

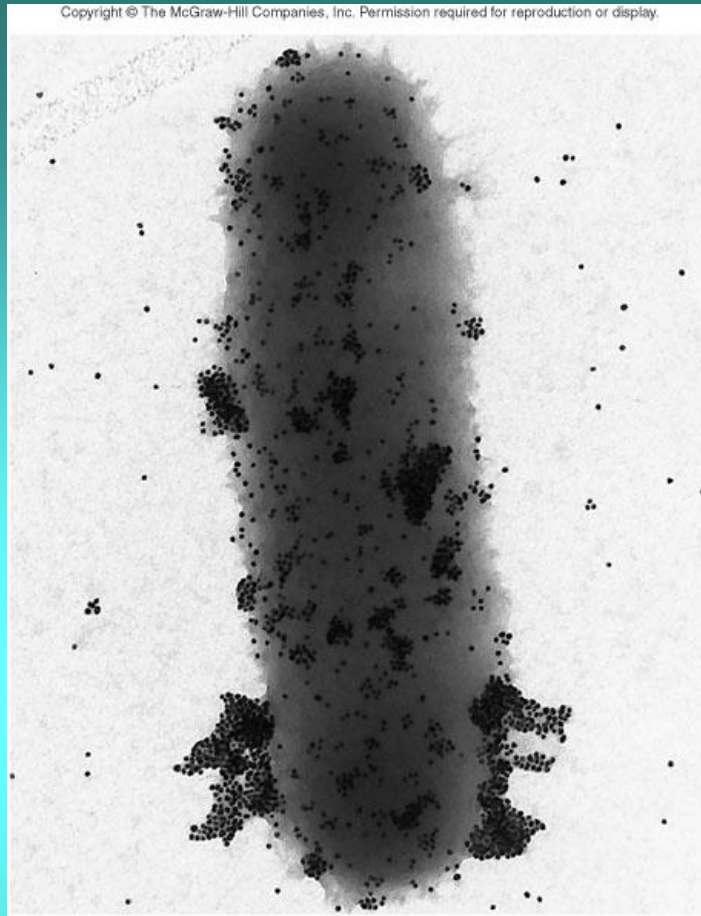
Foundations in Microbiology

Fifth Edition

Talaro

Chapter

20

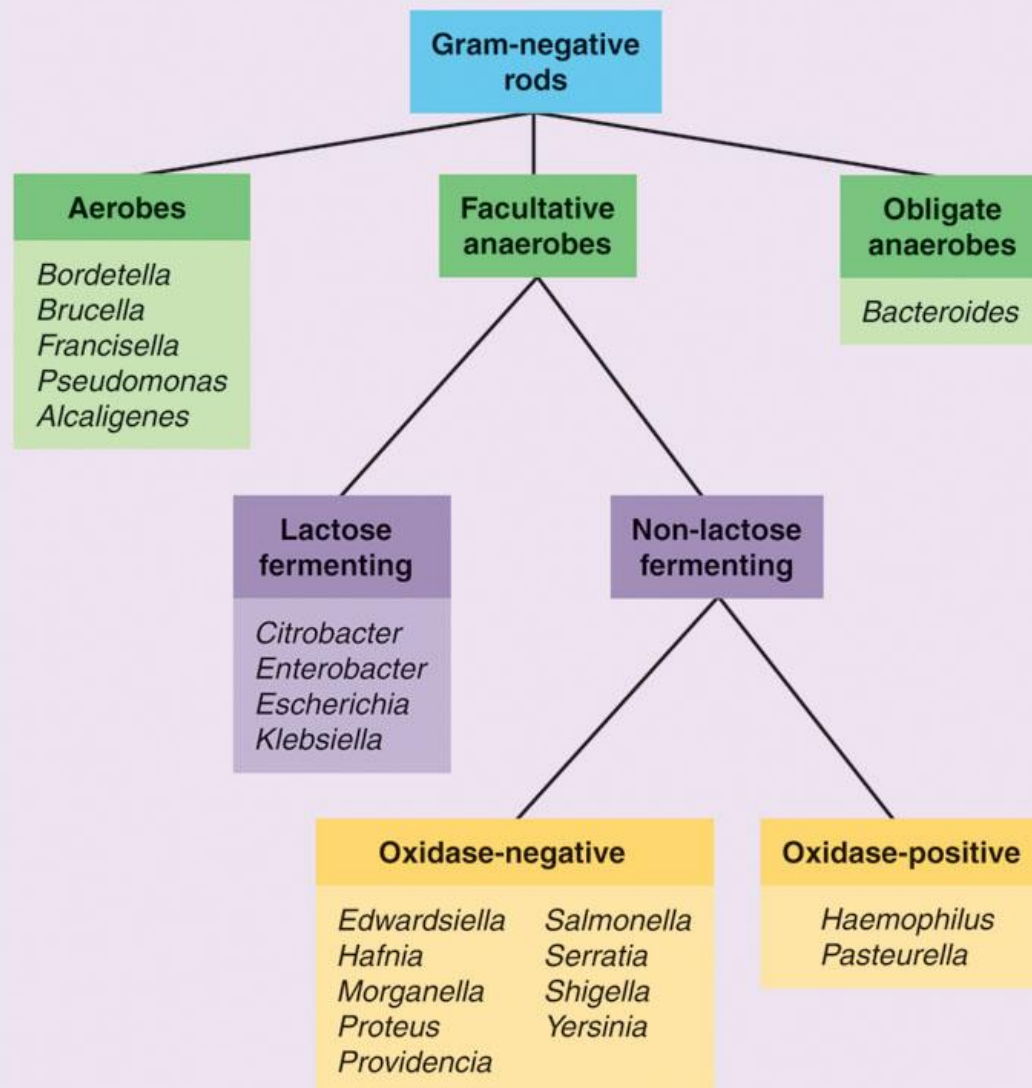


The Gram-Negative Bacilli of Medical Importance

Chapter 20

TABLE 20.1

Gram Negative Pathogens



Aerobic Gram-Negative Bacilli

- *Pseudomonas* – an opportunistic pathogen
- *Brucella* & *Francisella* – zoonotic pathogens
- *Bordetella* & *Legionella* – mainly human pathogens
- *Alcaligenes* – opportunistic pathogen

Pseudomonas

- small gram-negative rods with a single polar flagellum, produce oxidase & catalase
- highly versatile metabolism

Pseudomonas aeruginosa

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Pseudomonas aeruginosa

- common inhabitant of soil & water
- intestinal resident in 10% normal people
- resistant to soaps, dyes, quaternary ammonium disinfectants, drugs, drying
- frequent contaminant of ventilators, IV solutions, anesthesia equipment
- opportunistic pathogen

Pseudomonas aeruginosa

- common cause of nosocomial infections in hosts with burns, neoplastic disease, cystic fibrosis
- complications include pneumonia, UTI, abscesses, otitis, & corneal disease
- endocarditis, meningitis, bronchopneumonia
- grapelike odor
- greenish-blue pigment (pyocyanin)
- multidrug resistant
- cephalosporins, aminoglycosides, carbenicillin, polymixin, quinolones, & monobactams

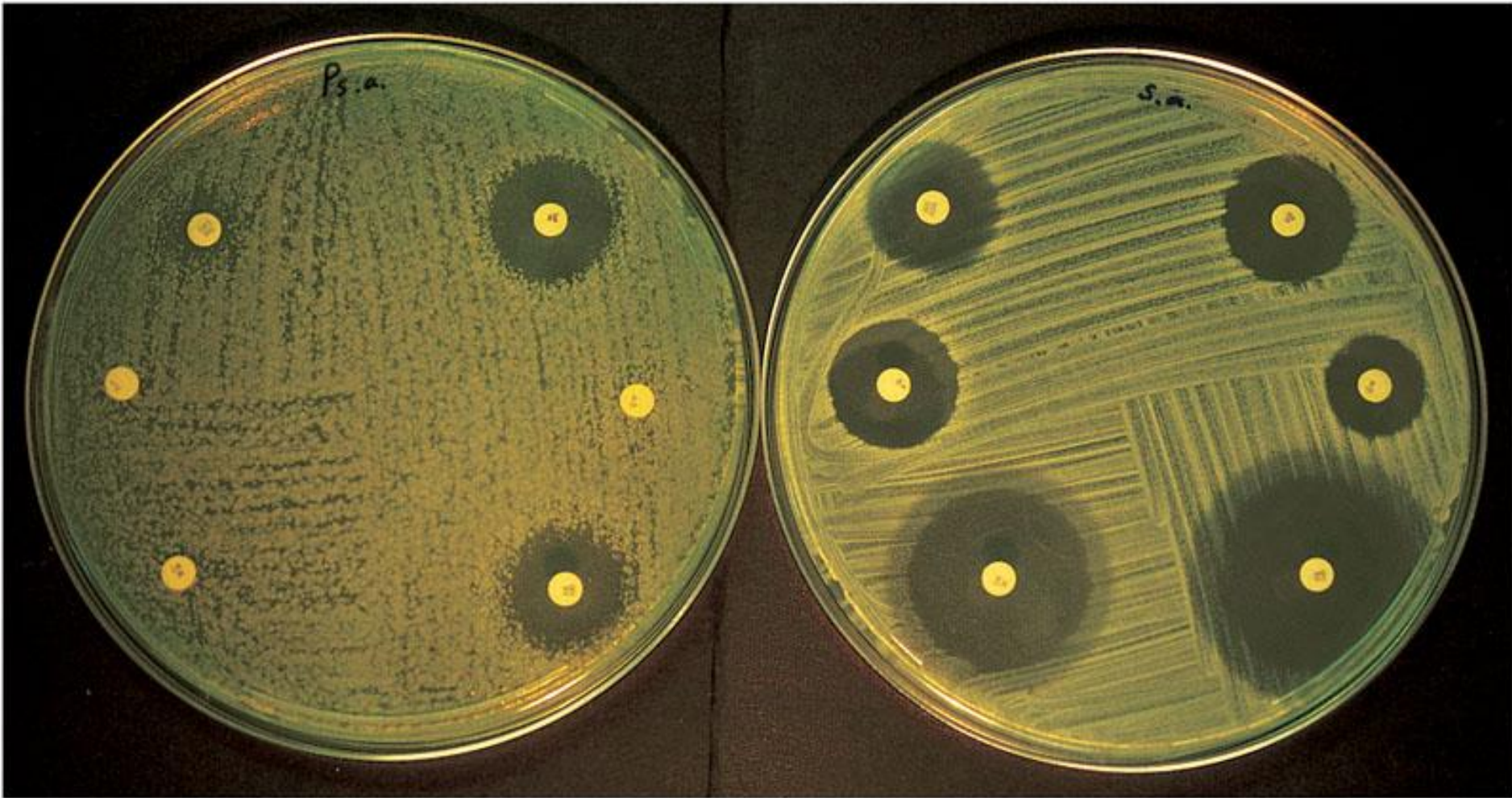
Pseudomonas aeruginosa

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Pseudomonas aeruginosa

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Bordetella pertussis

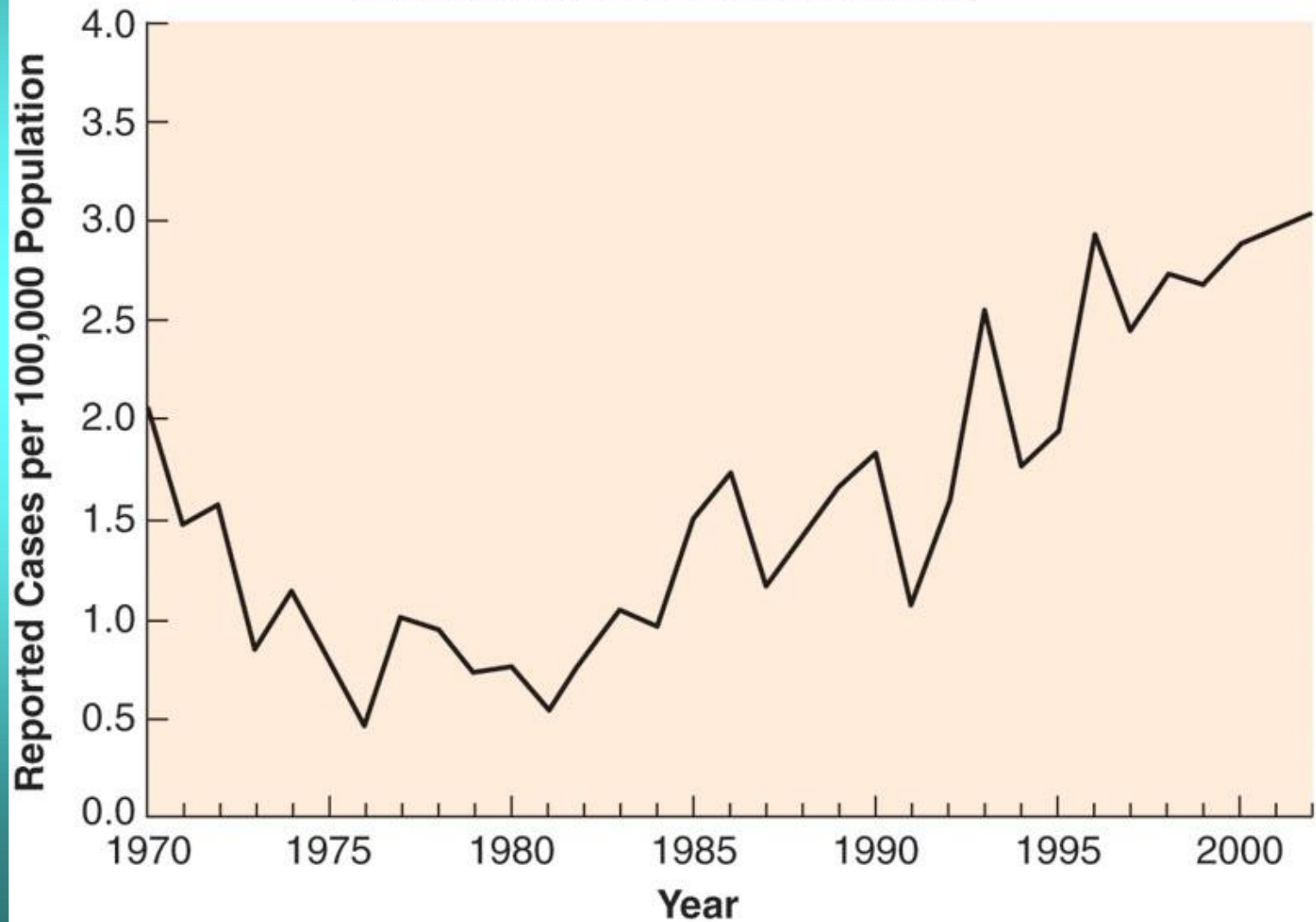
- minute, encapsulated coccobacillus
- causes pertussis or whooping cough, a communicable childhood affliction
- acute respiratory syndrome
- often severe, life-threatening complications in babies
- reservoir – apparently healthy carriers
- transmission by direct contact or inhalation of aerosols

Bordetella pertussis

- virulence factors
 - receptors that recognize & bind to ciliated respiratory epithelial cells
 - toxins that destroy & dislodge ciliated cells
- loss of ciliary mechanism leads to buildup of mucus & blockage of the airways
- vaccine – DTaP- acellular vaccine contains toxoid & other Ags

Pertussis

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Legionella pneumophila

- widely distributed in water
- live in close association with amebas
- 1976 epidemic of pneumonia afflicted 200 American Legion members attending a convention in Philadelphia & killed 29
- Legionnaires disease & Pontiac fever
- prevalent in males over 50
- nosocomial disease in elderly patients
- fever, cough, diarrhea, abdominal pain, pneumonia
fatality rate of 3-30%
- azithromycin

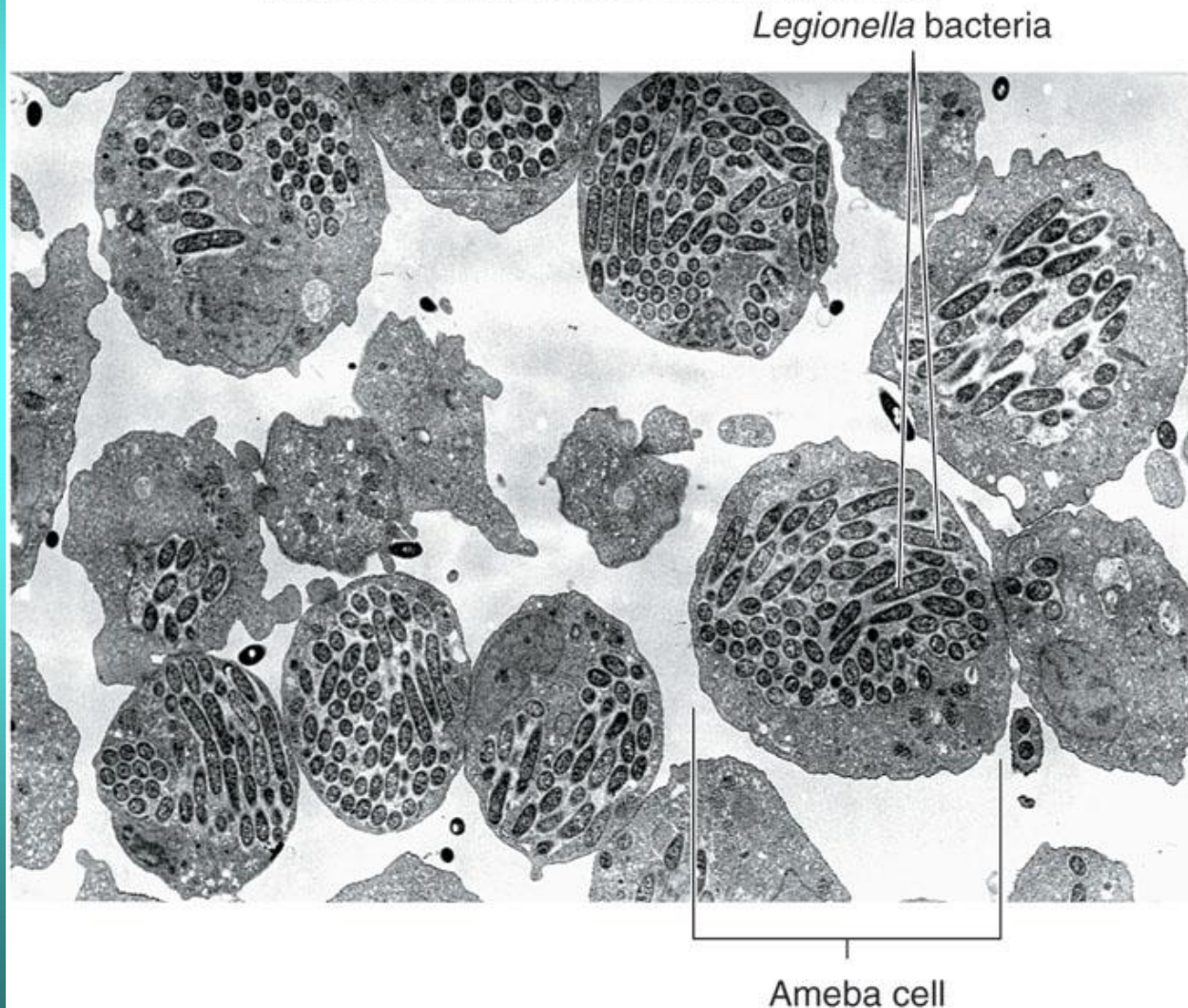
Legionella pneumophila

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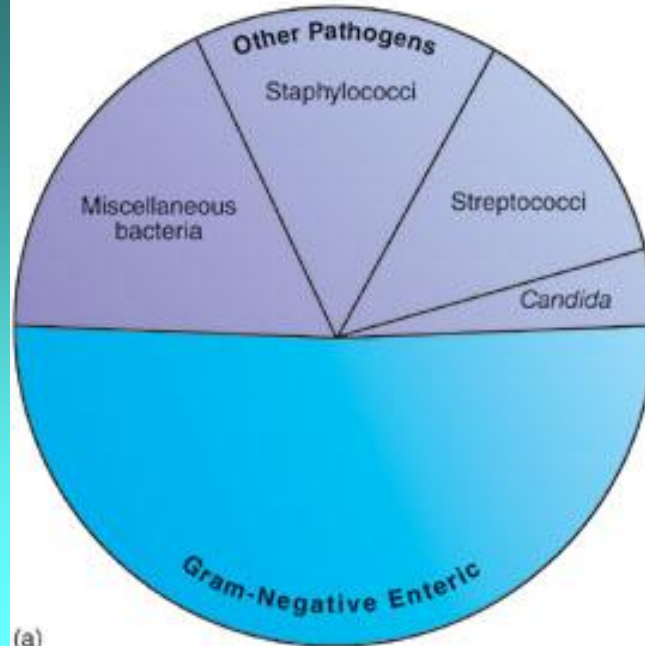
Legionella pneumophila

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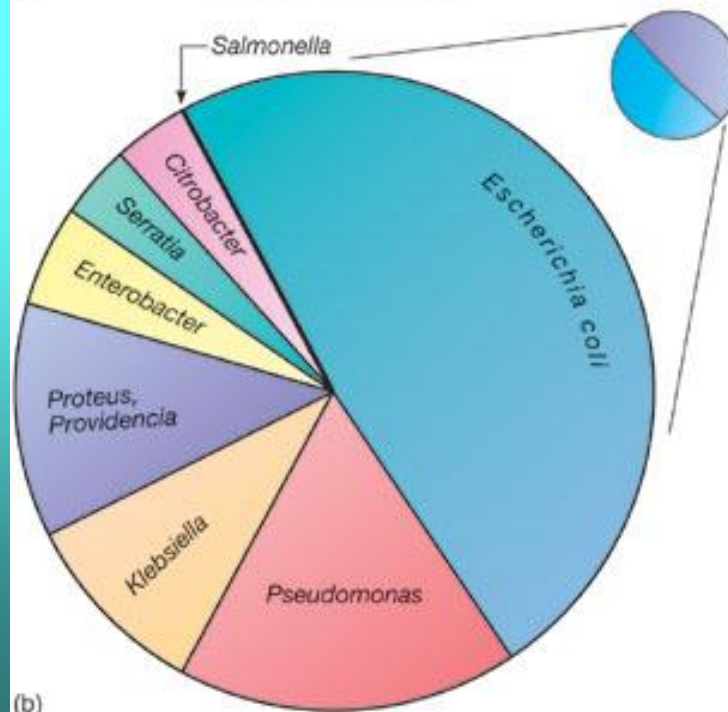


Enterobacteriaceae Family

- enterics
- large family of gram-negative bacteria
- many members inhabit soil, water, & decaying matter & common occupants of large bowel of humans & animals
- all members are small, non-sporing rods
- facultative anaerobes, grow best in air
- cause diarrhea through enterotoxins
- divided into coliforms (lactose fermenters) and non-coliforms (non lactose fermenters)



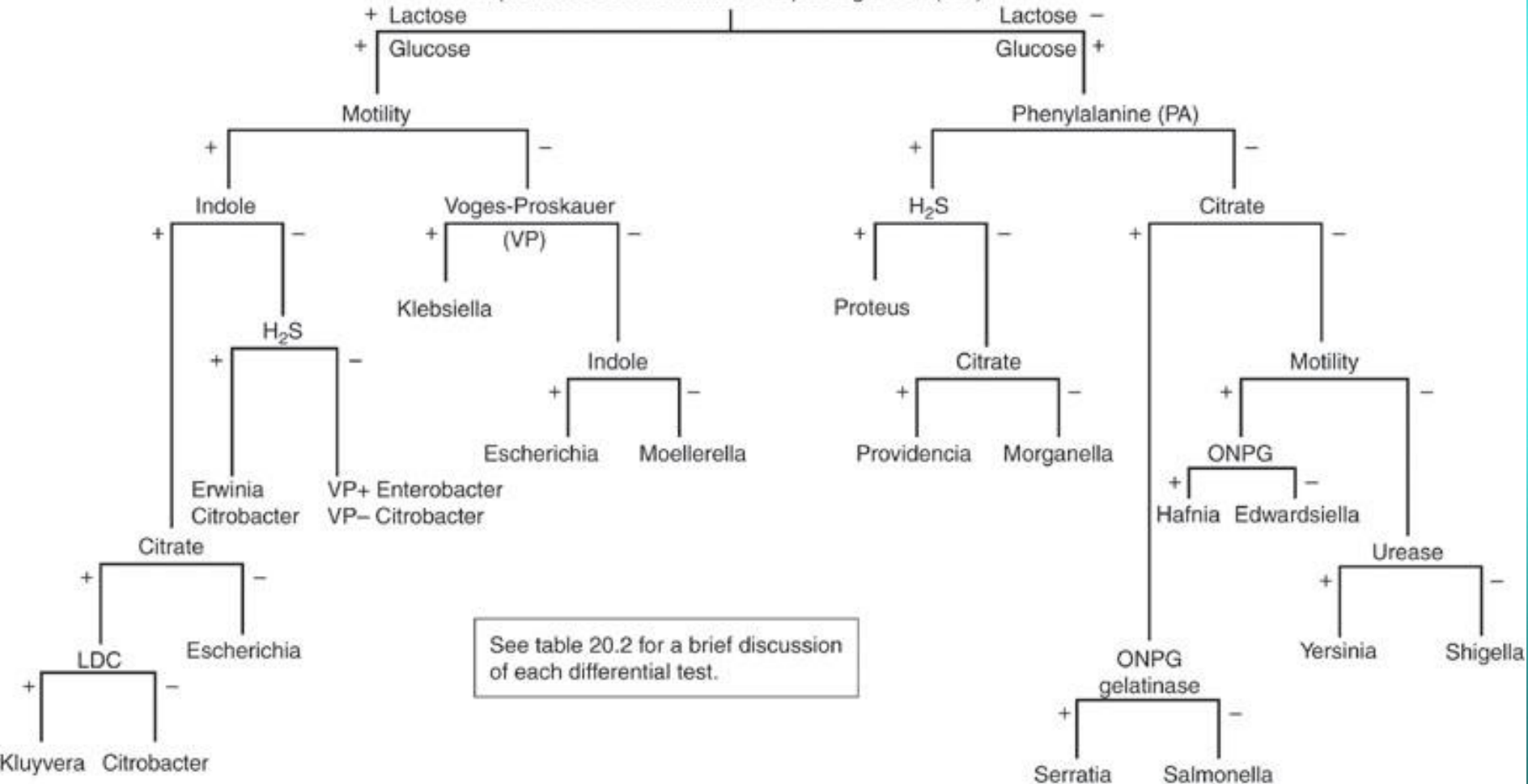
(a)



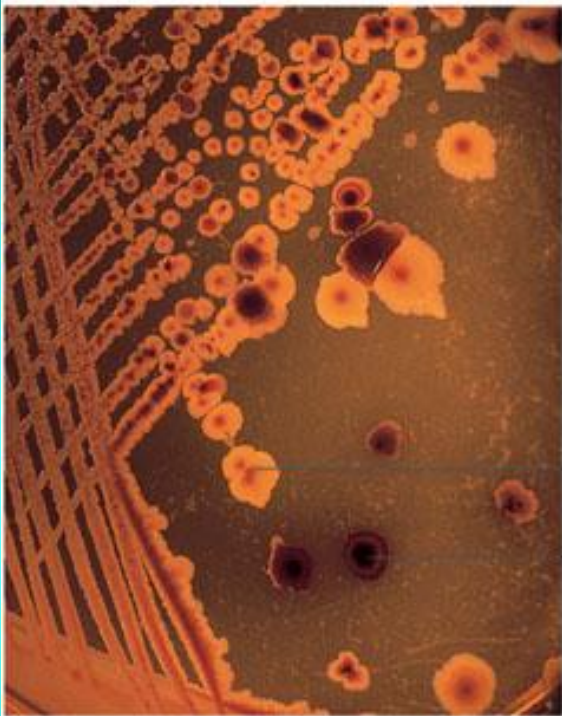
(b)



Rapid lactose fermentation on triple-sugar iron (TSI)



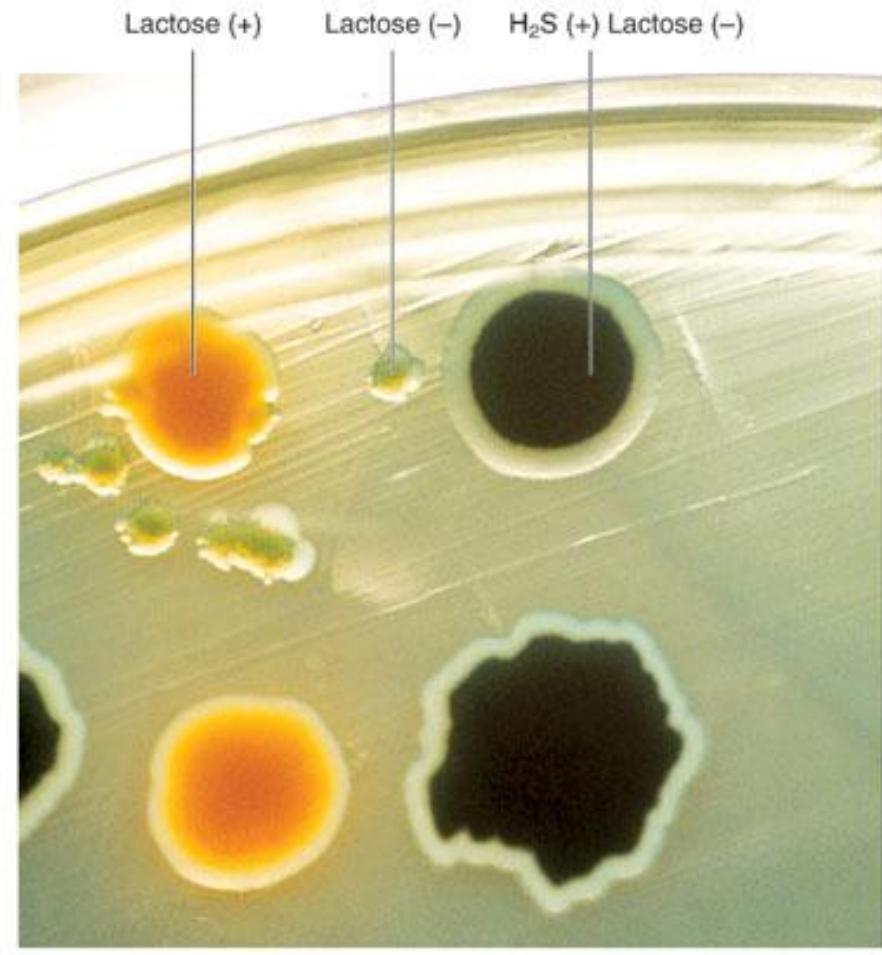
See table 20.2 for a brief discussion of each differential test.



Lactose (-)

Lactose (+)

(a)



(b)

FIGURE 20.10

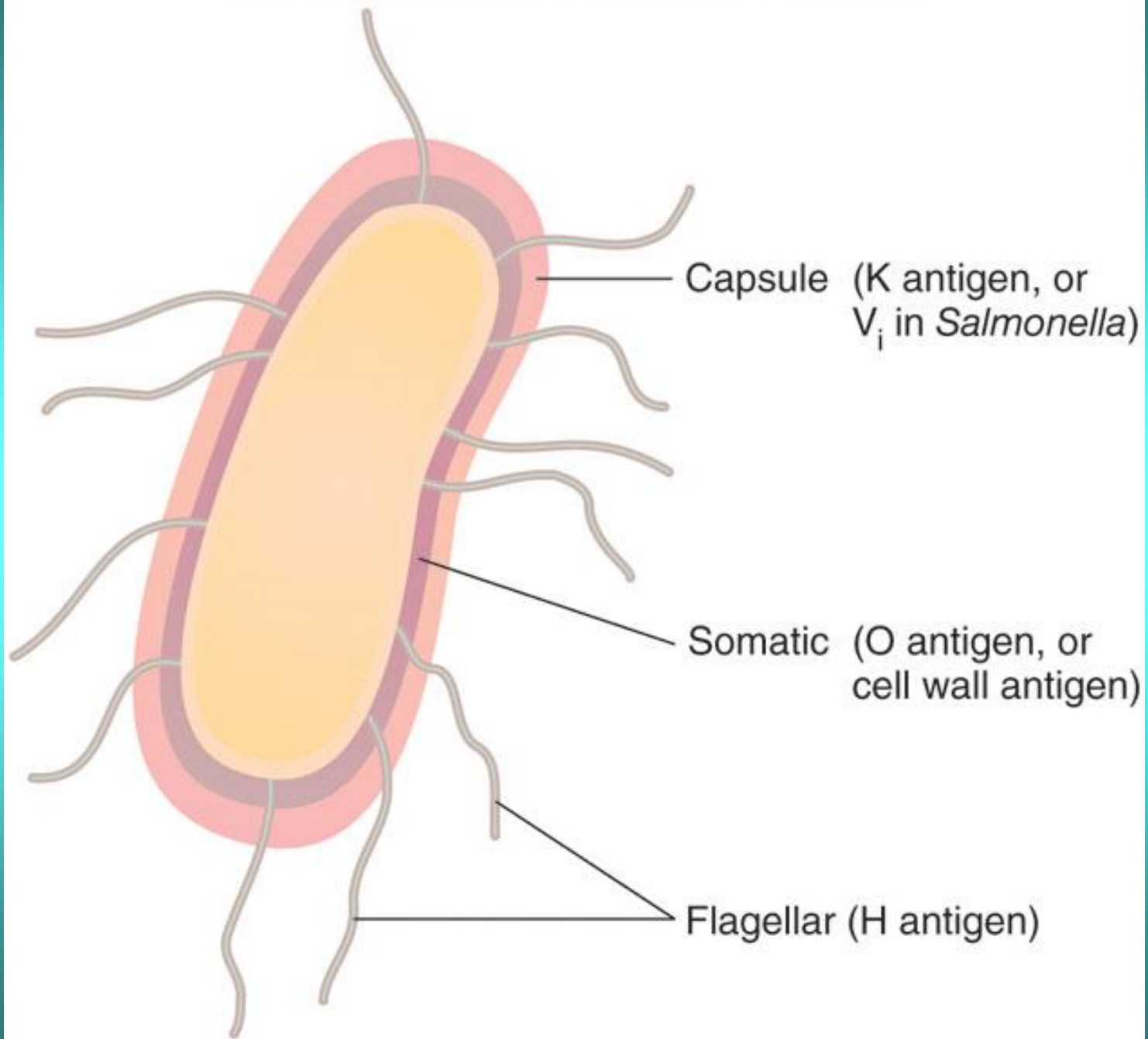
Isolation media for enterics, showing differentiating reactions.

(a) Levine's eosin methylene blue (EMB) agar. **(b)** Hektoen enteric agar.

(See table 20.2.)

Antigens & virulence factors

- H – flagellar Ag
- K – capsule &/or fimbrial Ag
- O – somatic or cell wall Ag – all have
- endotoxin
- exotoxins



Escherichia coli: the most prevalent enteric bacillus

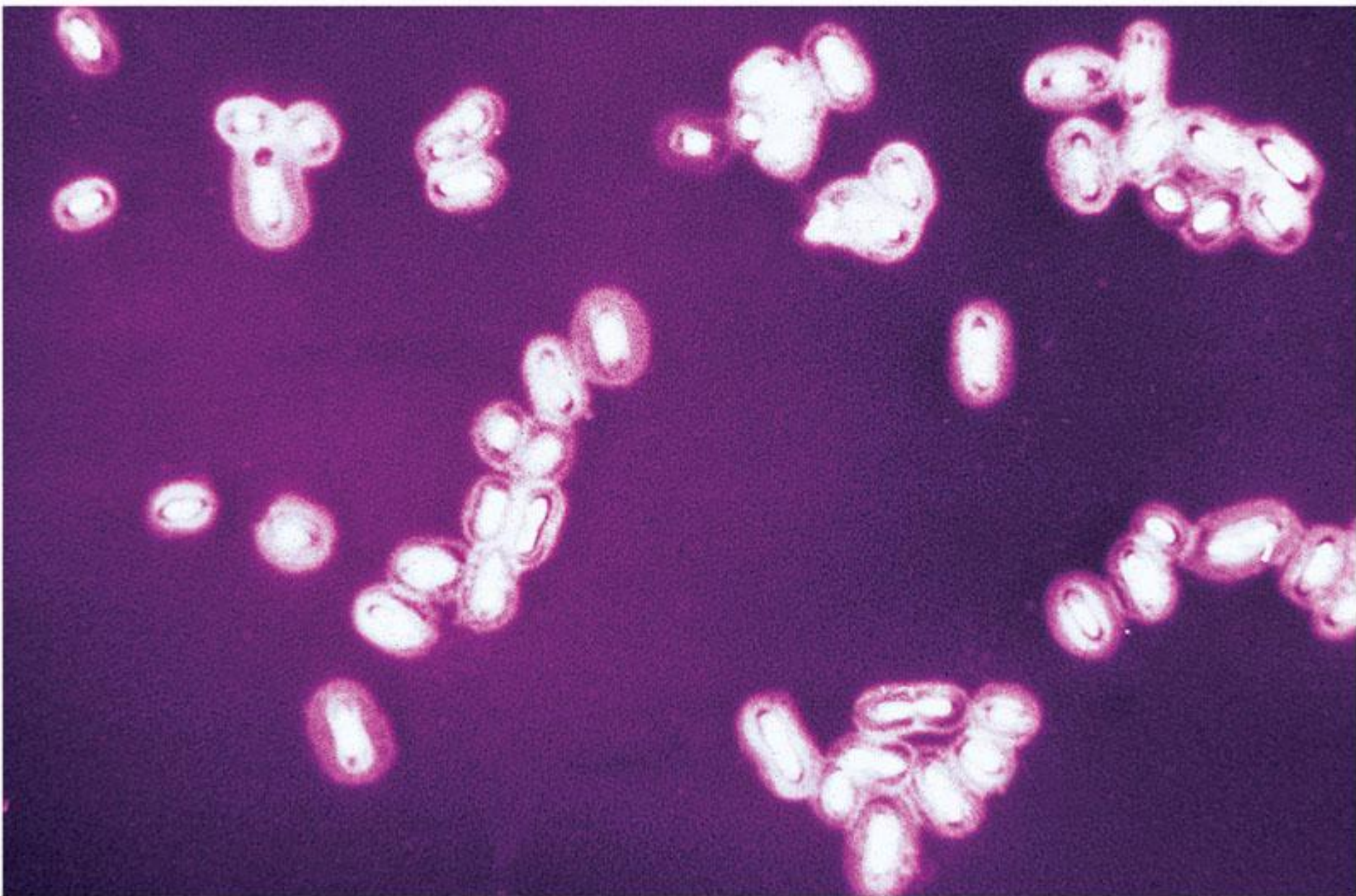
- most common aerobic & non-fastidious bacterium in gut
- enterotoxigenic *E. coli* causes severe diarrhea due to heat-labile toxin & heat-stable toxin – stimulate secretion & fluid loss; also has fimbriae
- enteroinvasive *E. coli* causes inflammatory disease of the large intestine
- enteropathogenic *E. coli* linked to wasting from infantile diarrhea; O157:H7 strain causes hemorrhagic syndrome & kidney damage

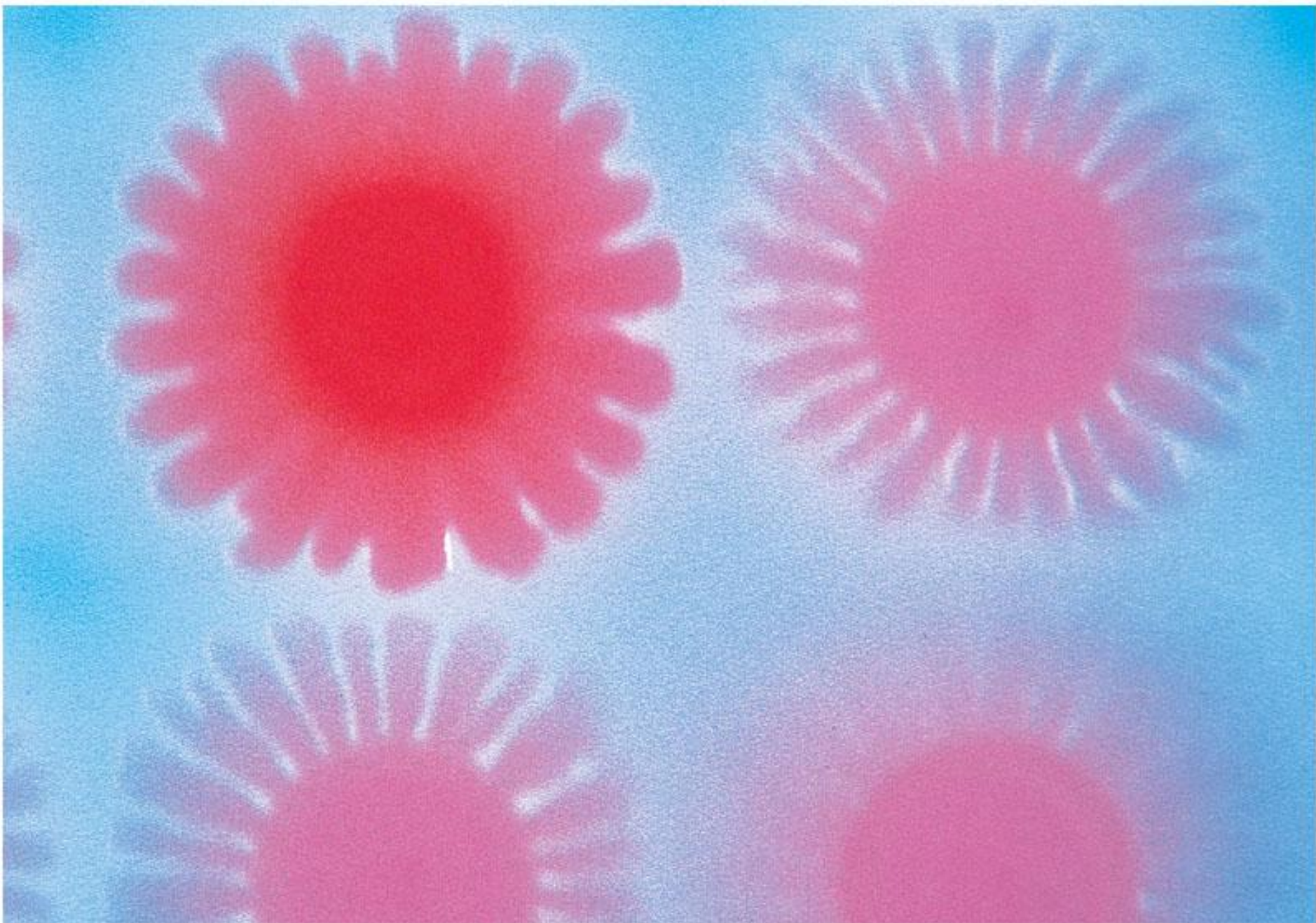
Escherichia coli

- pathogenic strains frequent agents of infantile diarrhea – greatest cause of mortality among babies
- causes ~70% of traveler's diarrhea
- causes 50-80% UTI
- indicator of fecal contamination in water

Other coliforms

- *Klebsiella pneumoniae* – normal inhabitant of respiratory tract, has large capsule, cause of nosocomial pneumonia, meningitis, bacteremia, wound infections & UTIs
- *Enterobacter* – UTIs, surgical wounds
- *Serratia marcescens* – produces a red pigment; causes pneumonia, burn & wound infections, septicemia & meningitis
- *Citrobacter* – opportunistic UTIs & bacteremia



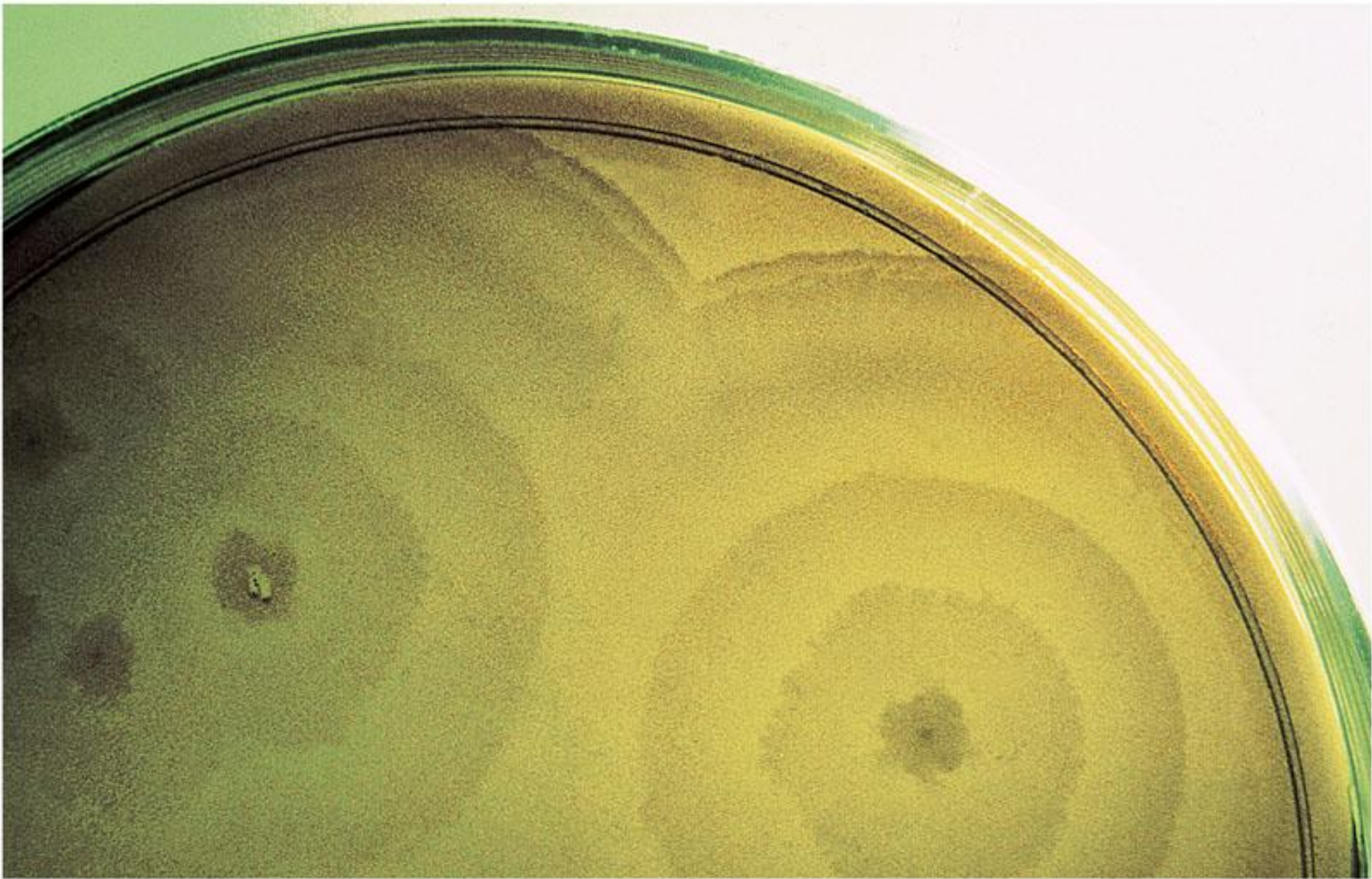


Noncoliform lactose-negative enterics

- *Proteus*
- *Salmonella & Shigella*

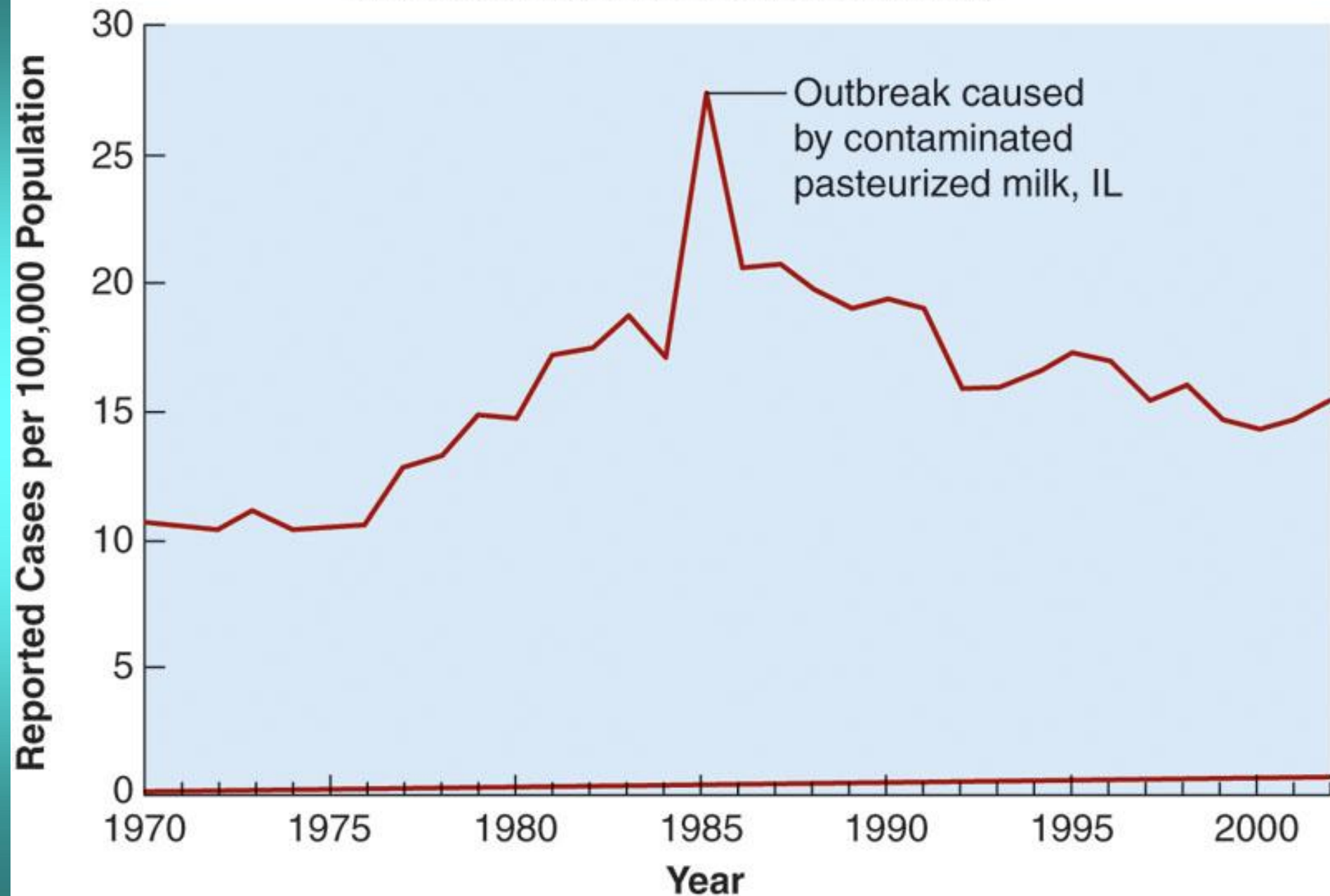
Proteus

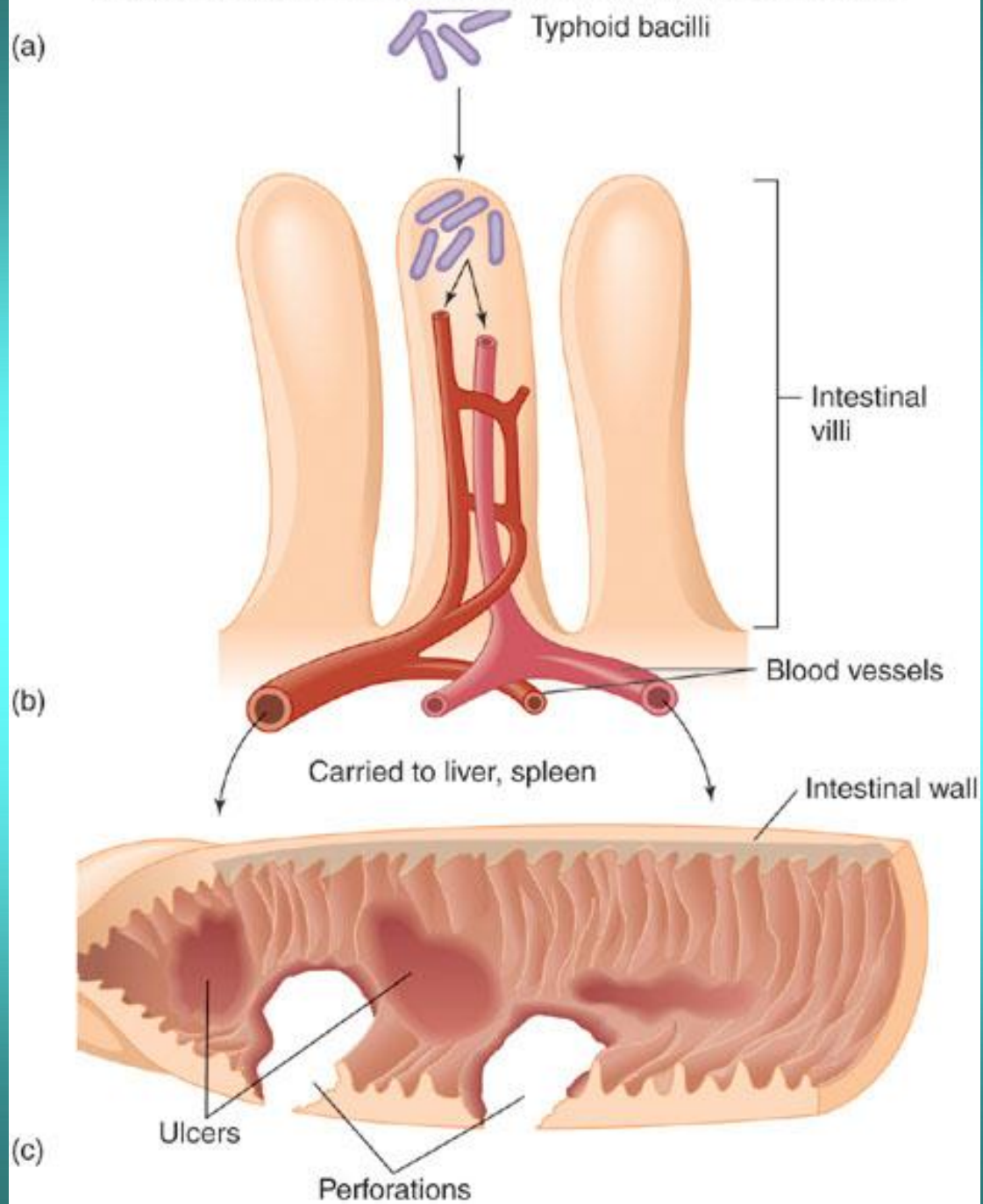
- Swarm on surface of moist agar in a concentric pattern
- Cause UTI, wound infections, pneumonia, septicemia, & infant diarrhea



Salmonella

- motile; ferments glucose
- resistant to chemicals –bile & dyes
- *S. typhi* – typhoid fever – ingested bacilli adhere to small intestine, cause invasive diarrhea that leads to septicemia
 - 2 new vaccines
- *S. cholerae-suis* - pigs
- *S. enteritidis* – 1,700 serotypes- salmonellosis – zoonotic
 - gastroenteritis 2-5 days

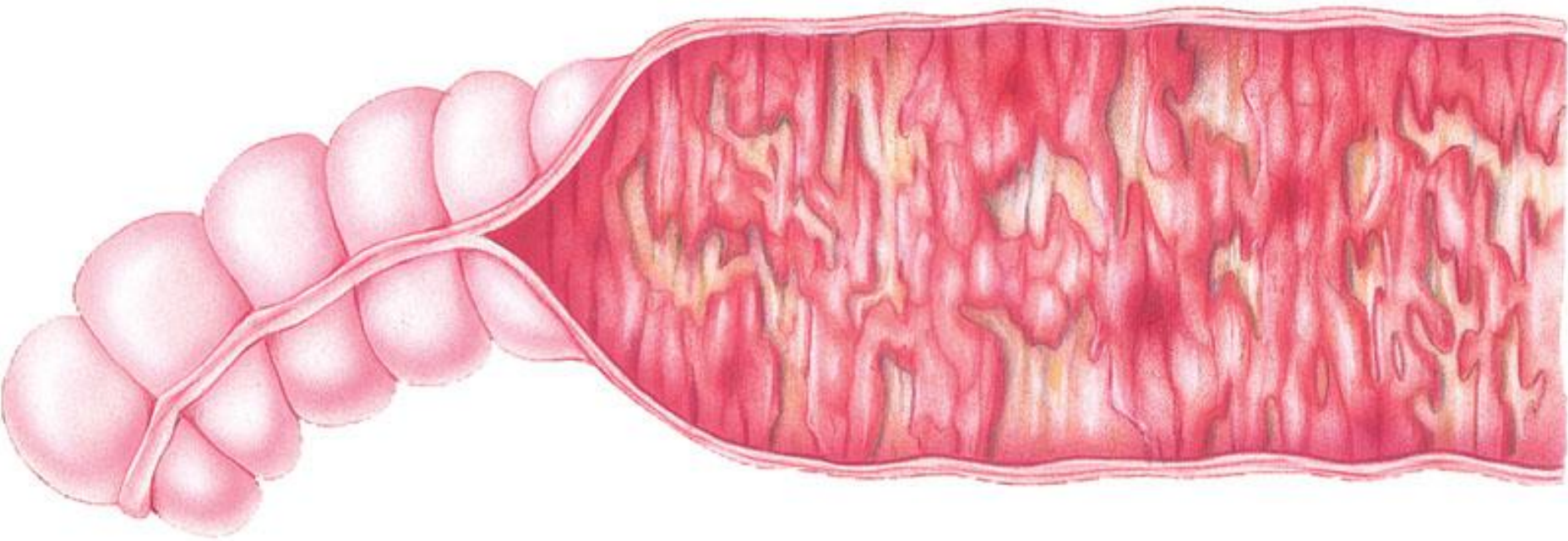




Shigella

- shigellosis – incapacitating dysentery
- *S. dysenteriae*, *S. sonnei*, *S. flexneri* & *S. boydii*
- produce H₂S or urease
- invades villus of large intestine, can perforate intestine or invade blood
- enters Peyer's patches instigates inflammatory response; endotoxin & exotoxins
- treatment – fluid replacement & ciprofloxacin & sulfa-trimethoprim

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Yersinia pestis

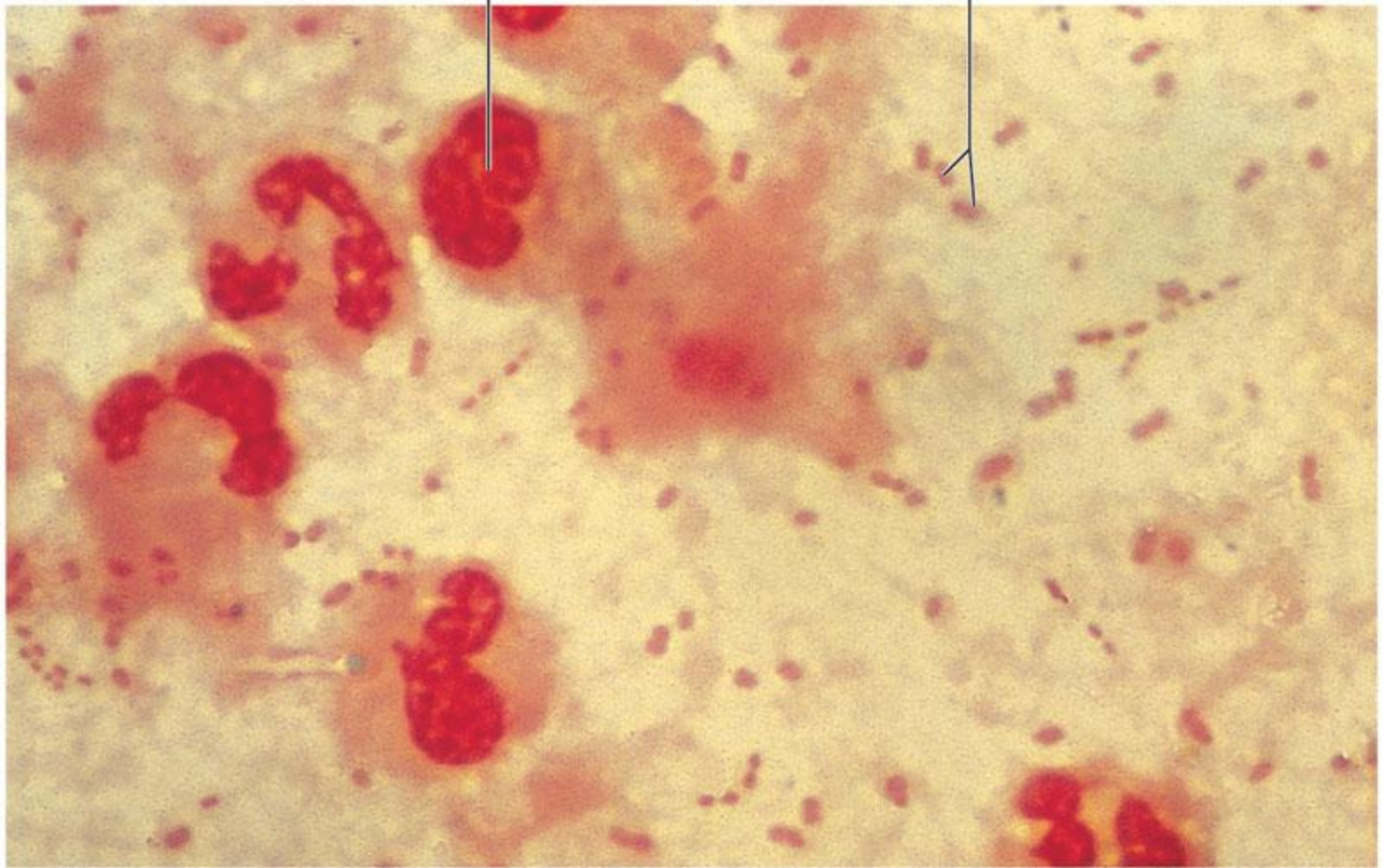
- nonenteric
- tiny, gram-negative rod, unusual bipolar staining & capsules
- virulence factors – capsular & envelope proteins protect against phagocytosis & foster intracellular growth
 - coagulase, endotoxin, murine toxin

Yersinia pestis

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White blood cell

Y. pestis

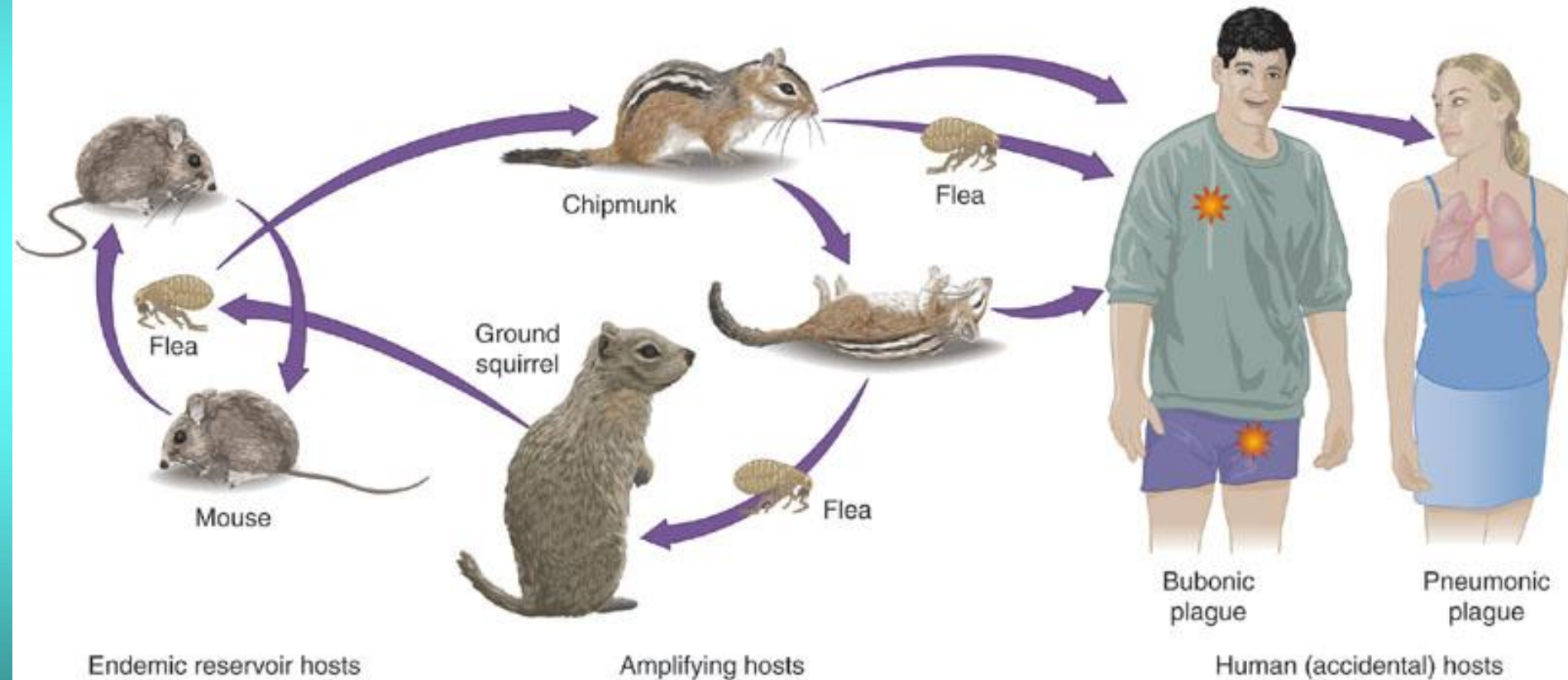


Yersinia pestis

- humans develop plague through contact with wild animals (sylvatic plague) or domestic or semidomestic animals (urban plague) or infected humans
- found in 200 species of mammals – rodents without causing disease
- flea vectors – bacteria replicates in gut, coagulase causes blood clotting that blocks the esophagus; flea becomes ravenous

Yersinia pestis

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Pathology of plague

- 3-50 bacilli
- bubonic – bacillus multiplies in flea bite, enters lymph, causes necrosis & swelling called a **bubo** in groin or axilla
- septicemic – progression to massive bacterial growth; virulence factors cause intravascular coagulation subcutaneous hemorrhage & purpura – black plague
- pneumonic – infection localized to lungs, highly contagious; fatal without treatment
- treatment: streptomycin, tetracycline or chloramphenicol
- Killed or attenuated vaccine



Pasteruella multocida

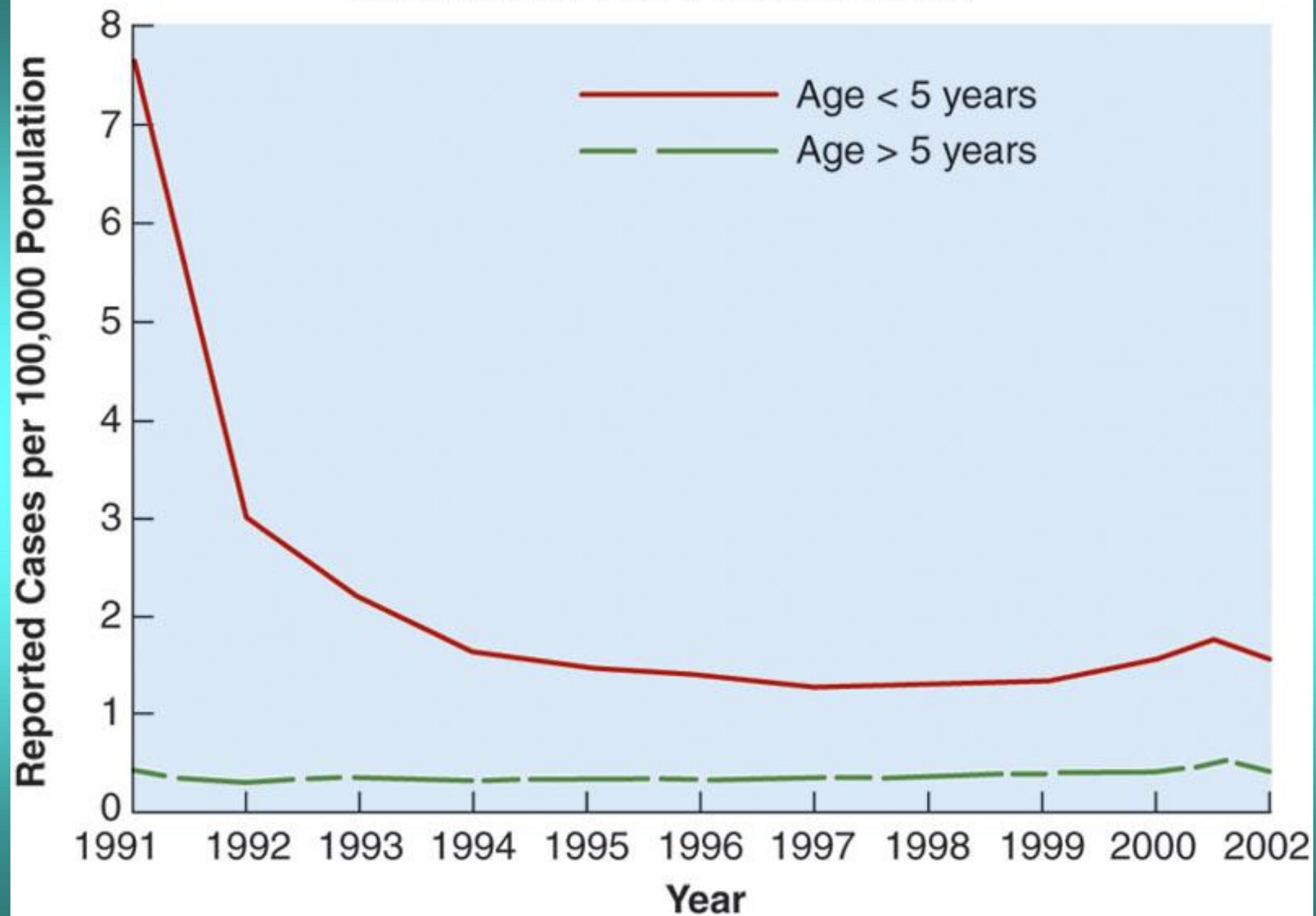
- zoonotic genus
- opportunistic infections
- animal bites or scratches cause local abscess that can spread to joints, bones, & lymph nodes
- treatment: penicillin & tetracycline

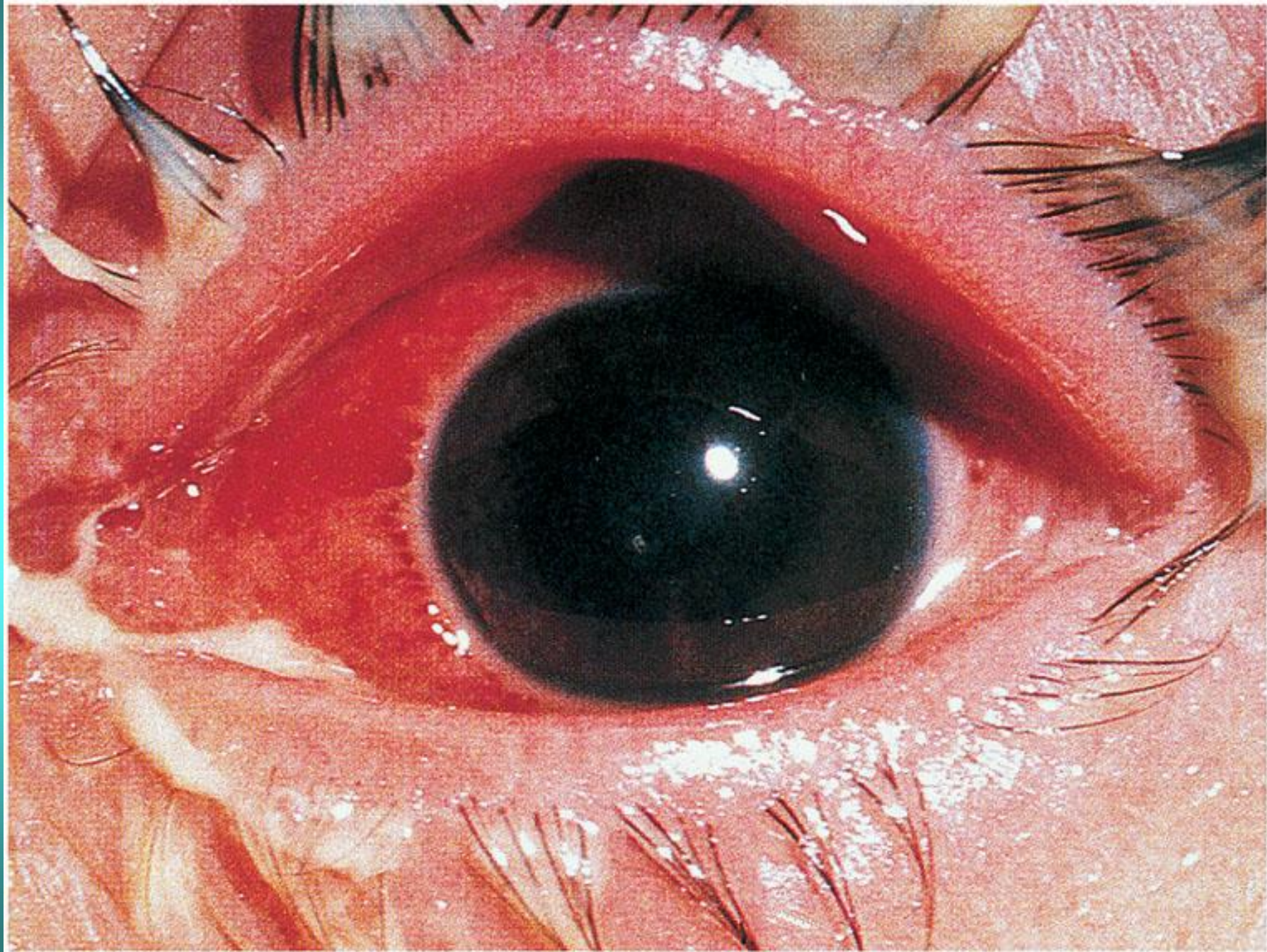
Hemophilus

- tiny gram-negative pleomorphic rods
- fastidious, sensitive to drying, temperature extremes, & disinfectants
- none can grow on blood agar without special techniques – chocolate agar
- require hemin, NAD or NADP
- some species are normal colonists of upper respiratory tract or vagina (*H. aegyptius*, *H. parainfluenzae*, *H. ducreyi*)
- others are virulent species responsible of conjunctivitis, childhood meningitis, & chancroid

Hemophilus

- *H. influenzae* – acute bacterial meningitis, epiglottitis, otitis media, sinusitis, pneumonia, & bronchitis
 - Subunit vaccine Hib
- *H. aegyptius* –conjunctivitis, pink eye
- *H. ducreyi* – chancroid STD
- *H. parainfluenzae* & *H. aphrophilus* – normal oral & nasopharyngeal flora; infective endocarditis





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"Say... this looks like a good place!"