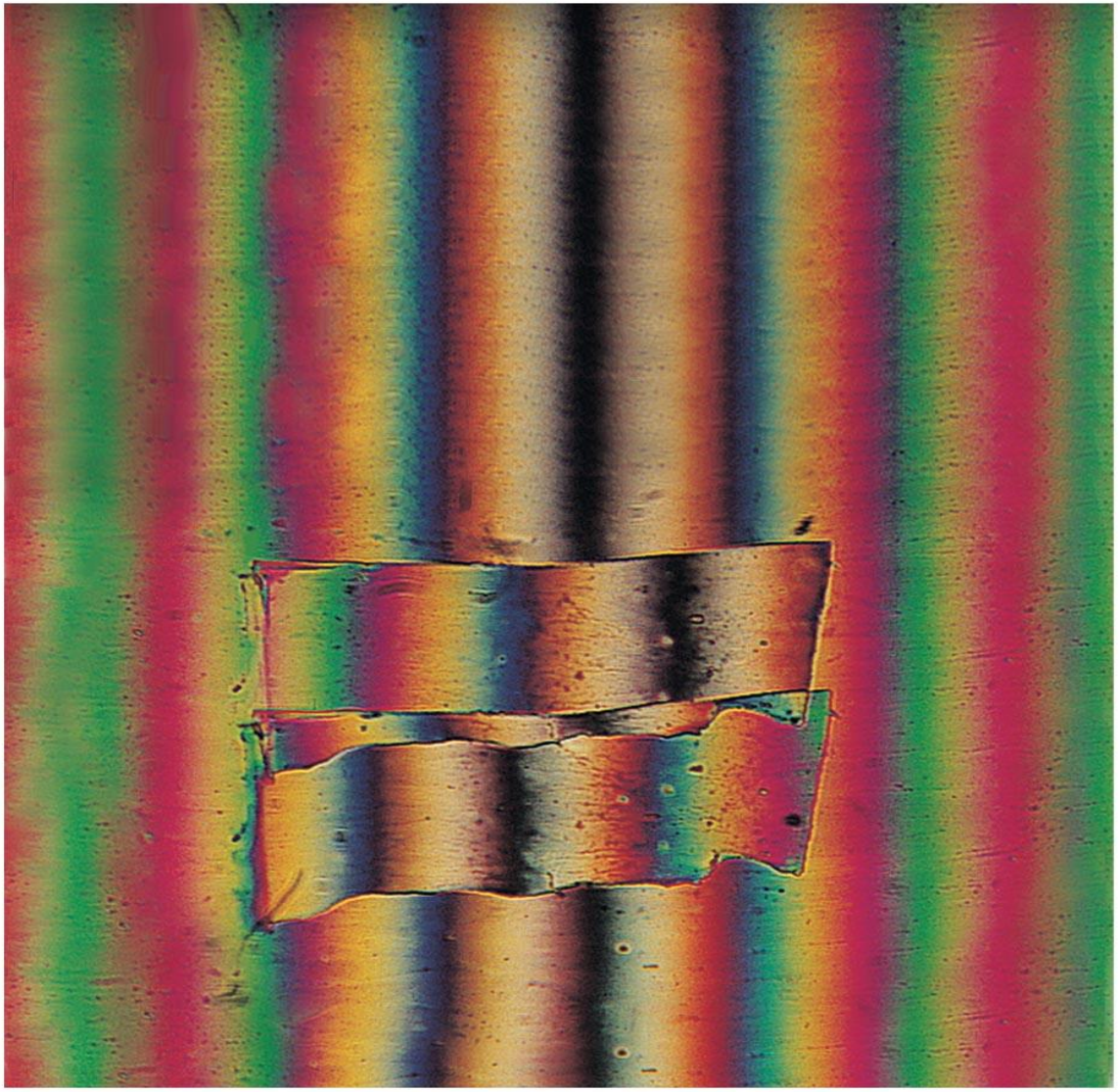
Chapter 4.0 Microscopy, Staining, and Classification



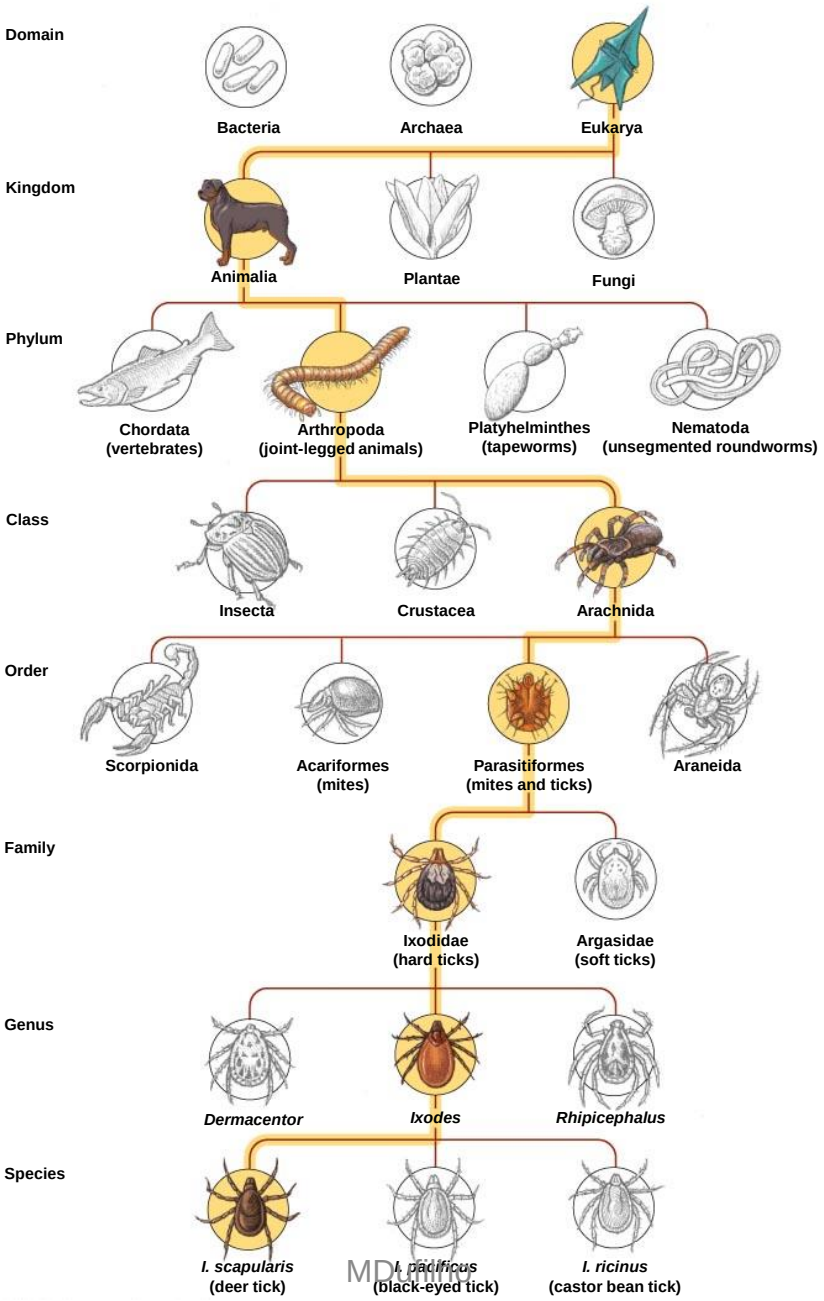
Classification and Identification of Microorganisms

- **Taxonomy** consists of classification, nomenclature, and identification
- Organize large amounts of information about organisms
- Make predictions based on knowledge of similar organisms
- To understand evolutionary connections

Classification and Identification of Microorganisms

- **Linnaeus and Taxonomic Categories**
  - Linnaeus
    - His system classified organisms based on common characteristics
    - Grouped organisms that can successfully interbreed into categories called species
    - Used binomial nomenclature

Figure 4.19 Levels in a taxonomic scheme.



Classification and Identification of Microorganisms

- **Linnaeus and Taxonomic Categories**
  - Linnaeus proposed only two kingdoms
  - Later taxonomic approach based on five kingdoms:
    - Animalia, Plantae, Fungi, Protista, and Prokaryotae
  - Linnaeus's goal was classifying organisms to catalog them
  - Modern goal is understanding relationships among organisms
  - Goal of modern taxonomy is to reflect phylogenetic hierarchy
  - Greater emphasis on comparisons of organisms' genetic material led to proposal to add domain

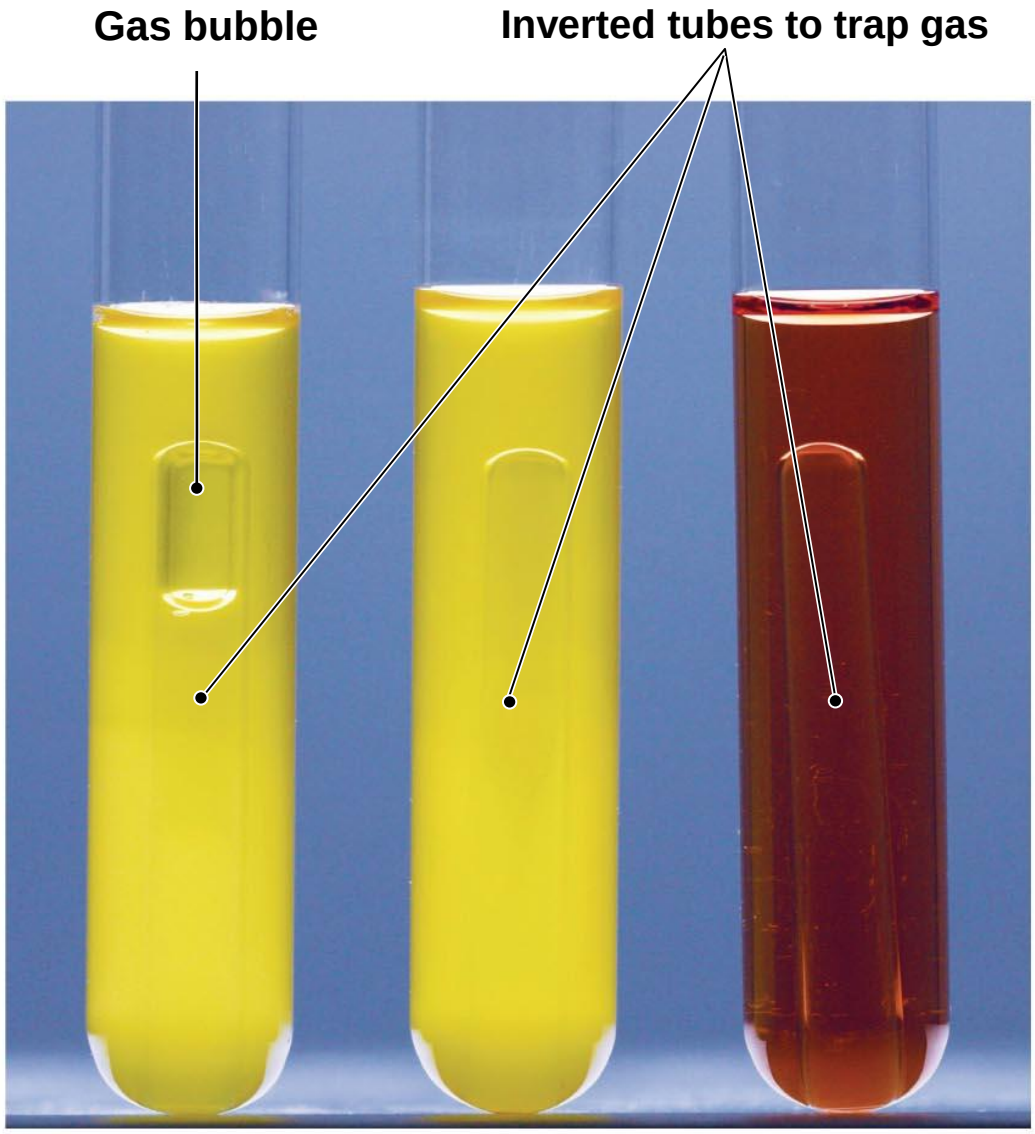
Classification and Identification of Microorganisms

- **Domains**
  - Carl Woese compared nucleotide sequences of rRNA subunits
  - Proposal of three domains as determined by ribosomal nucleotide sequences:
    - Eukarya, Bacteria, and Archaea
  - Cells in the three domains also differ with respect to many other characteristics

Classification and Identification of Microorganisms

- **Taxonomic and Identifying Characteristics**
  - Physical characteristics
  - Biochemical tests
  - Serological tests
  - Phage typing
  - Analysis of nucleic acids

Figure 4.20 Two biochemical tests for identifying bacteria.



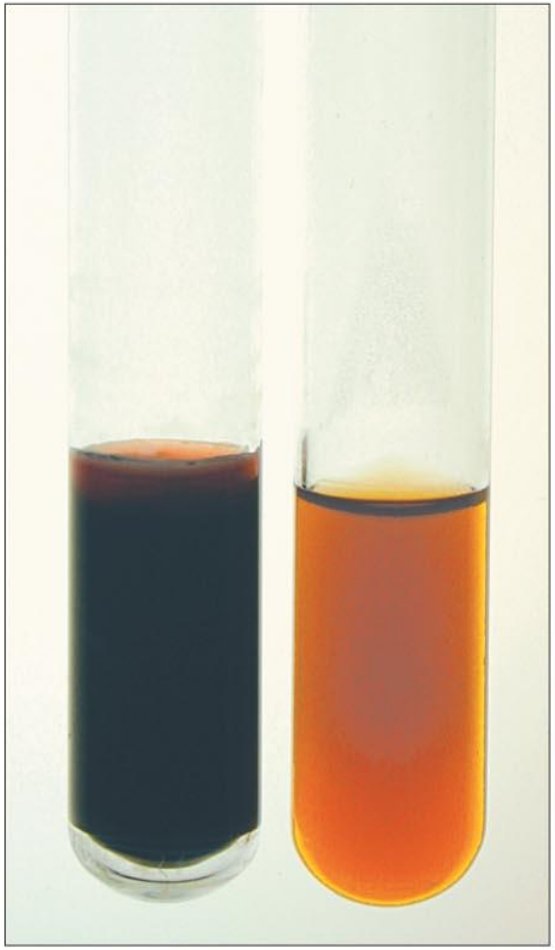


Figure 4.22 An agglutination test, one type of serological test.

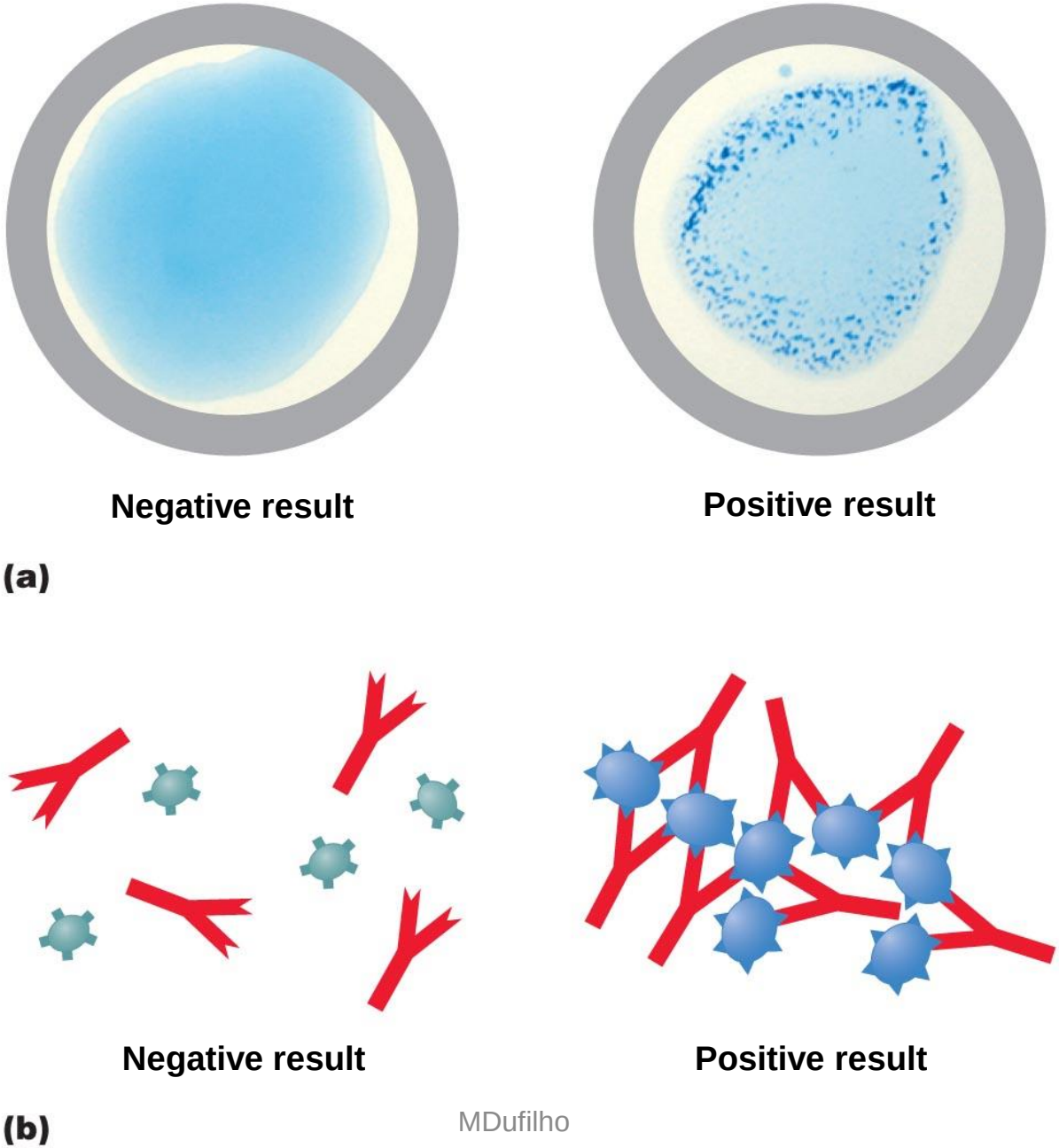
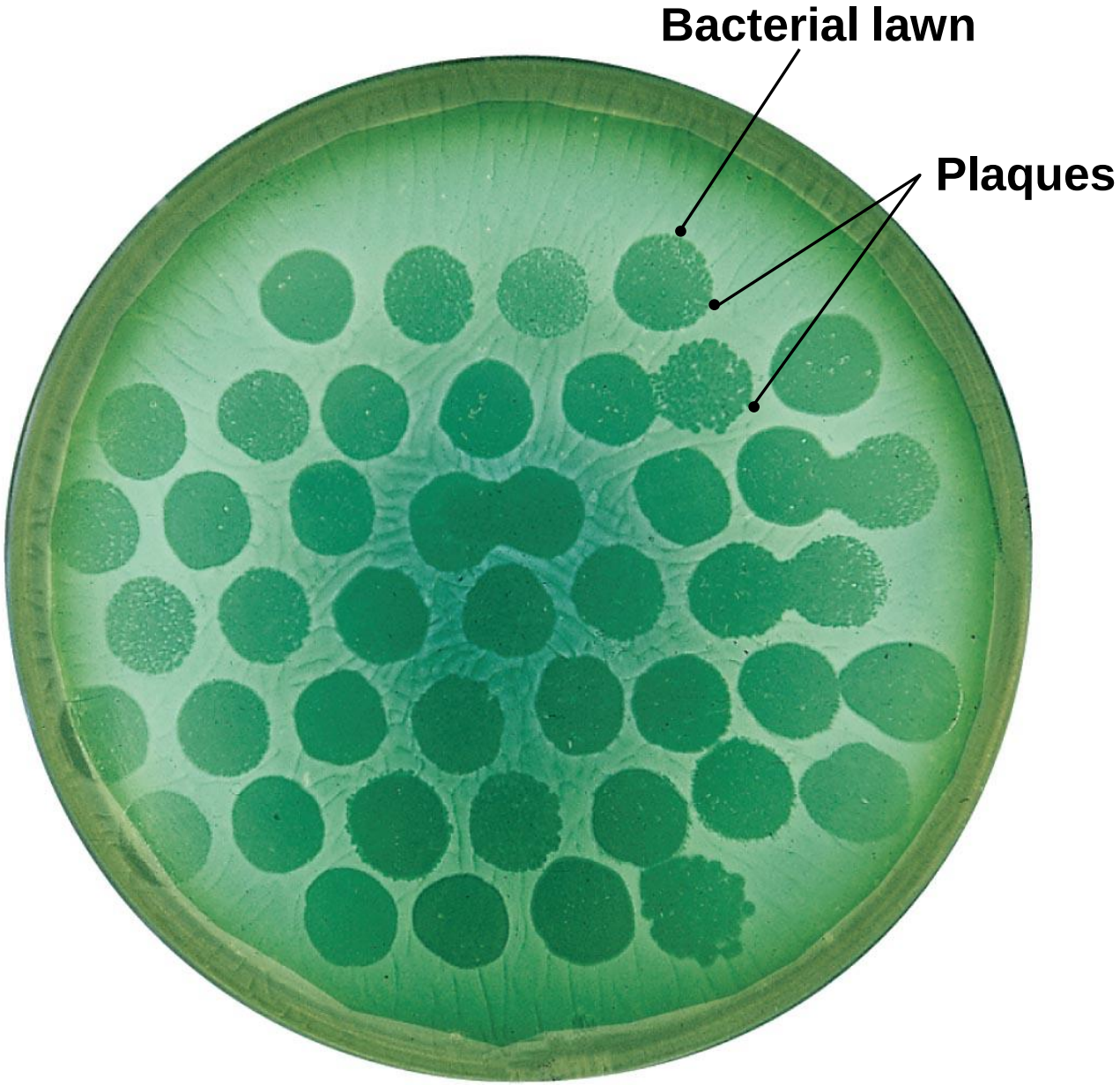


Figure 4.23 Phage typing.



Classification and Identification of Microorganisms

- **Taxonomic Keys**
  - Dichotomous keys
    - Series of paired statements where only one of two "either/or" choices applies to any particular organism
  - Key directs user to another pair of statements, or provides name of organism

Figure 4.24 Use of a dichotomous taxonomic key.

1a. Gram-positive cells…… Gram-positive bacteria
1b. Gram-negative cells……... 2

2a. Rod-shaped cells…… 3
2b. Non-rod-shaped cells…… Cocci and pleomorphic bacteria

3a. Can tolerate oxygen…… 4
3b. Cannot tolerate oxygen…… Obligate anaerobes

4a. Ferments lactose…… 5
4b. Cannot ferment lactose…… Non-lactose-fermenters

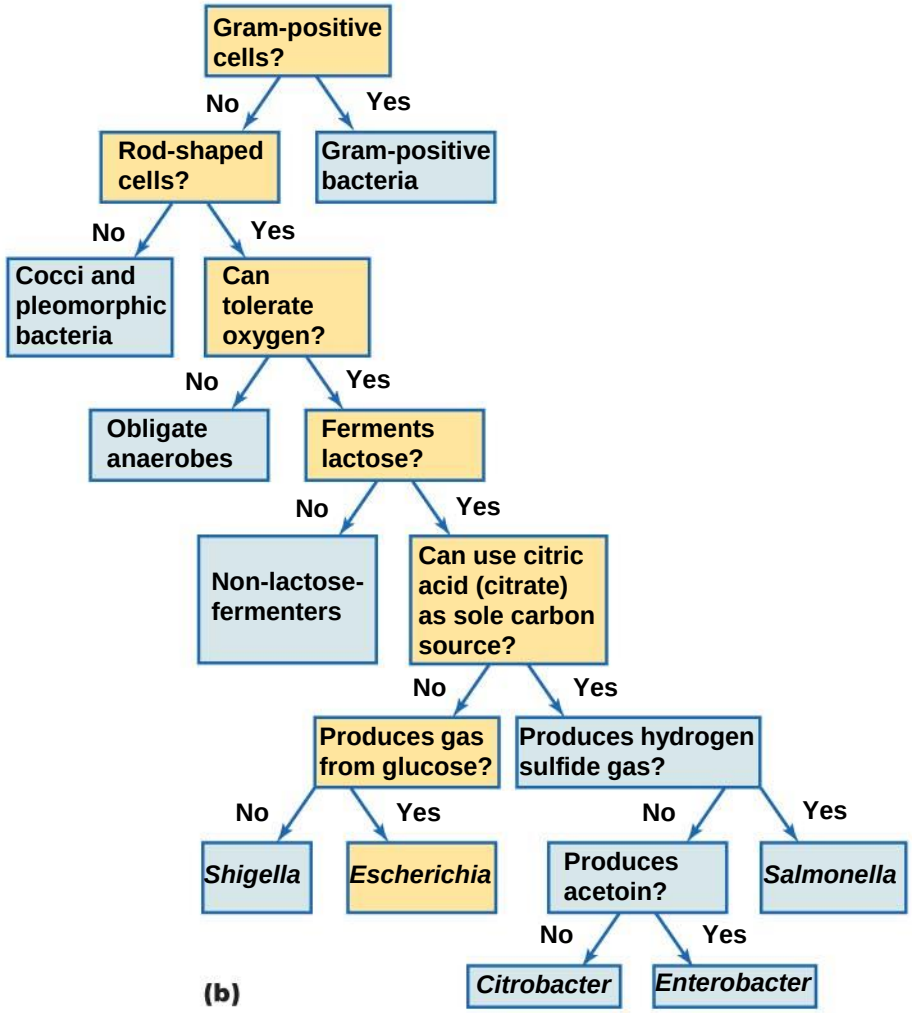
5a. Can use citric acid as a sole carbon source……...6
5b. Cannot use citric acid alone……...8

6a. Produces hydrogen sulfide gas…….. *Salmonella*
6b. Does not produce hydrogen sulfide gas…7

7a. Produces acetoin…… *Enterobacter*
7b. Does not produce acetoin…… *Citrobacter*

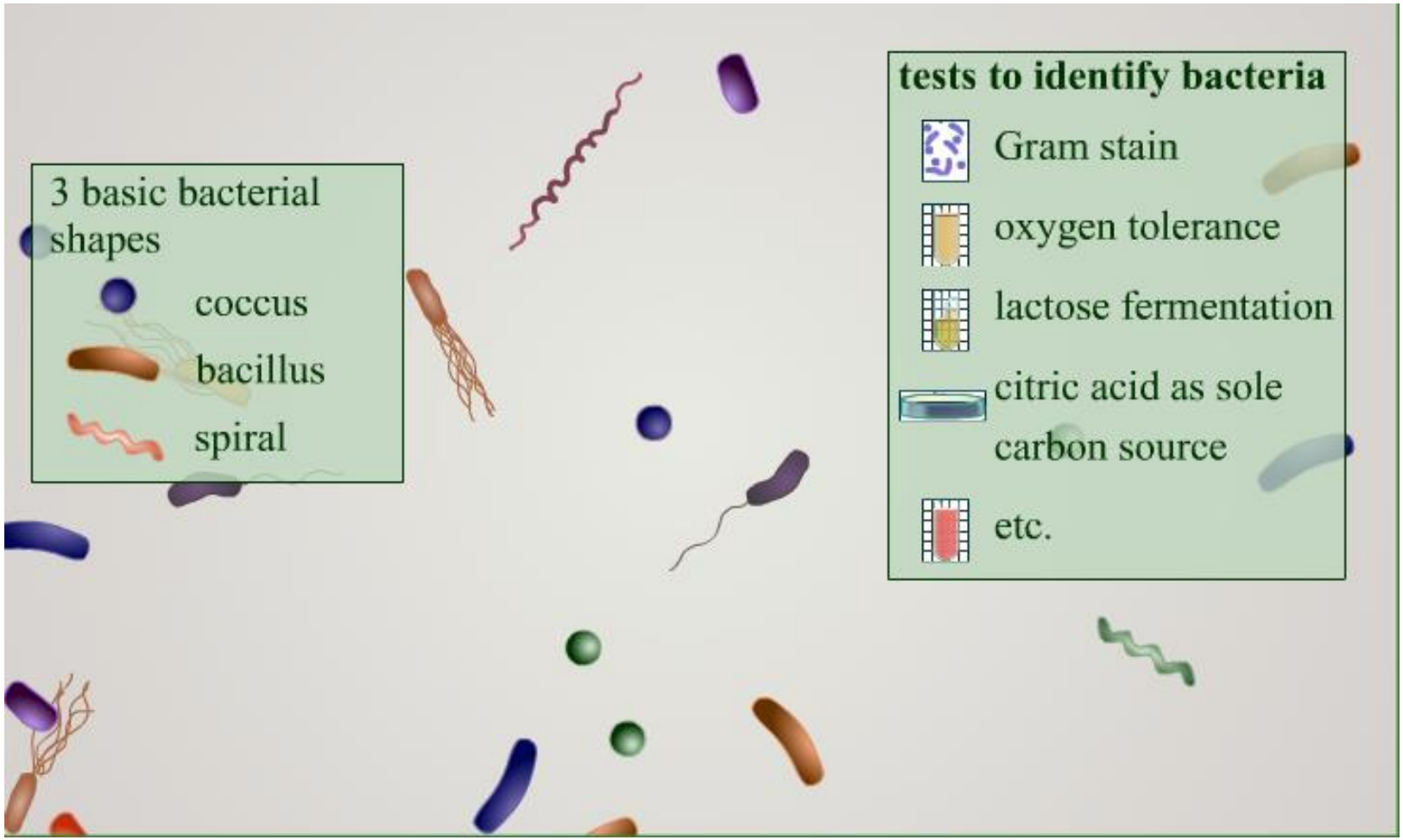
8a. Produces gas from glucose…….. *Escherichia*
8b. Does not produce gas from glucose…….. *Shigella*

(a)



(b)

Dichotomous Keys: Overview



PLAY **Dichotomous Keys: Overview**

Micro Matters

- **In the Micro Matters video in chapter 4, Cindy researches how penicillin works to treat her strep throat infection.**
  - The bacterium *Streptococcus pyogenes* causes strep throat.
  - Bacteria are often classified as Gram-positive or Gram-negative based on their cell wall structure.
  - The outer membrane of Gram-negative bacteria is not permeable to large molecules such as the antibiotic penicillin.
  - Penicillin inhibits the proper formation of peptidoglycan which can make bacterial cells susceptible to osmotic pressure.