

Introduction to Medical Microbiology

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Course description & objectives

Course description

- It is designed to prepare students to describe, differentiate, and identify pathogenic microorganisms using concepts and principles of microbiology and applications of microbiological techniques in health care and community setting

Course objectives

After completion of this course, the student will be able to:

- describe the nature of medically important microorganisms, classification, and mode of transmission;
- explain the pathogenesis and clinical outcome of infections;
- identify basic microbiology laboratory diagnostic methods/ tests; and
- apply the skills in infectious disease prevention and control practices.

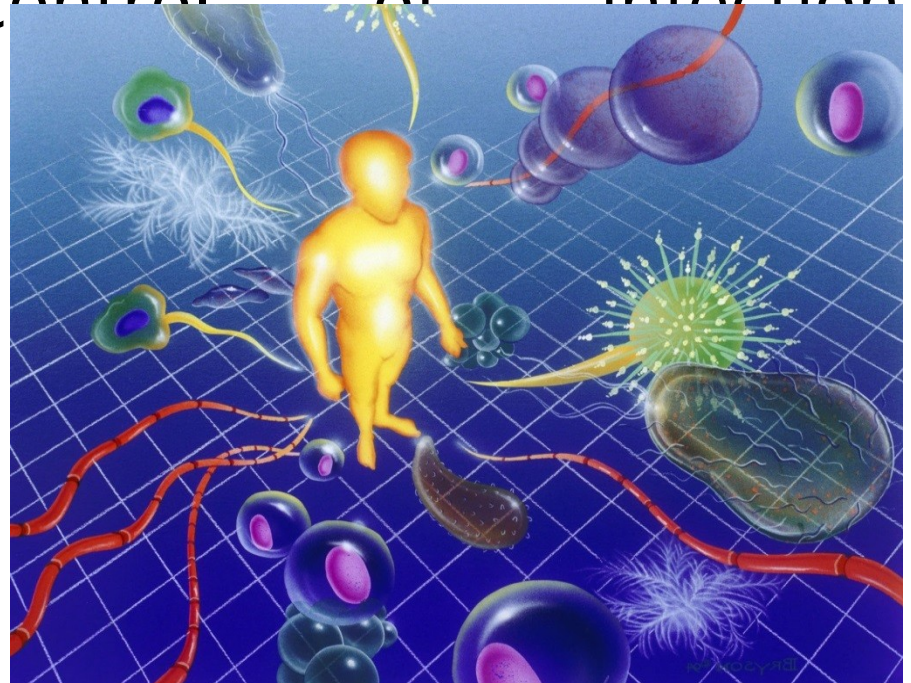
Microbiology

Historical background

- They study of microbes or microorganisms
 - Microbes, or microorganisms are minute living things that are usually unable to be viewed with the naked eye.
- It considers the microscopic forms of life and deals about their
 - evolution, classification, morphology, reproduction, physiology,
 - participation in the process of nature,
 - helpful and harmful relationship with other living things,
 - significance in science and industry

Medical microbiology

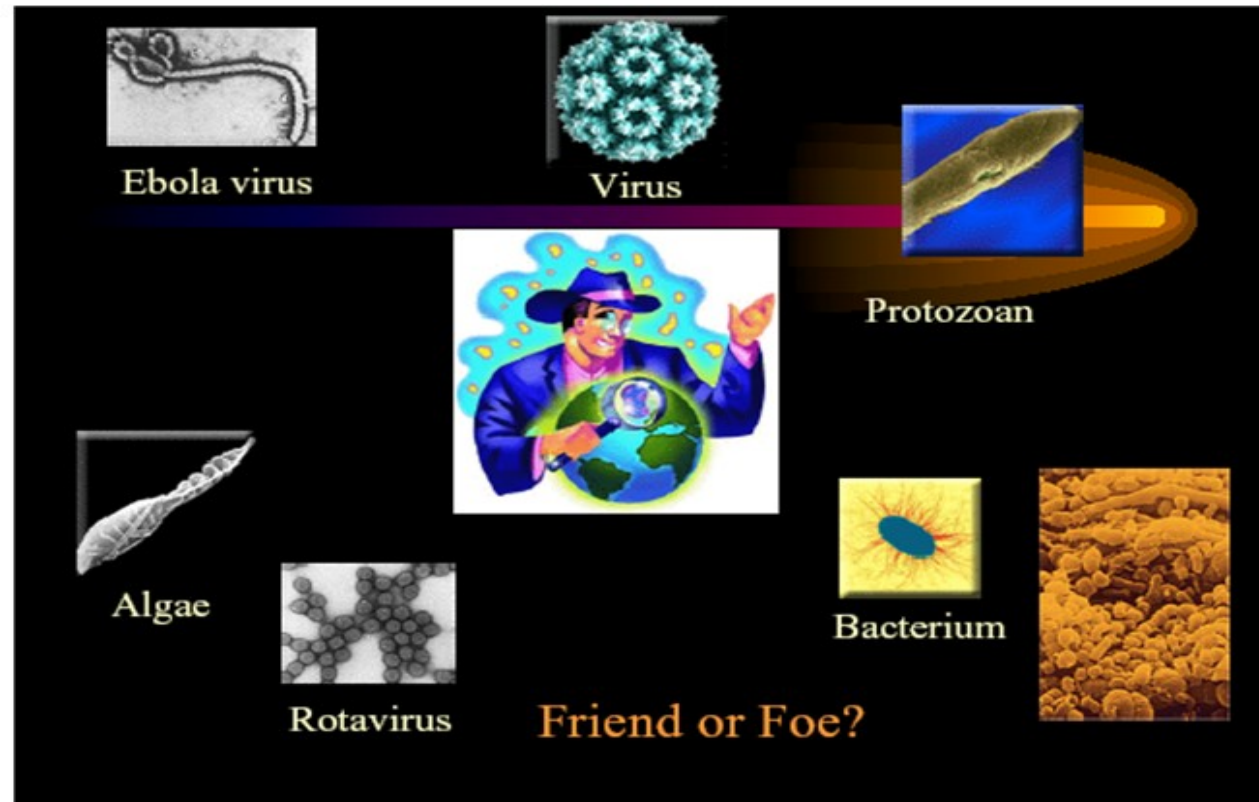
- is the study of causative agents of **infectious diseases of humans** and their reactions to such infections.
- In other words it deals with etiology, pathogenesis, laboratory diagnosis, specific treatment and control of infection.



What are Microorganisms?

- Microorganisms are creatures that are not directly visible to the unaided eye, with dramatic biological effects

- Viruses ,
- bacteria,
- fungi,
- protozoa and
- some algae



Sub divisions of microbiology

- **Bacteriology** – which deals with bacteria
- **Mycology**- which deals with fungi
- **Virology** -studies about viruses
- **Parasitology**: Deals about parasites
- **Protozoology** – which deals with Protozoa.
- **Immunology** – the science which concerned with mechanisms of body protection against pathogenic microorganisms and foreign cells and substances.

Historical background

- Man kind has always been affected by diseases which were originally believed to be visitations by the *gods*
- ***Hippocrates***, father of medicine, observed that ill health resulted due to changes in air, winds, water, climate, food, nature of soil and habits of people.
- ***Fracastorius*** (1500 G.C.) proposed that the agents of communicable disease were *living germs*, that could be transmitted by direct contact with humans and animals, and indirectly by objects ;
 - but no proof because of lacking experimental evidence

Historical background

Antony Van Leeuwenhoek (1632-1723 G.C.),

- Father of Microbiology, observed “animalcules” using simple microscope with one lens.
- He was the first person who properly described the different shapes of bacteria.
- Question raised - where did they originate?
- Although Leeuwenhoek was not concerned about the origin of micro-organism; many other scientists were searching for an explanation for spontaneous appearance of living things from
 - decaying meat,
 - stagnating ponds, fermenting grains and infected wounds

Historical background

Two major theories were formulated

1. Theory of Abiogenesis
2. Theory of Biogenesis

Theory of Abiogenesis

- deals with the theory of spontaneous generation; stating that living things originated “spontaneously” from non-living things.
- **Aristotle (384-322 BC):** The founder of a theory spontaneous generation.
- He observed spontaneous existence of fishes from dried ponds, when the pond was filled with rain.

Theory of Biogenesis

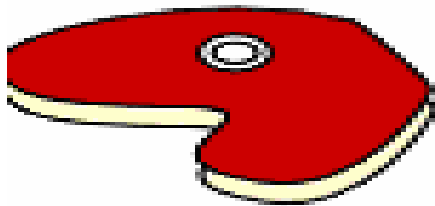
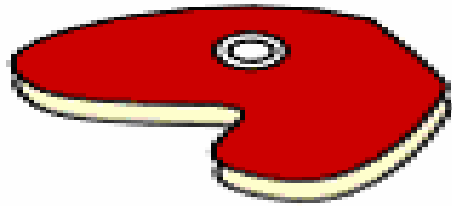
Francisco Redi

- States that life comes from pre existing life
- He is the scientist who first tried to set an experiment to disprove spontaneous generation.
- Performed experiments that disproved theory of Spontaneous Generation for more complex forms of life
- Utilized jars containing meat.
- Some were covered, some were not.
- Maggots appeared in uncovered jars.
- The controversy on spontaneous generation took 200 years.

Theory of Biogenesis: -

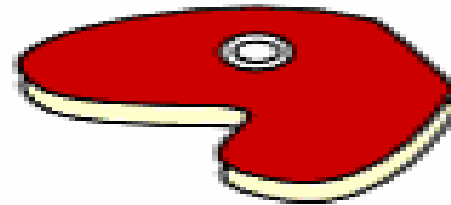
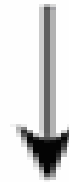
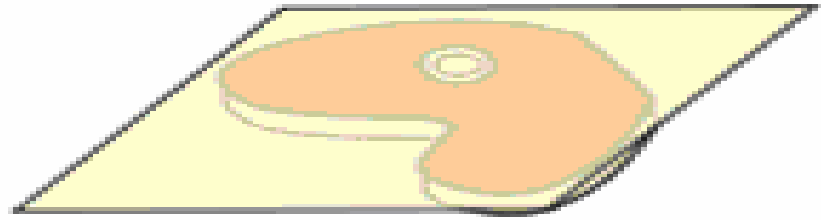
- Francesco Redi.

Exposed Meat



Maggots

Paper on Meat



No Maggots

Hypothesized: Redi suspected that flies landing on the meat laid eggs that eventually grew into maggots

Biogenesis

- In 1858 German scientist, **Rudolf Virchow** challenged spontaneous generation with his concept of **biogenesis**
- Living organisms arise from pre-existing life
- Virchow presented his idea to the scientific community, but could not back it up with a convincing experiment



Settlement of Spontaneous Generation

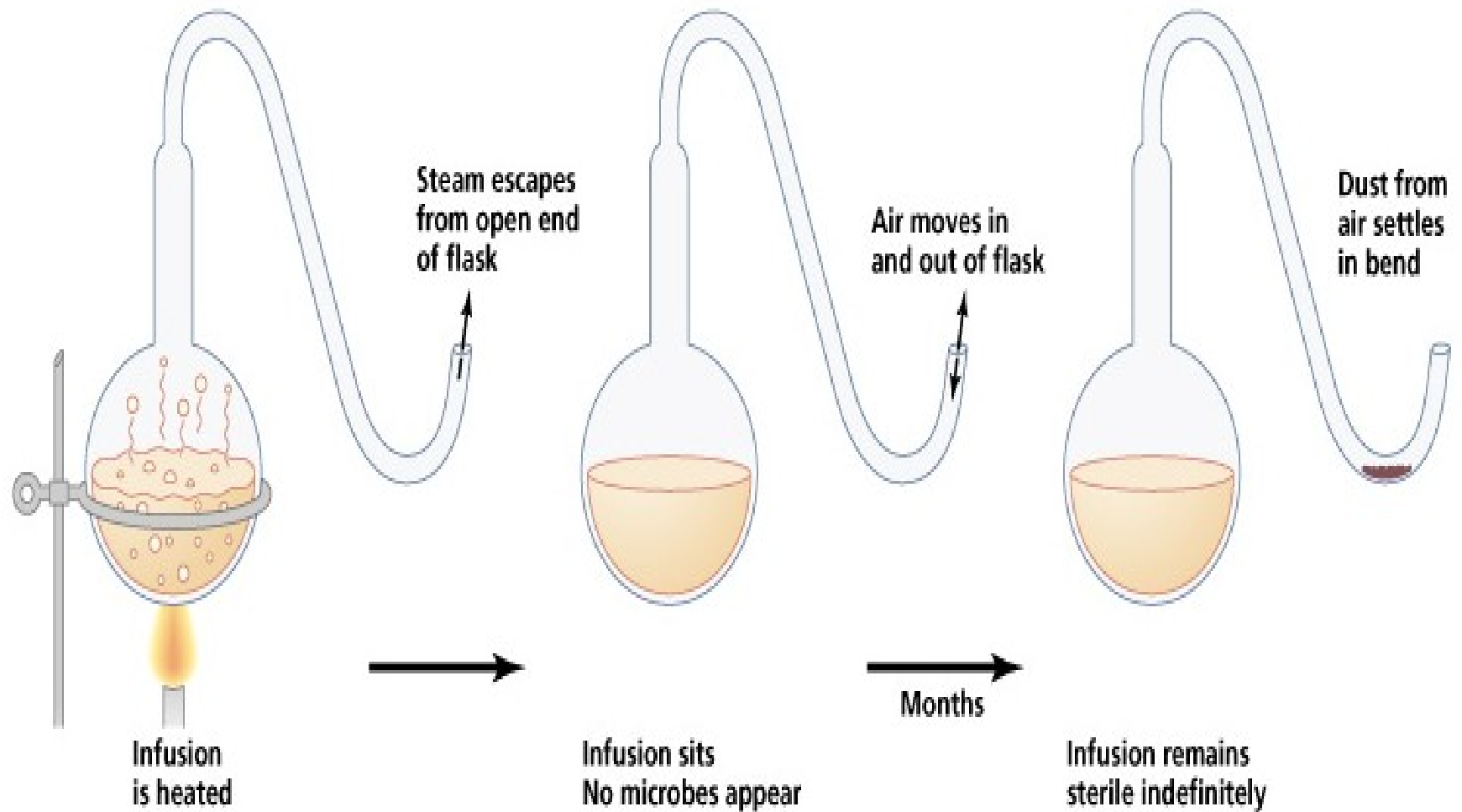
- In 1861, a French scientist -**Louis Pasteur** demonstrated where microorganisms came from
 - Father of Medical Microbiology
 - Demonstrated the microorganisms exist in the air and could contaminate sterile solutions by passing air through cotton filters
 - The filter trapped tiny particles floating in the air



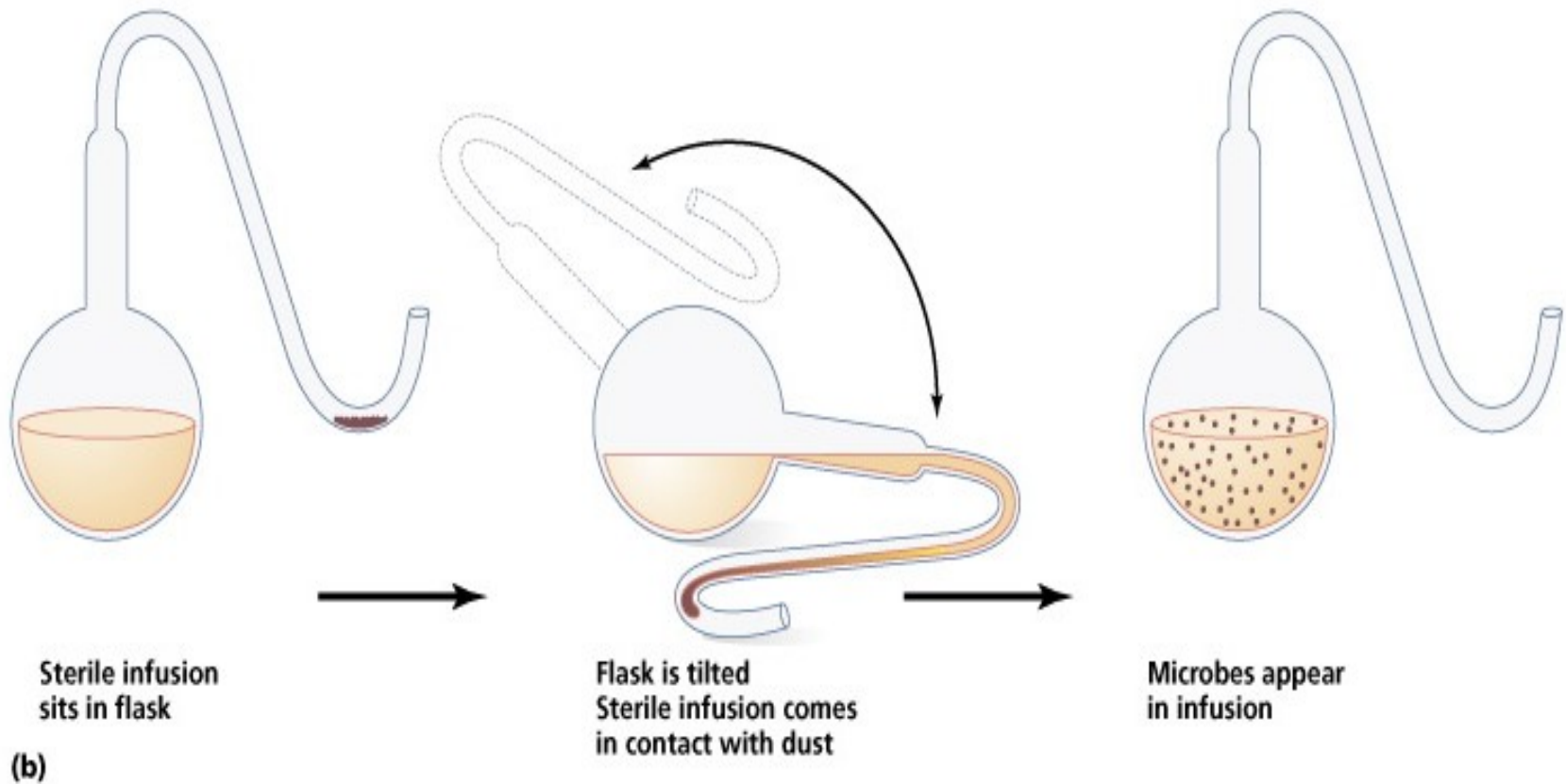
Louis pasteur (1822- 1895)

- was the scientist who disproved the theory of abiogenesis once and for all.
- Performed experiment to disprove Theory of spontaneous generation.
- In his experiment he filtered air through cotton plug.
- He placed plug in infusion broth, broth became cloudy - organisms present in the air.
- He designed a large curved flask (pasteur goose neck flask) and placed a sterile infusion broths.
- Flasks remained sterile unless tilted or neck broken.

Louis pasteur.- experiment



(a)



- Pasteur proved that microorganisms entered to the broth with the air and micro organisms did not evolve spontaneously*

The Germ Theory of diseases

- **Pasture** has also developed the germ theory of diseases, which states that a specific disease is caused by a specific type of microorganism.
- **Robert Koch**, in 1876 established an experimental procedure to prove the germ theory of disease, which states that specific disease is caused by specific pathogen.
- The scientific procedure is known as **Koch's Postulate.**

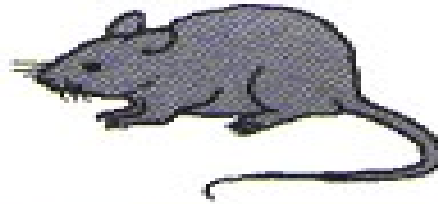
Koch's Postulate: - proof of germ theory of disease

- A Micro-organism can be accepted as a causative agent of an infectious disease only if the following conditions are satisfied.
 1. The specific causative agent must be found in every case of the disease.
 2. The disease organism must be isolated from the lesions of the infected case and maintained in pure culture.
 3. The pure culture, inoculated into a susceptible or experimental animal, should produce the symptoms of the disease.
 4. The same bacterium should be re-isolated in pure culture from the intentionally infected animal.

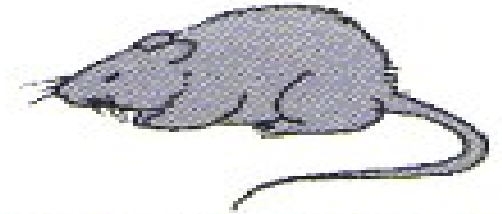
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Observe microorganisms in sick mouse that are not present in healthy mouse

Healthy



Sick



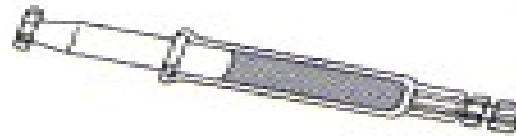
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Isolate microorganism and grow in laboratory

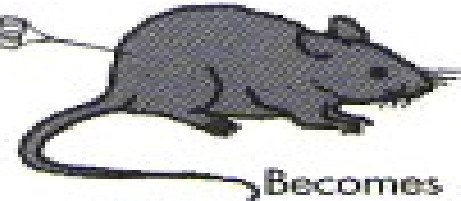


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Healthy mouse injected with the isolated micro-organism becomes sick



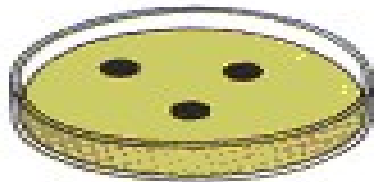
Healthy



Becomes

④

Reisolate identical microorganism from sick mouse



Sick

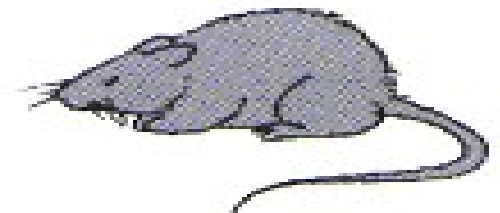


Fig. Koch's postulate

Exceptions to Koch's postulate

- Many healthy people carry pathogens but do not exhibit symptoms of the disease.
- Some microbes are very difficult or impossible to grow in vitro (in the laboratory) in artificial media. Eg. *Treponema pallidum*.
- Many pathogens are species specific. Eg. *Brucella abortus* cause abortion in animals but not in humans.
- Certain diseases develop only when an opportunistic pathogen invades immuno-compromised host.

Any Last questions ???

