HOST & PARASITE RELATHIONSHIP

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INTRODUCTION

- Infection involves interactions between the animal body (host) & the infecting microorganisms
- Based on their relationship to hosts, microorganisms can be classified as

- Saprophytes
- Parasites

SAPROPHYTES

- They are free living microbes that subsist on dead or decaying organic matter
- They are found in soil & water & play a important role in the degradation of organic material in nature
- They are generally incapable of multiplying on living tissues, & therefore of little relevance in infectious diseases

PARASITES

- They are microbes that can establish themselves, deprive the host of it's nutrition & multiply in hosts

Pathogens: are microorganisms capable of producing disease in the host

and then we have another class i.e.

Commensals: these live in complete harmony with the host without causing damage to it

INFECTION

- The multiplication of parasite in or on the tissue of a host constitutes infection
- It does not invariably result in disease

Primary infection

- Reinfections
- Secondary infection
- Focal infection
- Cross infection
- Nosocomial infection
- Iatrogenic infection
- Inapparent infection
- Subclinical infection
- Latent infection

SOURCES OF INFECTION

- Man
- Animals
- Insects
- Soil & water
- Food

MAN

- The commonest source of infection for man is man himself
- Carrier is a person who harbours the pathogenic microorganisms without suffering from any ill effect
- Types
  - Healthy
  - Convalescent
  - Temporary
  - Chronic
  - Contact
  - Paradoxical

ANIMALS

- Many pathogens are able to infect both man & animal
- Reservoir host – asymptomatic infection in animals
- Zoonoses – Infectious disease transmitted from animals to man

INSECTS

- Blood sucking insects may transmit pathogen to man

- The diseases so caused are called arthropod borne diseases
- Insects sudh as mosquitoes, ticks, mites, flies, fleas, & lice may transmit infection are called vectors

- Transmission may be mechanical or biological

SOIL & WATER

- Spores of tetanus bacilli may remain viable in soil for several decades & serve as source of infection

- Water acts as a source of infection due to contamination by pathogenic microorganisms cholera, hepatitis

FOOD

- Presence of pathogens in food may be due to external contamination
- or due to pre-existent infection in meat e.g. tapeworm infection

METHODS OF TRANSMISSION

Contact

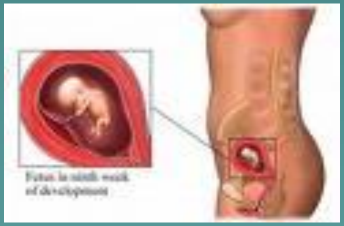
Inhalation

Ingestion

Inoculation

- Insects

Congenital



Iatrogenic

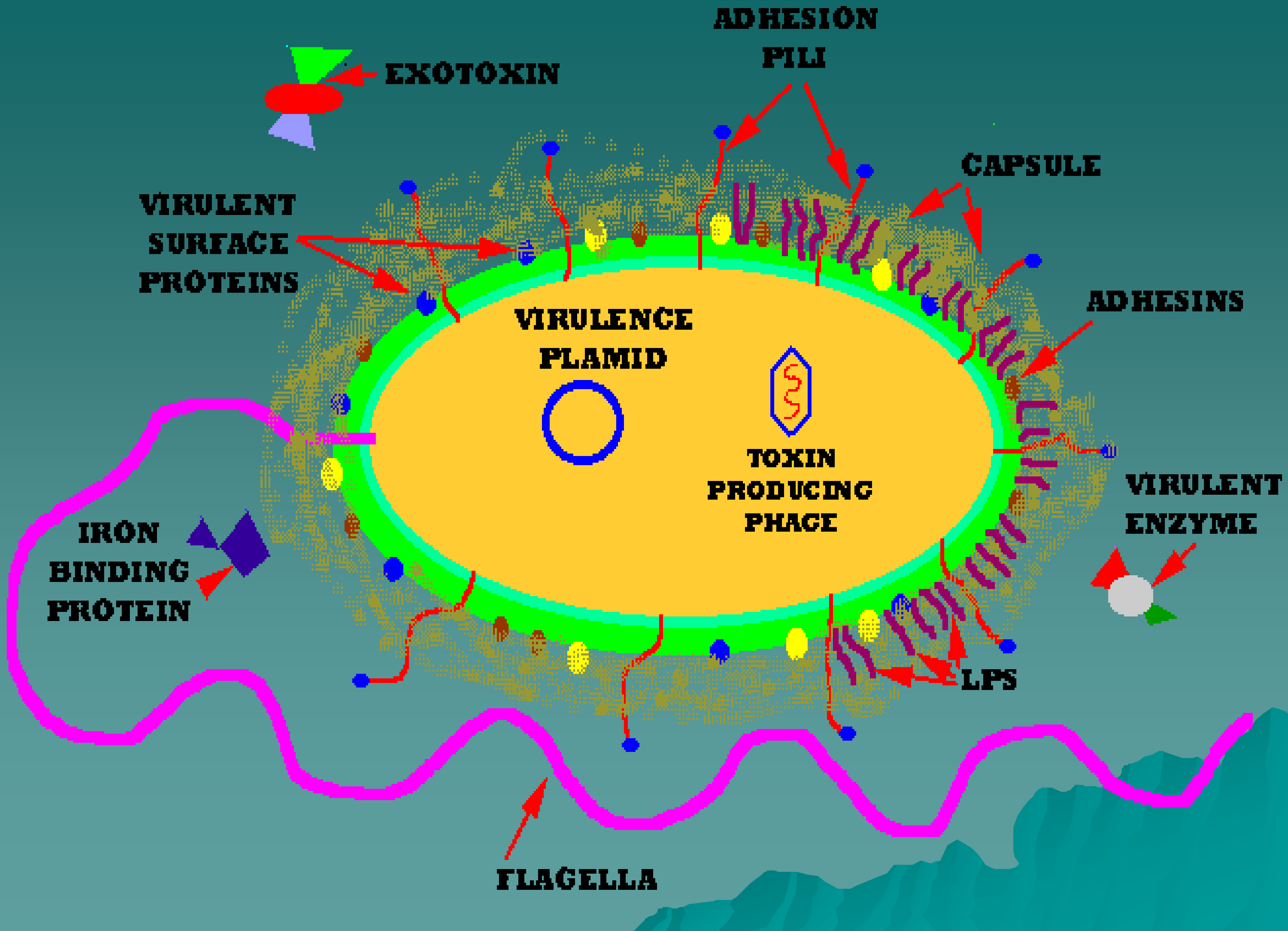
Laboratory

FACTORS PREDISPOSING TO MICROBIAL PATHOGENECITY

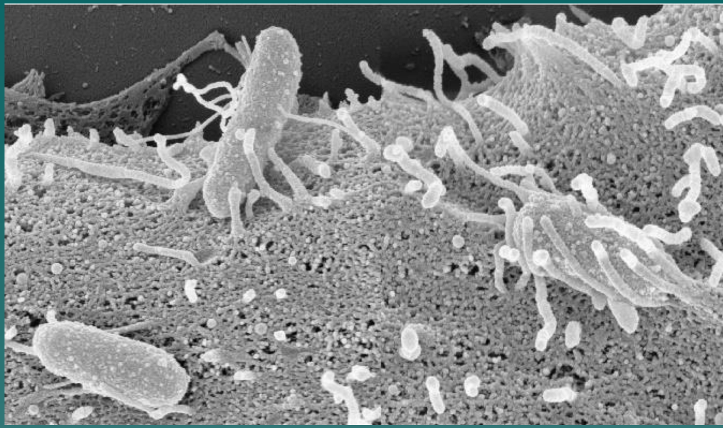
- The terms pathogenecity & virulence refer to the ability of microbe to produce disease or tissue injury
- Pathogenecity is generally employed to refer to the ability of microbe to produce disease
- Virulence is applied to the same property in a strain of microorganisms

VIRULENCE

- Adhesion
- Invasiveness
- Toxigenicity
- Communicability &
- Other bacterial products
- Bacterial appendages
- Infecting dose
- Route of infection

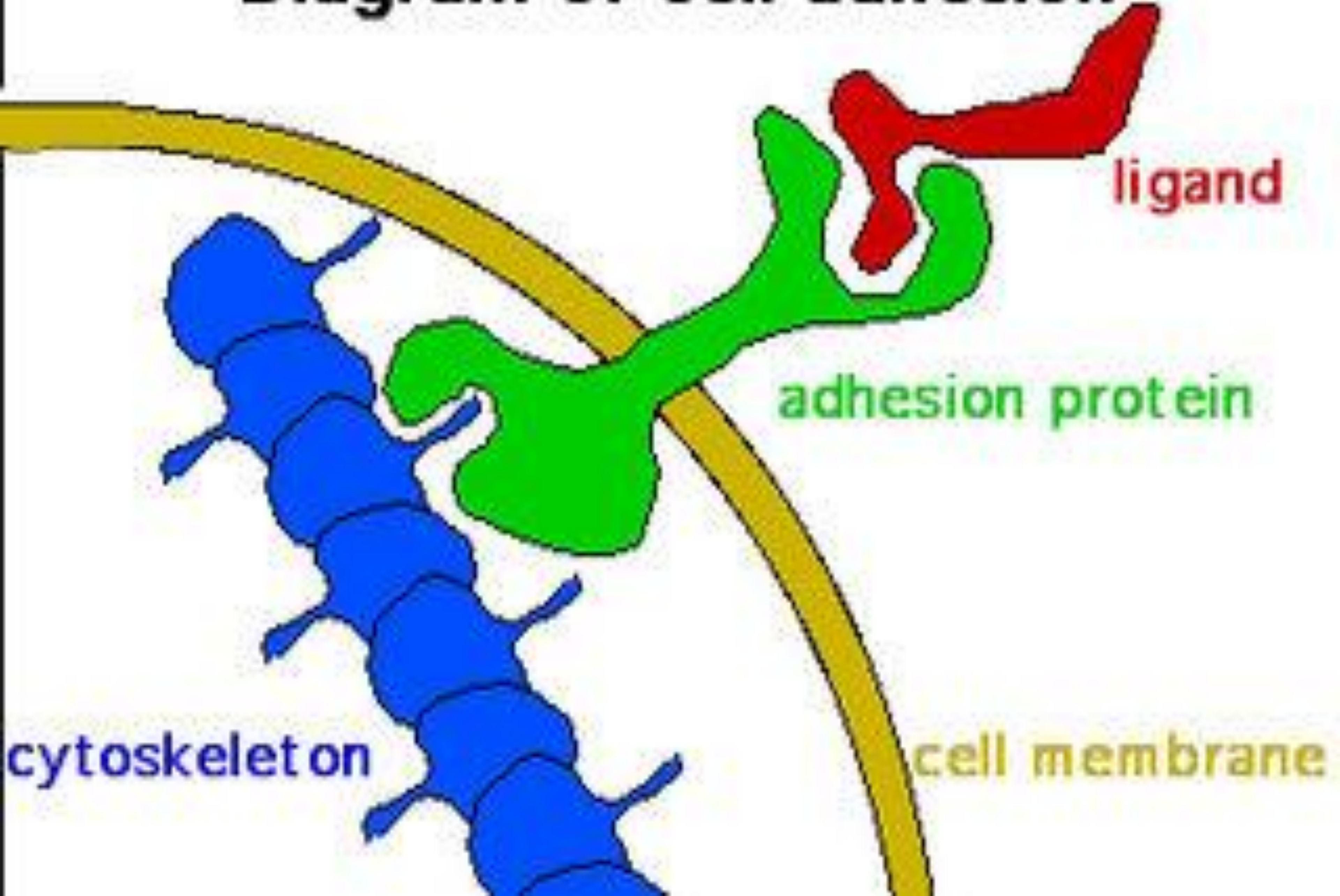

ADHESION PILI
EXOTOXIN
CAPSULE
VIRULENT SURFACE PROTEINS
ADHESINS
VIRULENCE PLAMID
TOXIN PRODUCING PHAGE
VIRULENT ENZYME
IRON BINDING PROTEIN
LPS
FLAGELLA

ADHESION



- Initial event in pathogenesis
- Specific reaction between surface receptors on the epithelial cells & adhesive structure on the surface of bacteria
- These adhesive structure called adhesins

Diagram of cell adhesion



INVASIVENESS

- Ability of a pathogen to spread in the host tissue after establishing infection

- Highly invasive pathogens produce spreading lesions

Enzymes like hyaluronidase assist them

- Less invasive pathogen caused localised lesion or tghey get localised becoz of coagulase enzyme

TOXIGENICITY

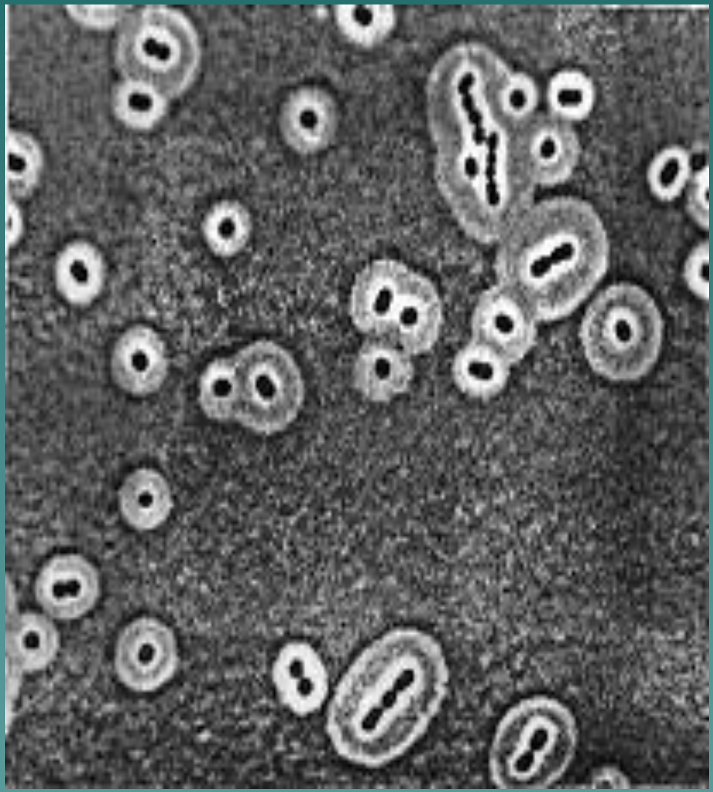
EXOTOXINS	ENDOTOXINS
Proteins	Protein-polysaccharide-lipid
Heat labile	Heat stable
Actively secreted by cells	Forms part of cell wall
Separable from cultures by filtration	Obtained by cell lysis
Specific pharmacological effect	Effect nonspecific
Specific tissue affinities	No specific tissue affinity
Active in minute doses	Active in large doses
Highly antigenic	Weakly antigenic
Action specifically neutralised by antibody	Neutralisation by antibody insffective
Can be toxoided	Cannot be toxoided
Produced by gram positive bacteria	Gram negative bacteria

OTHER BACTERIAL PRODUCTS

- Coagulase
- Fibrinolysins
- Hyaluronidases
- Haemolysins
- Leucocidins

BACTERIAL APPENDAGES

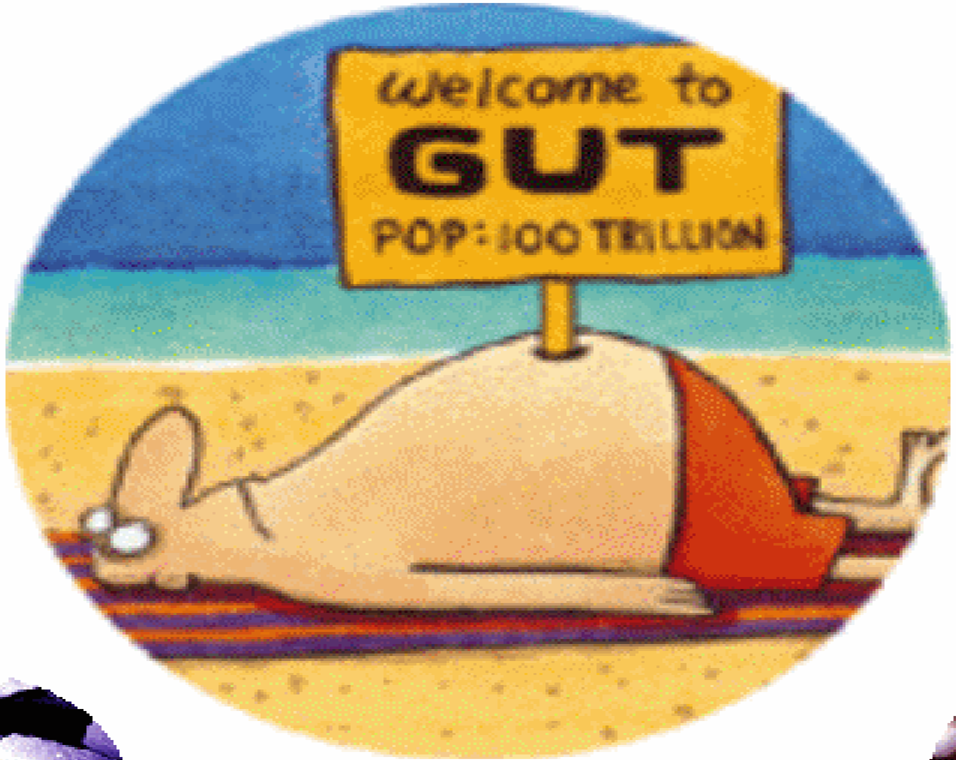
- Capsule helps the bacteria to withstand phagocytosis & the lytic activity of complement

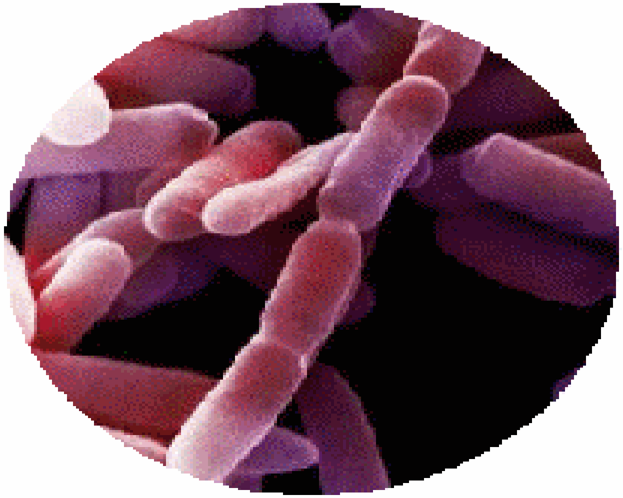


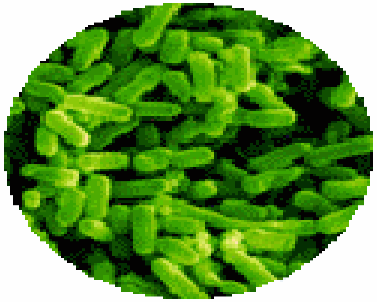
INFECTING DOSE

- Successful infections require that adequate number of bacteria should gain entry.
- This dosage may be estimated as the minimum infecting dose or minimum lethal dose

NORMAL FLORA







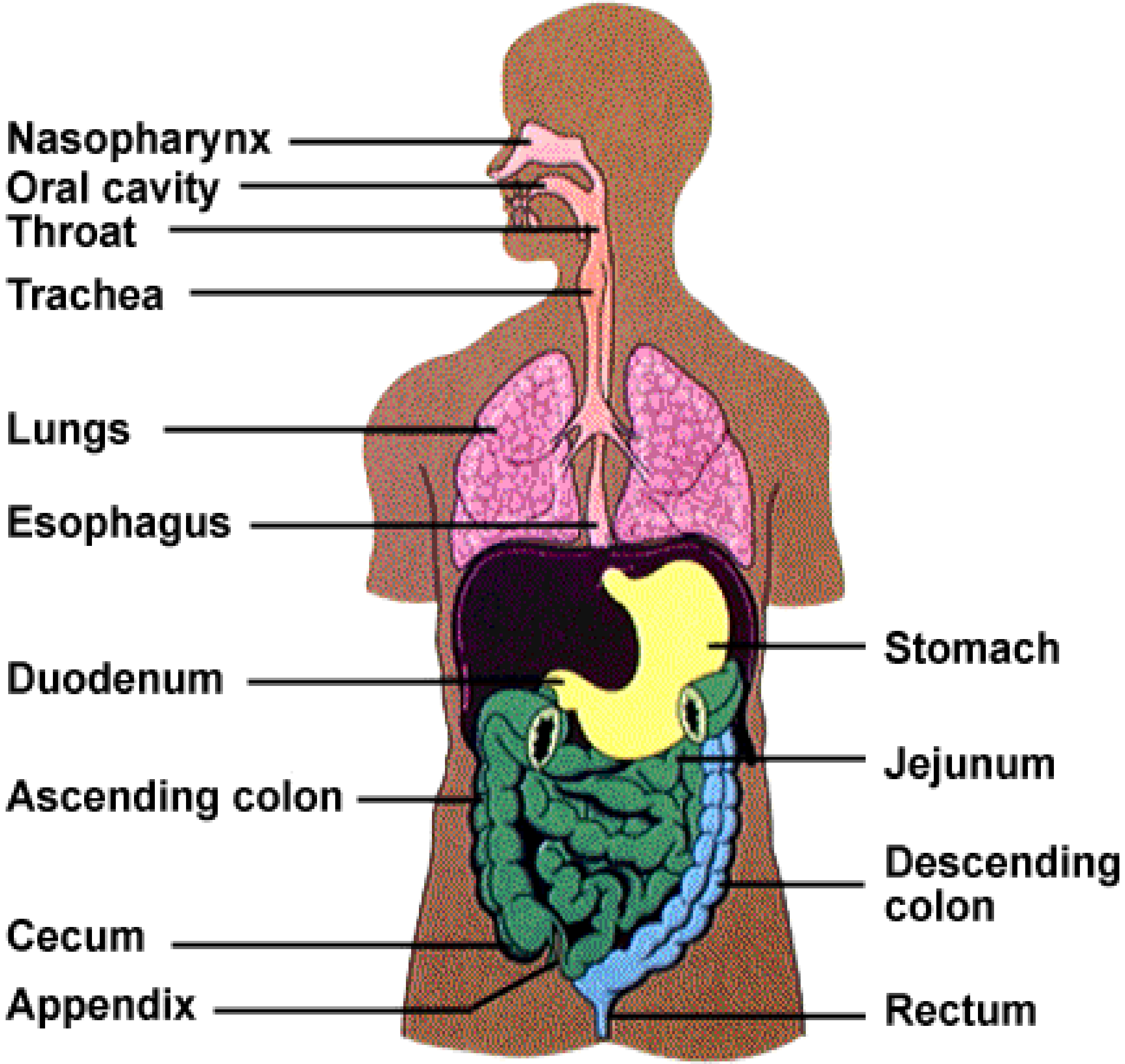
INTRODUCTION

- Microbes are everywhere.
- They populate the air, the water, the soil, and have even evolved intimate relationships with plants and animals.
- Without microbes, life on earth would cease.
- This is due mainly to the essential roles microbes play in the systems that support life on earth, such as nutrient cycling and photosynthesis.

MICROBES AND YOU

- You are covered with microorganisms!
- Microbes that colonize the human body during birth or shortly thereafter, remaining throughout life, are referred to as normal flora
- Normal flora can be found in many sites of the human body including the skin (especially the moist areas, such as the groin and between the toes),
- respiratory tract (particularly the nose),
- urinary tract, and
- the digestive tract (primarily the mouth and the colon).
- On the other hand, areas of the body such as the brain, the circulatory system and the lungs are intended to remain sterile (microbe free).

LOCATION OF NORMAL MICROBIAL FLORA



LIFE ON THE SURFACE, THE SKIN

- Human skin is not a particularly rich place for microbes to live.
- The skin surface is relatively dry, slightly acidic and the primary source of nutrition is dead cells.
- This is an environment that prevents the growth of many microorganisms, but a few have adapted to life on our skin.
- *Propionibacterium acnes* is a Gram positive bacterium that inhabits the skin.
- Another prominent member of the skin flora is *Staphylococcus epidermidis*. This is a highly adapted Gram positive bacterium that can survive at many sites throughout the body
- *Micrococci*
- *Diphtheroids (Coryneforms*)

A BACTERIAL SNEEZE, THE NOSE

- The human nose is home to the infamous Gram positive bacterium *Staphylococcus aureus*, best known for its role in hospitals where it is a major cause of surgical wound and systemic infection.
- Infections of this bacterium are now a very serious threat to human health because it has become resistant to all commercially available antibiotics, including methicillin and vancomycin.
- It is often carried in the noses of health care workers and transmitted from patient to patient. Why some people carry *S. aureus* while others do not, is unknown.

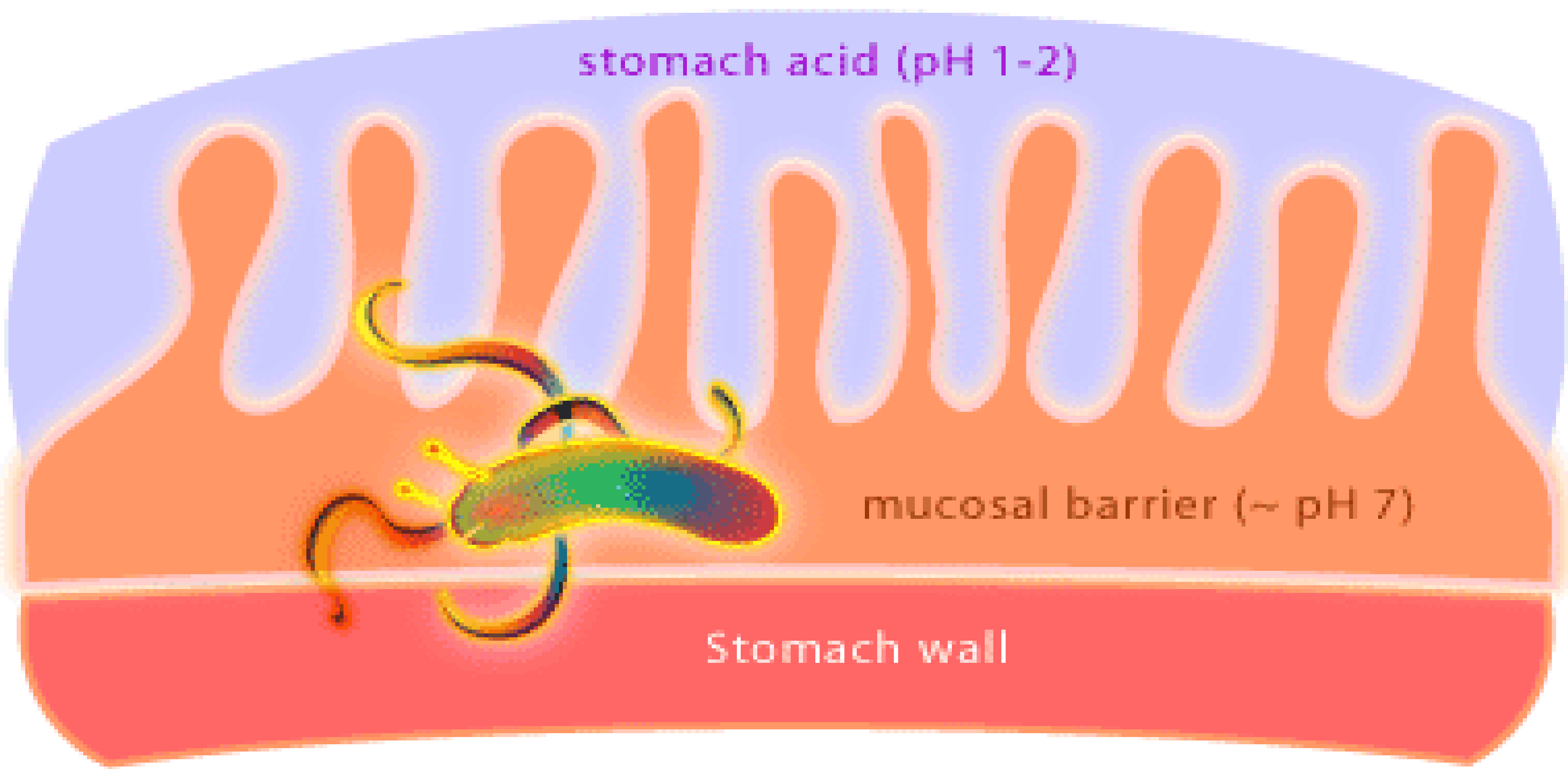
A MOUTHWASH AWAY

- It's estimated that 500-600 different kinds of bacteria thrive on mucus and food remnants in the mouth.
- A predominant member of this community is the Gram positive bacterium *Streptococcus mutans*.
- It grows on biofilms on the surface of teeth (plaque) where it consumes sugar and converts it to lactic acid.
- Lactic acid erodes the enamel on the surface of teeth, which leads to the formation of cavities.
- *Streptococcus pneumoniae* is a much more threatening bacteria that can colonize the mouth.
- It's an opportunistic pathogen that resides in the mouth and throat awaiting an opportunity to infect the lungs when defense systems are low, such as following an infection with influenza (the flu).
- Under normal circumstances the growth of *S. mutans* out competes the growth of *S. pneumoniae* in the mouth.

BRAVING STOMACH ACID

- What kind of organism would live in a highly acidic (pH 1-2) environment like the stomach? Not surprising there aren't many organisms that have adapted to life in this environment.
- One organism that has been discovered living in the human stomach is the Gram negative bacterium called *Helicobacter pylori*.
- How can it survive? Well, it creates a less acidic microenvironment.
- The bacteria achieve this by burrowing into the stomach's mucosal lining to a depth where the pH is essentially neutral.
- In addition, *H. pylori* produce an enzyme called urease to convert urea produced by the stomach into ammonia and carbon dioxide.

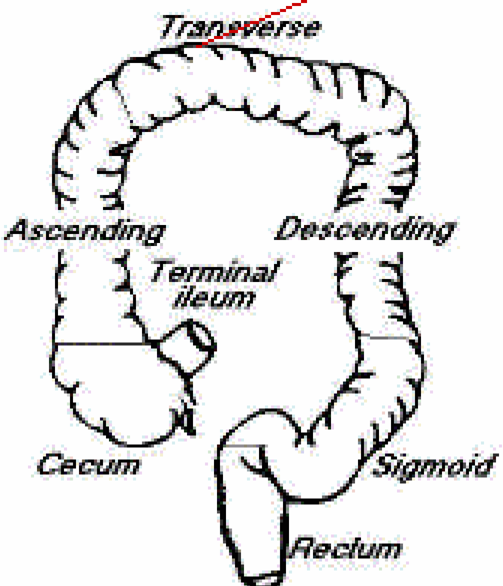
H. plyori creates it own microenvironment by burrowing into the mucosal lining of the stomach. Within the lining, the microbe is then able to avoid pH levels that would normally kill it. Here, it may also produce ulcers.

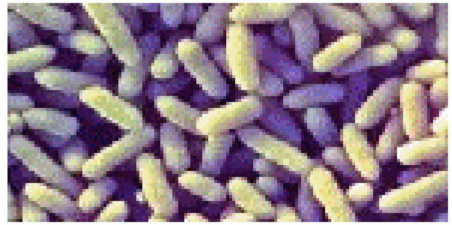


SMALL INTESTINE VS. THE COLON

- Compared to the stomach, the small intestine is a relatively hospitable environment
- However, the small intestine presents microbes with a new challenge—high flow rates.
- This makes it difficult for bacteria to colonize the small intestine because they get washed out very quickly.
- As a result the concentration of bacteria in the small intestine remains relatively low (106 bacteria per ml) and human enzymes carry out most of the digestion processes.
- Minimizing the concentration of bacteria in the small intestine may be a strategy that our bodies have adapted in order to avoid microbial competition for high value nutrients such as simple sugars and proteins.
- In the colon, things slow down. While it takes about 3-5 hours for food to move through the small intestine, it takes 24-48 hours for food to travel through the colon.
- This slower flow rate gives bacteria in the colon time to reproduce so that they reach very high concentrations (1012-1013 bacteria per ml).

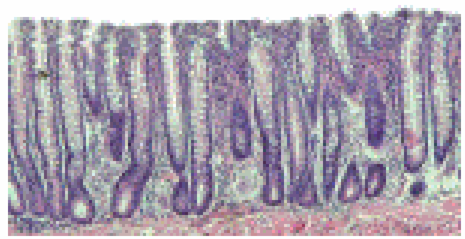
Intestinal bacteria: the hidden organ





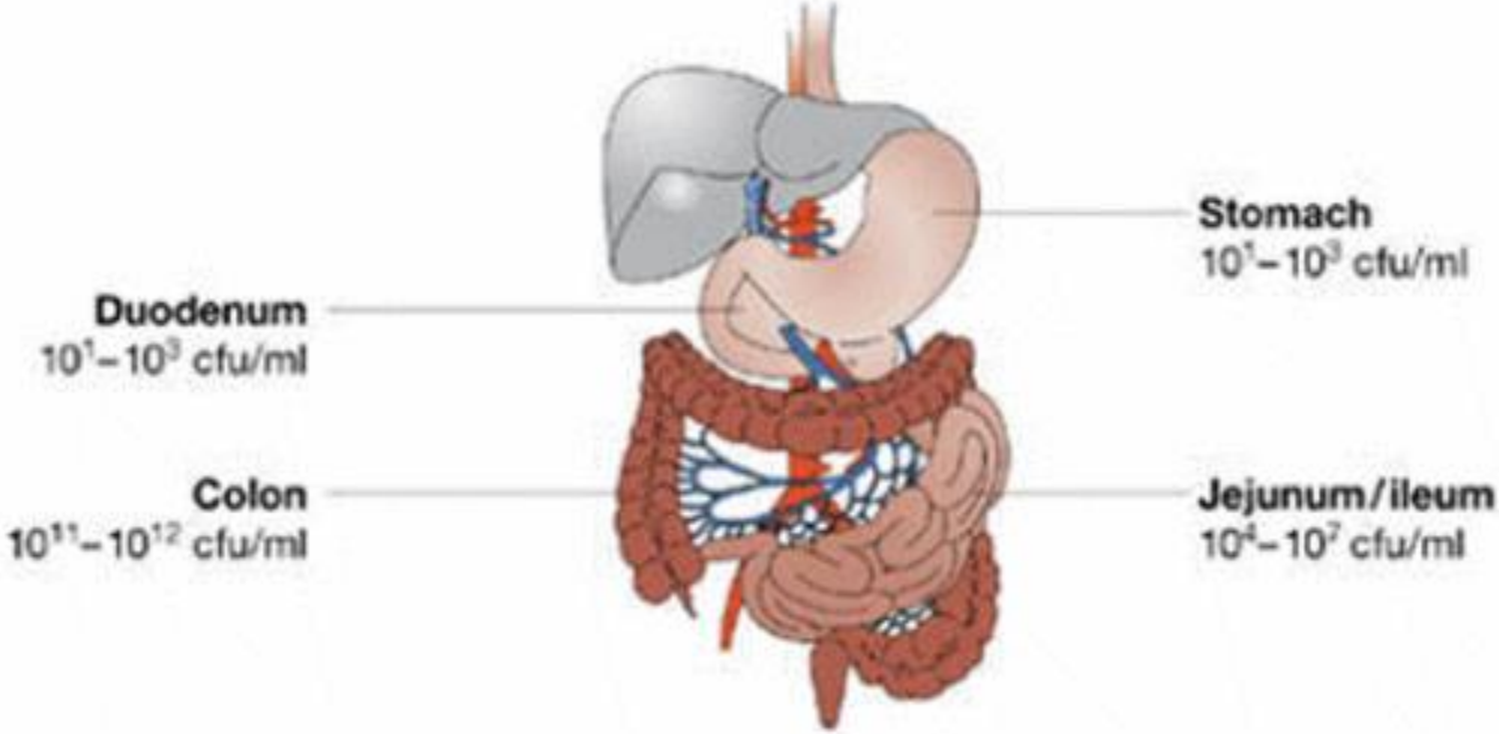
- More bacteria than cells in the body

- More bacteria than people on the planet



- Metabolic activity is a virtual organ

- Microbiome > Human genome

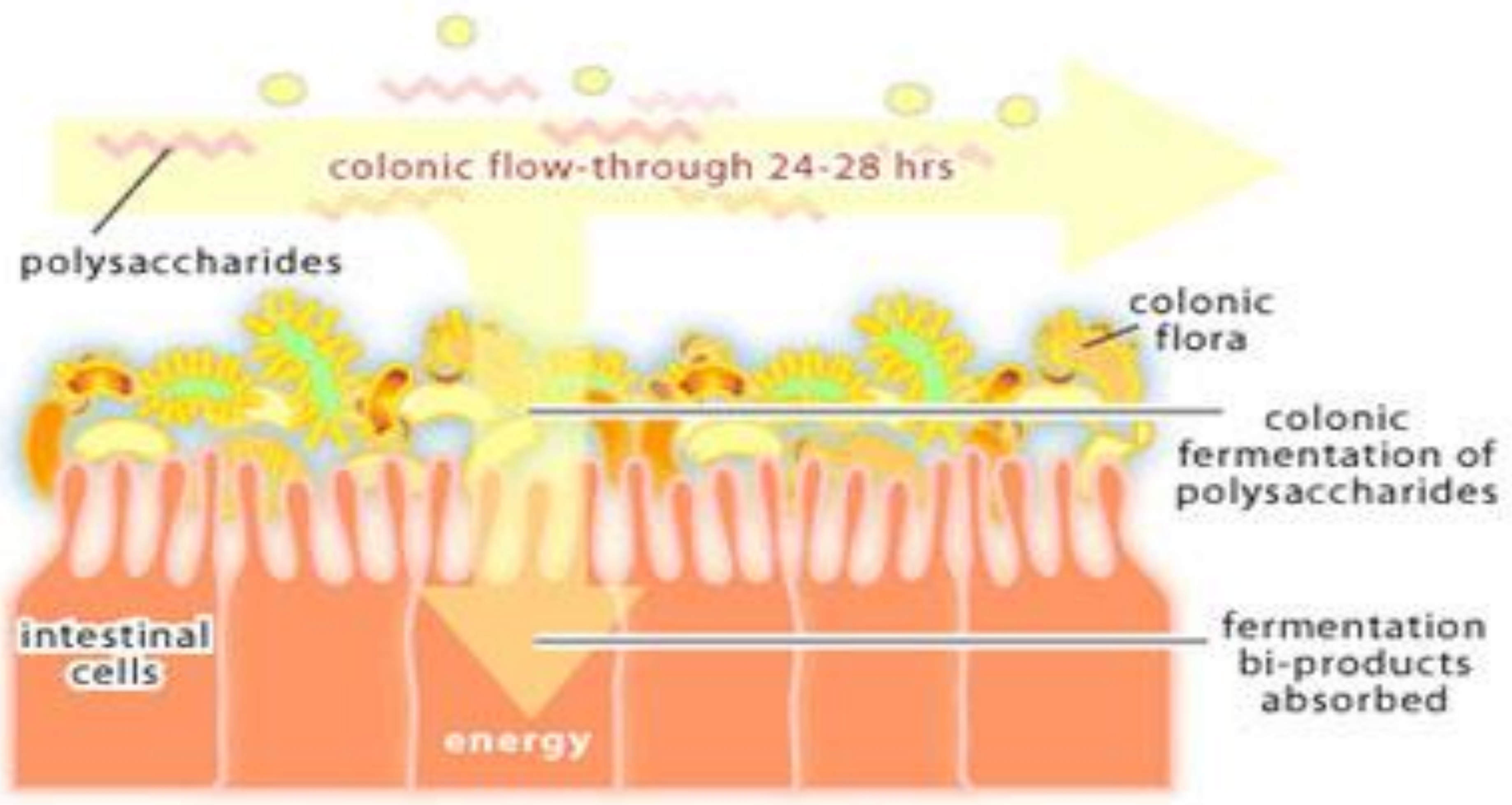


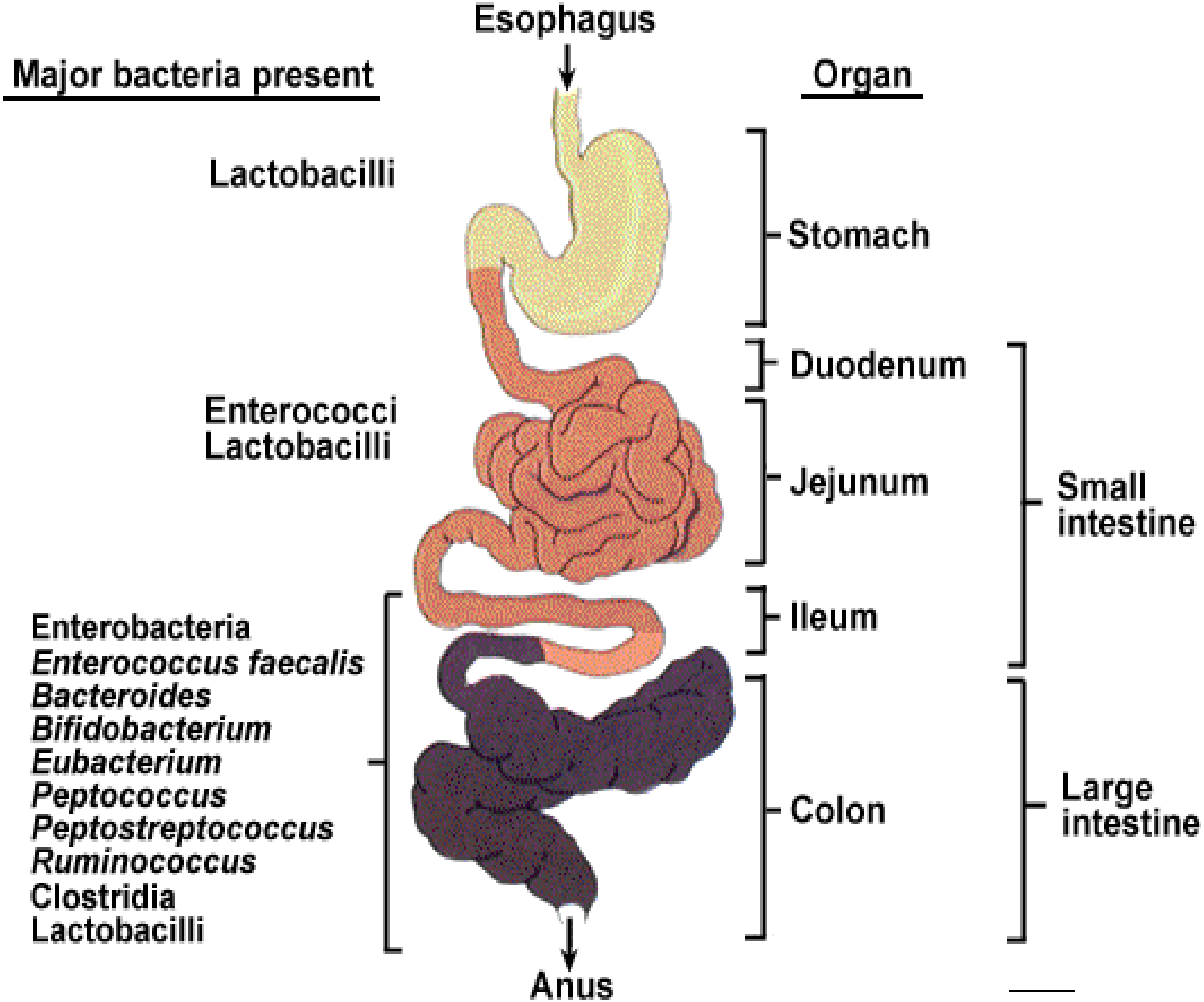
Anaerobic genera	Aerobic genera
Bifidobacterium	*Escherichia*
Clostridium	*Enterococcus*
Bacteroides	*Streptococcus*
Eubacterium	*Klebsiella*

SMALL INTESTINE VS. THE COLON (CONT.)

- The colon is a holding tank for bacteria that participate in the end stages of food digestion.
- For it is here that bacteria are presented with polysaccharides that cannot be broken down by human enzymes.
- The process of polysaccharide degradation in the colon is referred to as colonic fermentation.
- These polysaccharides are derived from plant material (eg. cellulose, xylan and pectin) and from human cells (eg. the polysaccharides that glue intestinal cells together) and are readily degraded by colonic bacteria.
- Polysaccharide fermentation results in the production of acetate, butyrate and propionate, which are used as a source of carbon and energy by mucosal cells of the colon. Thus, the colon can be considered an organ of digestion where bacteria do the majority of the work.

A Colonic Habitant. Microbial flora within the colon are able to digest polysaccharides that float by, which would otherwise be indigestible.




Esophagus
Major bacteria present
Organ
Lactobacilli
Stomach
Duodenum
Enterococci
Lactobacilli
Jejunum
Small intestine
Ileum
Enterobacteria
Enterococcus faecalis
Bacteroides
Bifidobacterium
Eubacterium
Peptococcus
Peptostreptococcus
Ruminococcus
Clostridia
Lactobacilli
Colon
Large intestine
Anus

VAGINAL

- Relative to other microbial populations of the human body little is known about the normal flora of the vaginal tract.
- The predominant bacterial species are *Lactobacillus*.
- As is the case in other areas of the body, the presence of normal flora in the vaginal tract appears to have a protective role since women taking antibiotics for acne or urinary tract infections who have reduced levels of *Lactobacillus* often develop yeast infections.
- It is thought that *Lactobacillus* may prevent the growth of yeast by producing hydrogen peroxide, a bi-product of bacterial metabolism.

BRINGING IT ALL TOGETHER

The examples presented above describe a few examples of normal flora around the human body. From these examples several common themes can be extracted and to summarize, let’s discuss these themes:

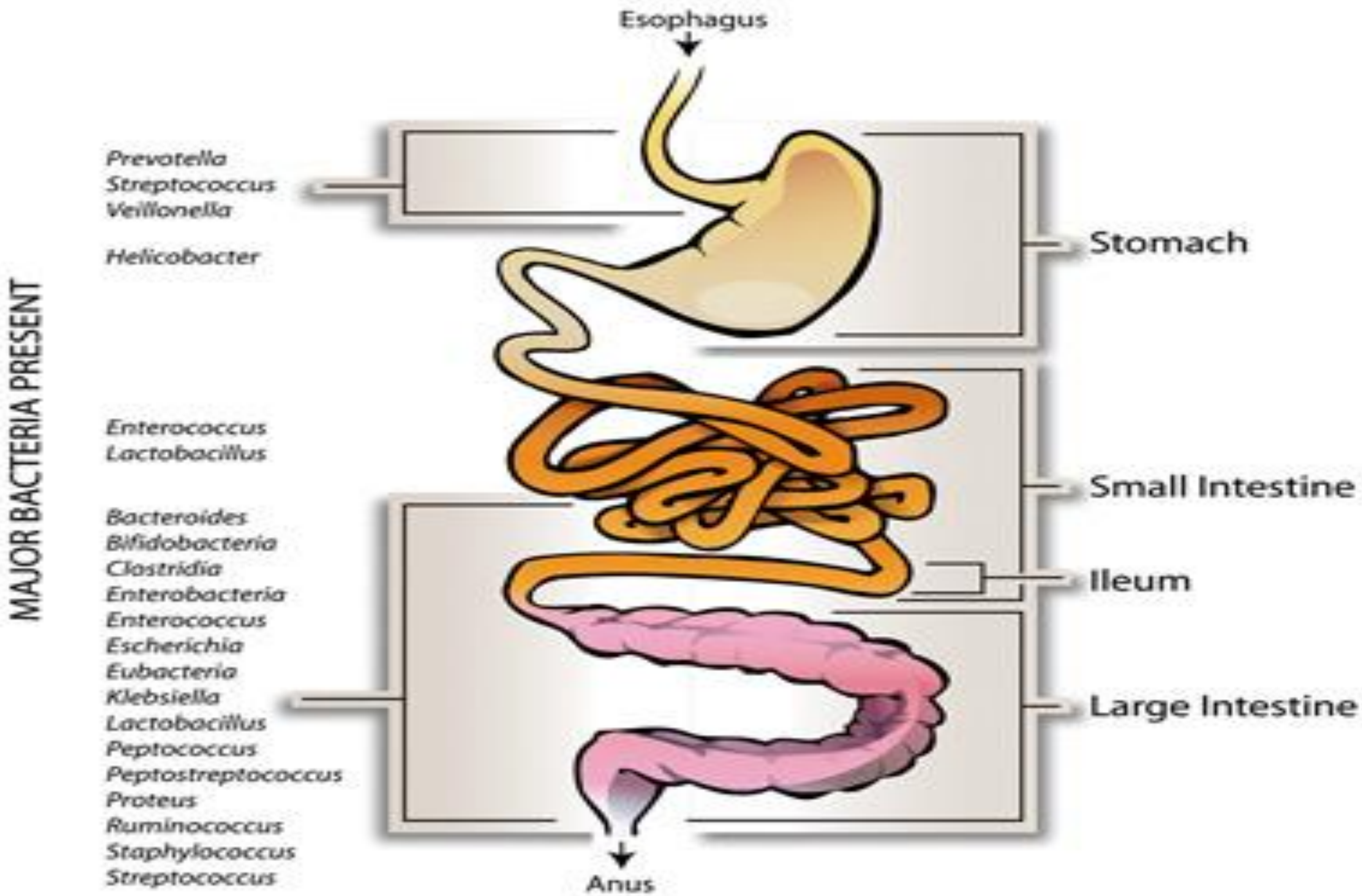
1. Bacteria perform physiological, nutritional and protective functions in the human body.

2. Maintaining a balance is crucial. Normal flora consists of communities of bacteria that function as microbial ecosystems. If these ecosystems are disrupted the consequences can be unpredictable. Antibiotics, tissue damage, medical procedures, changes in diet, and the introduction of new pathogens are examples of changes that can affect your normal flora.

BRINGING IT ALL TOGETHER

3. We are only beginning to appreciate the complexity and function of normal flora in the human body. Our understanding of microbial communities has been limited by our ability to culture microbes in the laboratory environment. It is thought that less that less than 1% of bacteria will grow on standard laboratory media. That means that we have yet to explore greater than 99% the microbial world. Today, new technologies such as the polymerase chain reaction (PCR), high-throughput DNA sequencing and DNA microarrays are starting to provide glimpses into these microbial ecosystems.

Figure A. Distribution of Nonpathogenic Microorganisms in Healthy Humans. Many of These Bacteria Possess Enzymes That Can Cleave ß-glycosidic Linkages



* Microbial Interactions with Humans. Chapter 21: 700-725. In: Madigan MT, Martinko JM. *Brock Biology of Microorganisms*. Pearson Prentice Hall, 2005.

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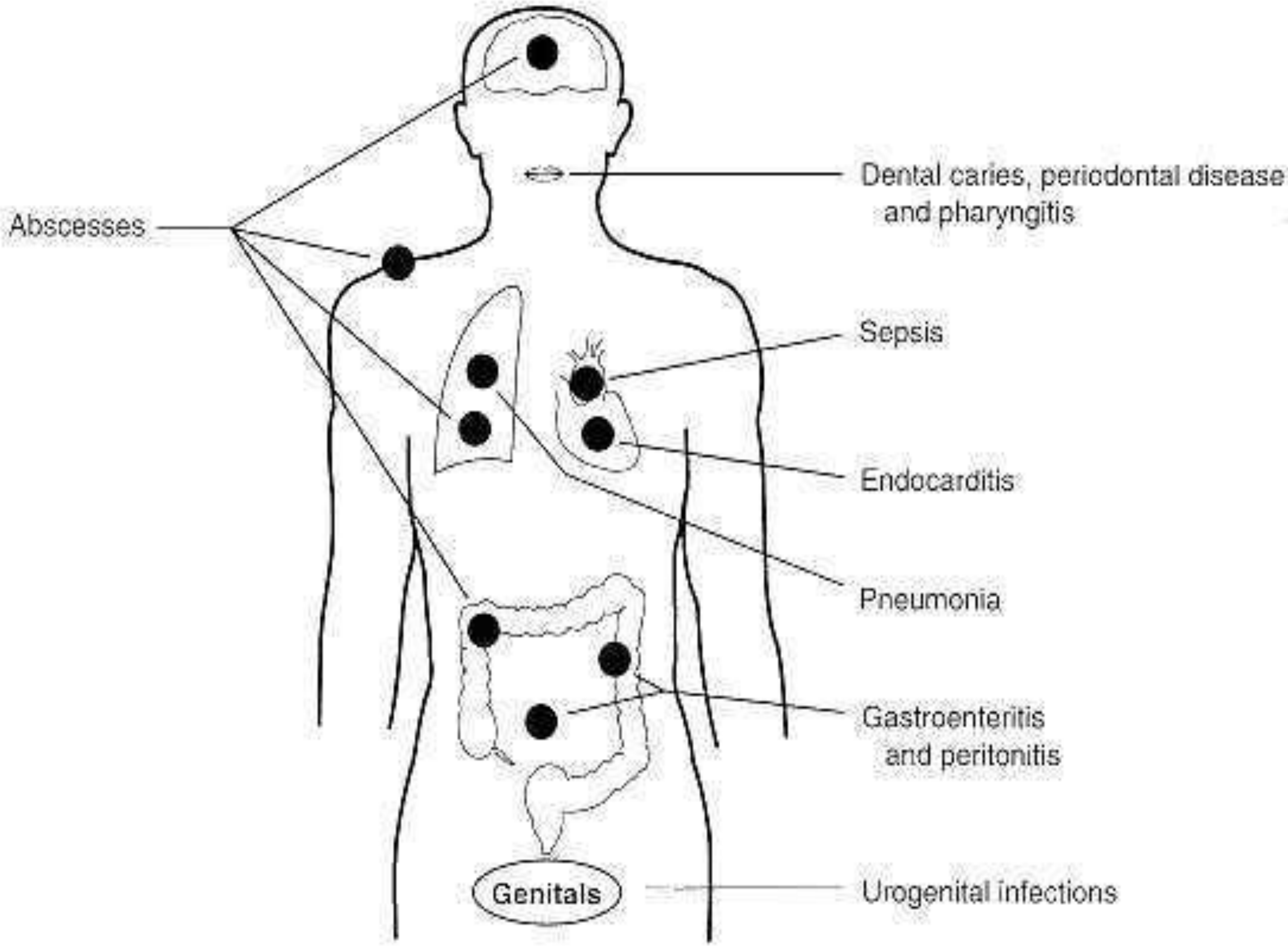
Representative microorganisms in the normal flora of humans

ANATOMICAL SITE	ORGANISM[A]
Skin	*Staphylococcus, Corynebacterium, Acinetobacter, Pityrosporum* (yeast), *Propionibacterium*
Mouth	*Streptococcus, Lactobacillus, Fusobacterium, Veillonella, Corynebacterium, Neisseria, Actinomyces*
Respiratory tract	*Streptococcus, Staphylococcus, Corynebacterium, Neisseria*
Gastrointestinal tract	*Lactobacillus, Streptococcus, Bacteroides, Bifidobacterium, Eubacterium, Peptococcus, Peptostreptococcus, Ruminococcus, Clostridium, Escherichia, Klebsiella, Proteus, Enterococcus*
Urogenital tract	*Escherichia, Klebsiella, Proteus, Neisseria, Lactobacillus (vagina* of mature females)


Dental caries, periodontal disease
and pharyngitis
Abscesses
Sepsis
Endocarditis
Pneumonia
Gastroenteritis
and peritonitis
Genitals
Urogenital infections

Thank You,
Thank You,