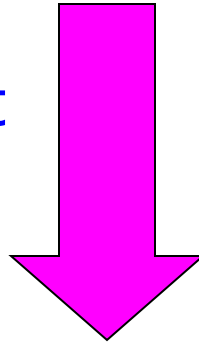
**Cytoplasm**

## Nucleoid

## Plasmid DNA

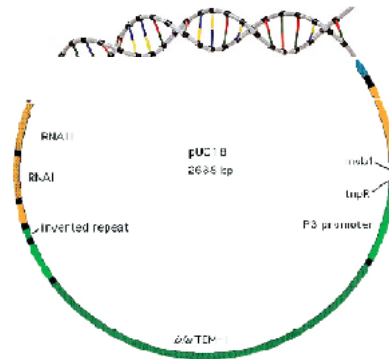
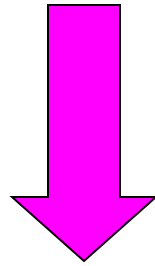
# Bacterial cell

Plasmid DNA get Amplified

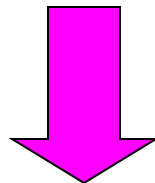




Plasmid DNA  
Purified



Ready to use



# *METHODS OF DELIVERY*



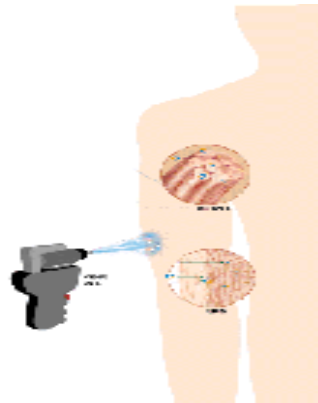
## ☐ Syringe delivery:-



Either  
intramuscularly  
  
or  
  
Intradermally

*Contd..*

## ☐ Gene gun delivery:-



- ☐ Adsorbed plasmid DNA into gold particles
- ☐ Ballistically accelerated into body with gene gun.

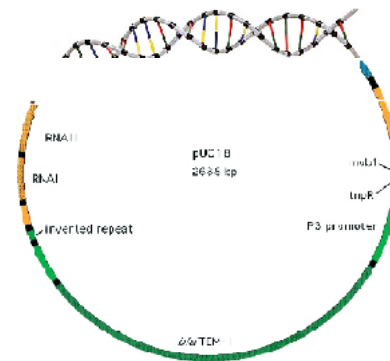
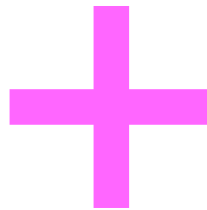
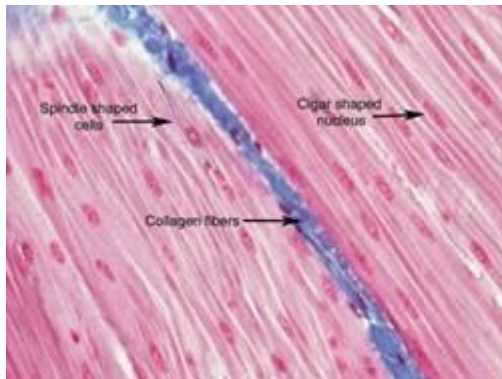
# *HOW DNA VACCINE WORKS*

## **BY TWO PATHWAYS**

**ENDOGENOUS** :- Antigenic Protein is presented by cell in which it is produced

**EXOGENOUS** :- Antigenic Protein is formed in one cell but presented by different cell

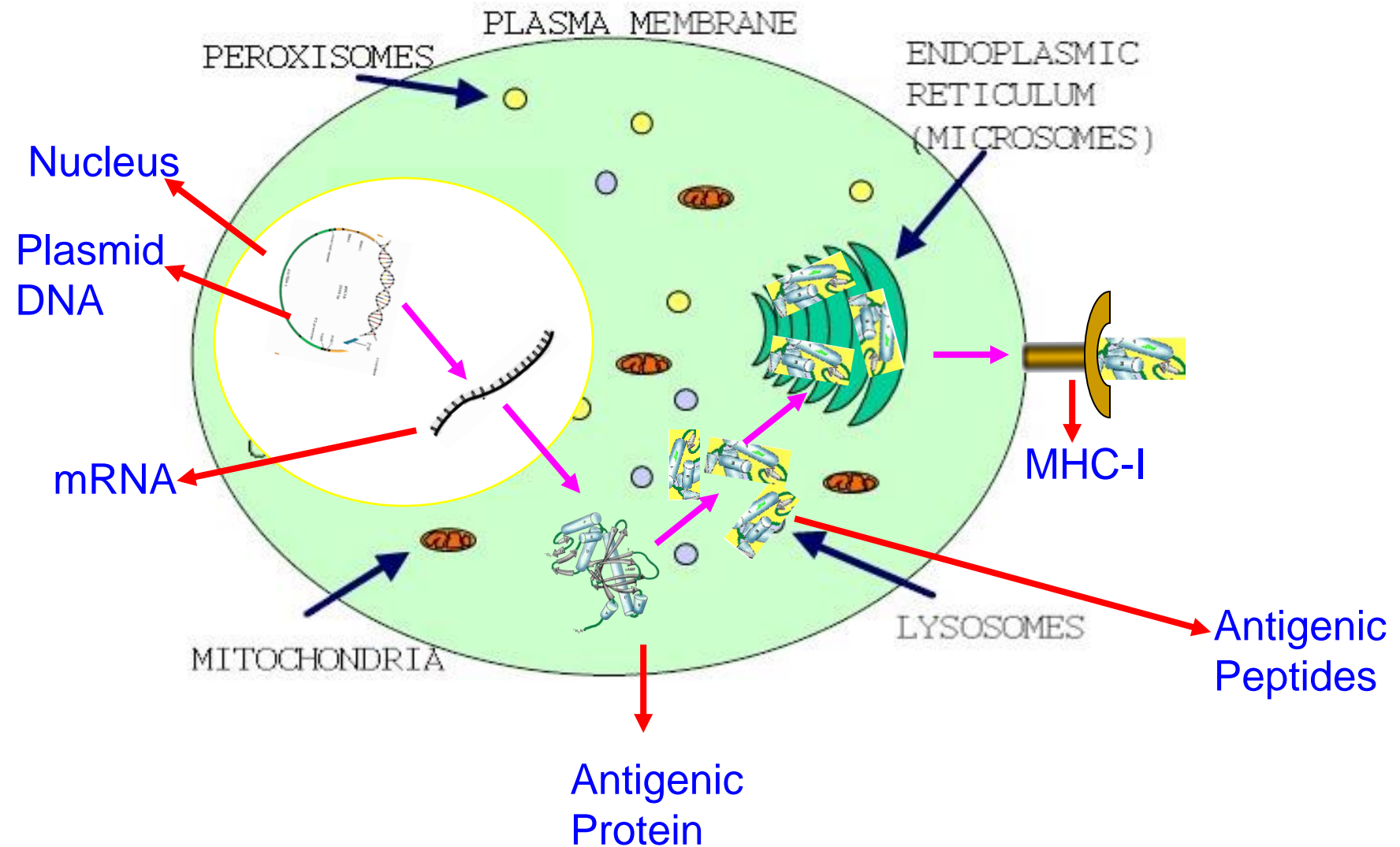
# HOW DNA VACCINES WORK

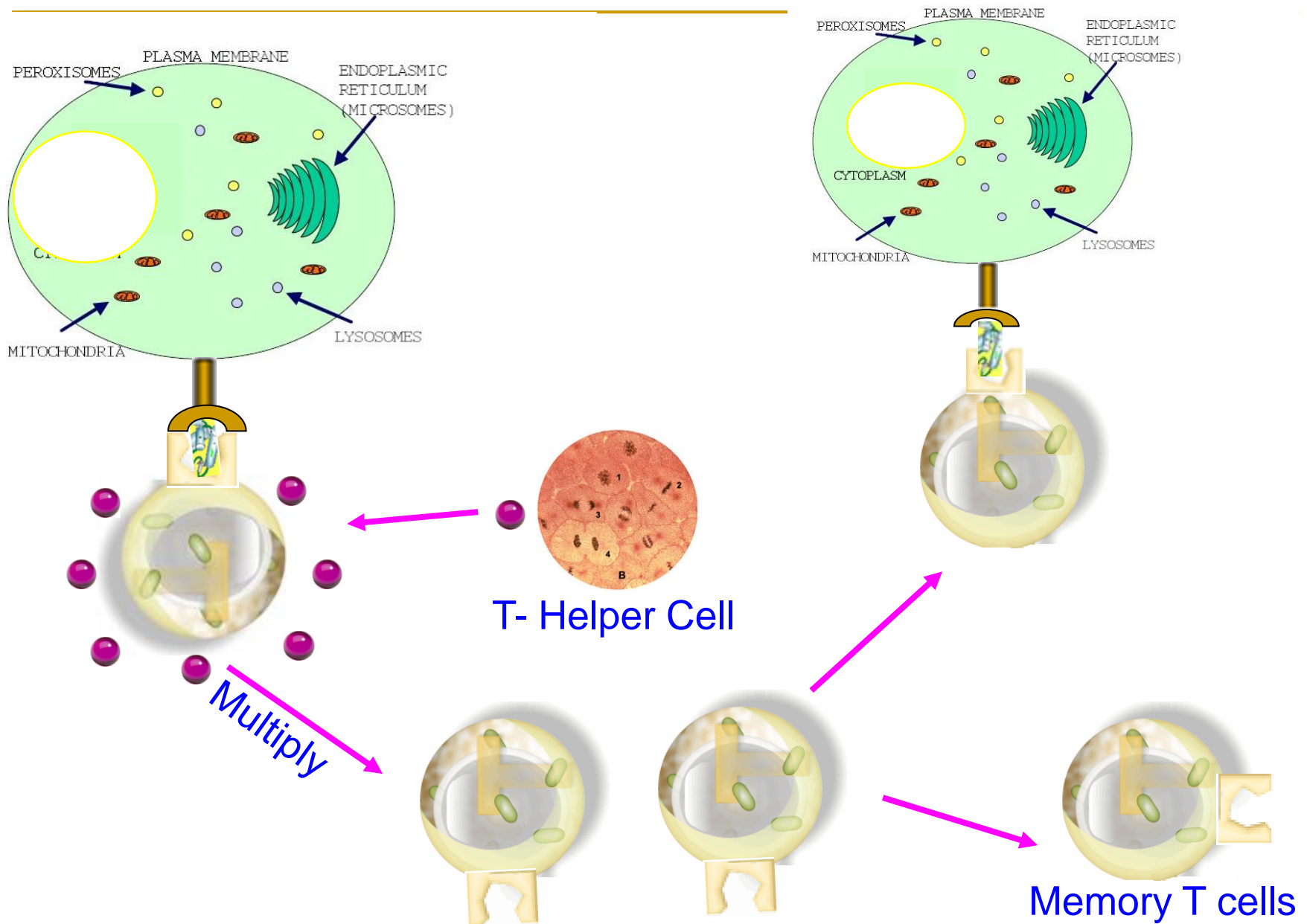


Muscle Cells

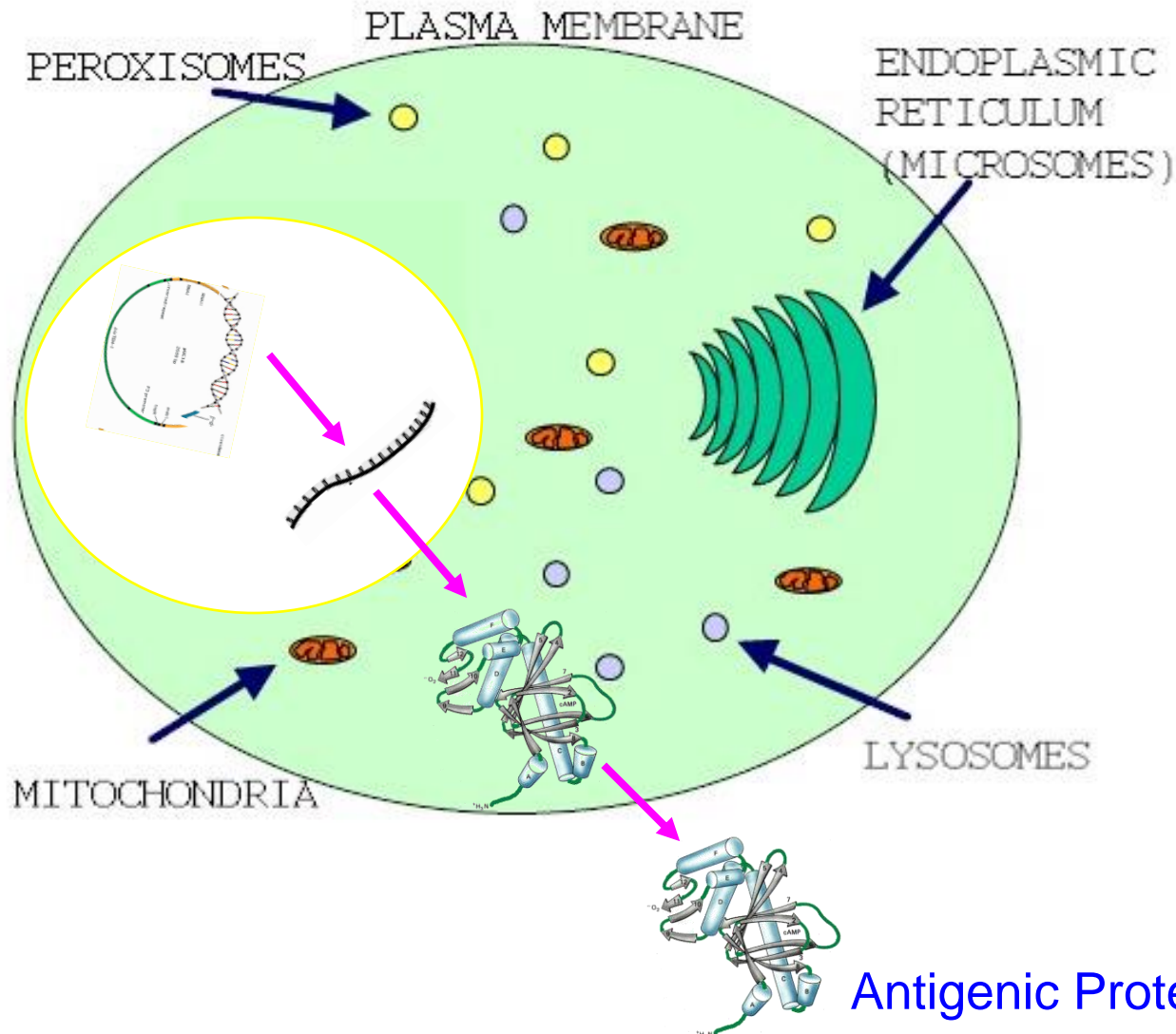
Plasmid DNA

# ENDOGENOUS PATHWAY

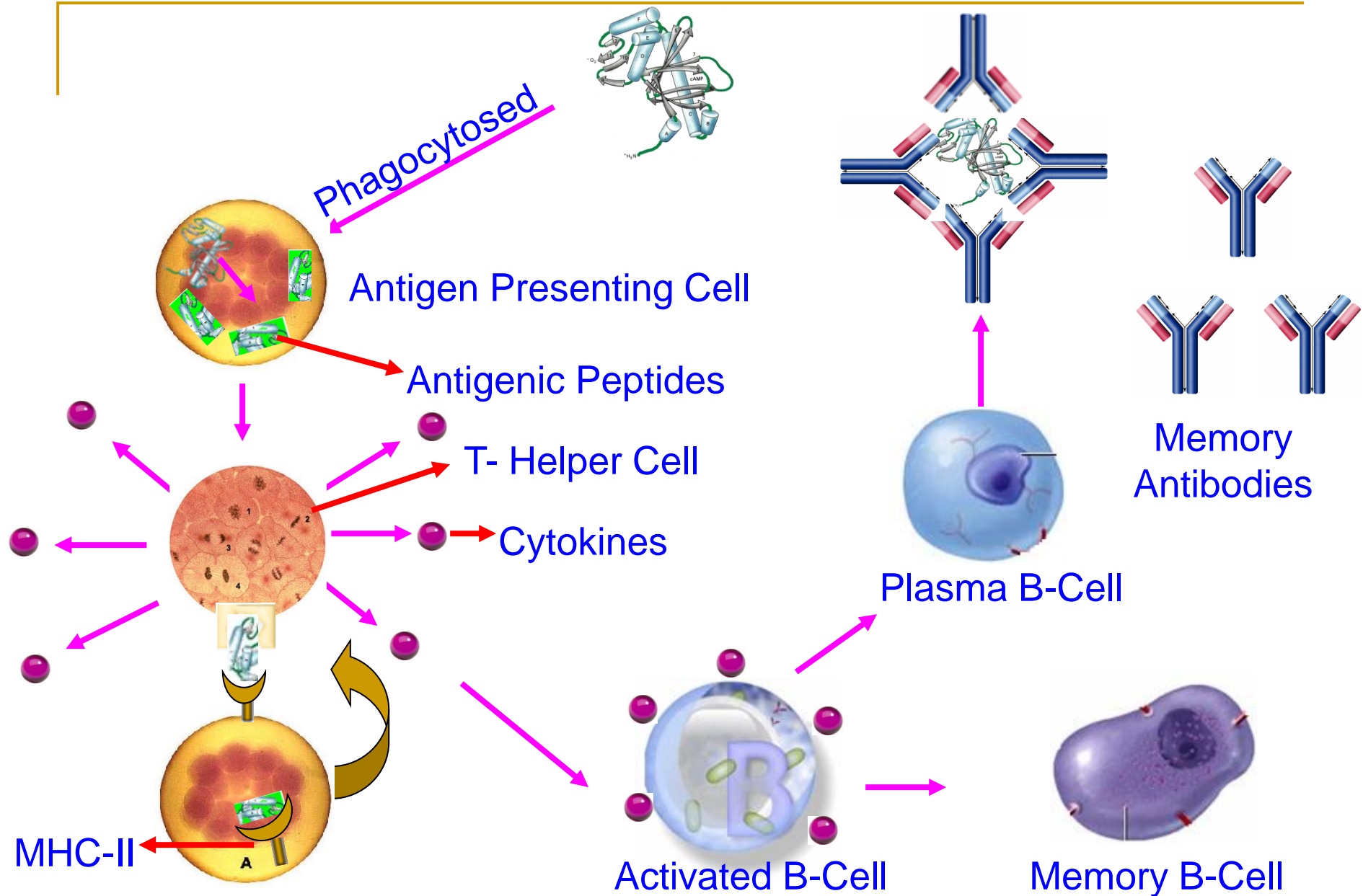




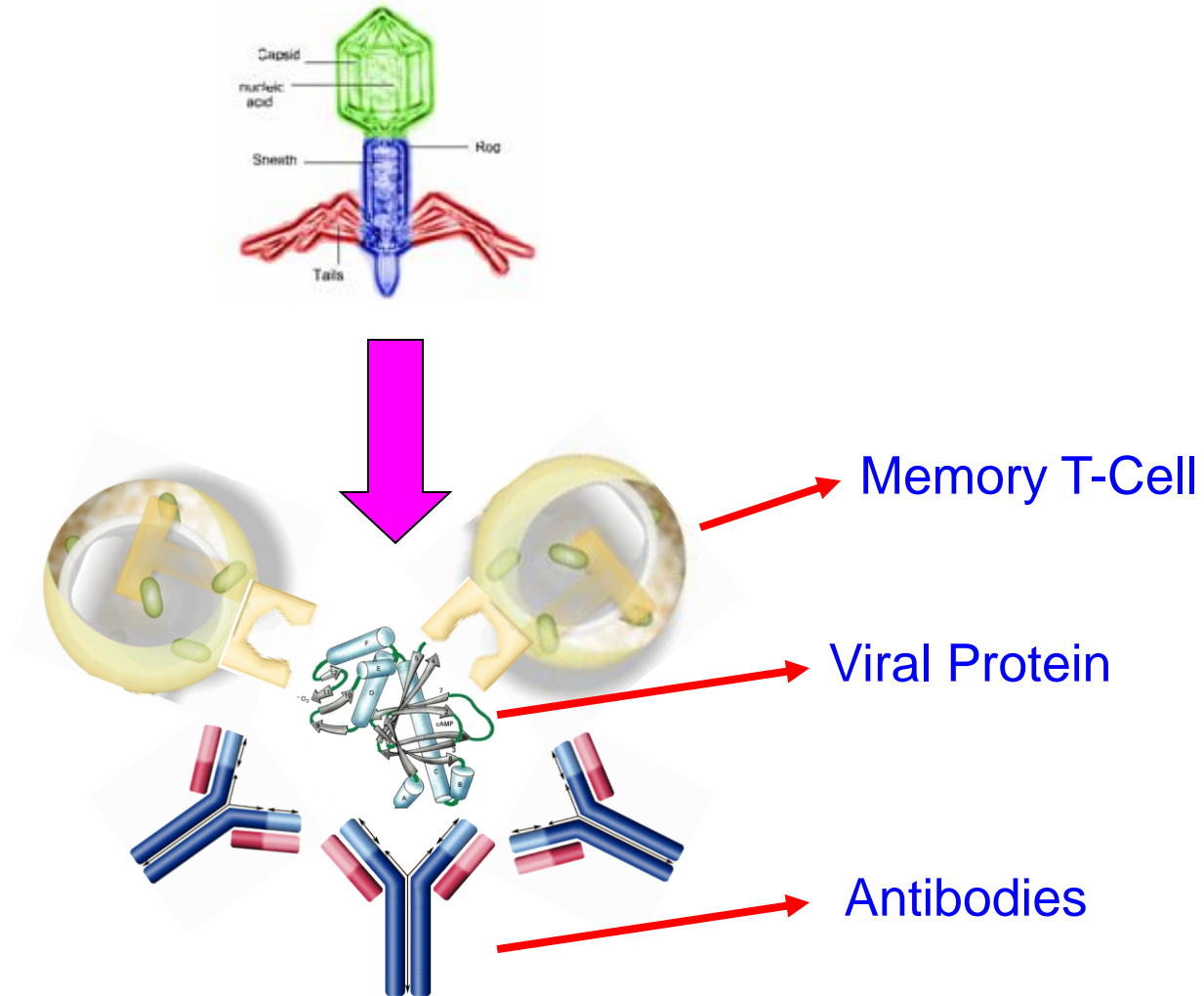
# EXOGENOUS PATHWAY







# WHEN VIRUS ENTER IN THE BODY



# *ADVANTAGES*

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- ☐ Elicit both Humoral & cell mediated immunity
- ☐ Focused on Antigen of interest
- ☐ Long term immunity
- ☐ Refrigeration is not required
- ☐ Stable for storage

## *DISADVANTAGES*

- ❑ Limited to protein immunogen only
- ❑ Extended immunostimulation leads to chronic inflammation
- ❑ Some antigen require processing which sometime does not occur

# *CURRENT CLINICAL TRIALS*

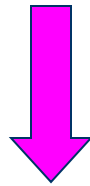
- ❑ June 2006, DNA vaccine examined on horse  
Horse acquired immunity against west  
nile viruses
- ❑ August 2007, DNA vaccination against  
multiple Sclerosis was reported as being  
effective



# Safety Issues

# *Genetic Toxicity*

Integration of DNA vaccine into host Genome



- Insertional mutagenesis
- Chromosome instability
- Turn ON Oncogenes
- Turn OFF Tumor suppressor genes

## *Over Expression of DNA vaccine*

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- ➡ Acute or chronic inflammatory responses
- ➡ Destruction of normal tissues



# *Generation of Autoimmune diseases*

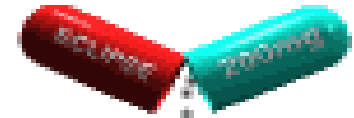
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- ➡ Anti DNA Antibodies
- ➡ Autoimmune diseases
- ➡ Autoimmune Myositis

# *Antibiotic Resistance*

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- ➡ Plasmid used is resistance to antibiotics for selection
- ➡ Raise the resistance to same antibiotic in the host



## *FUTURE PROSPECTS*

- ❑ Plasmid with multiple genes provide immunity against many diseases in one booster
- ❑ DNA vaccines against infectious diseases such as AIDS, Rabies, Malaria can be available



# **COMMERCIAL/LICENSED DNA VACCINES FOR FISH ????????????**

# *References*

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- ❑ Immunology by Kuby 6<sup>th</sup> Edition
- ❑ Immunology by Tizard 4<sup>th</sup> Edition

*THANK YOU*



*Queries?*

