# Growth Characteristics of Bacteria

## Objectives:

1. Recognize the presence of pigment in a bacterial agar culture.

2. If pigment is present, determine the location of the pigment: intracellular or extracellular.

3. Determine the consistency (mucoid or dry) of bacterial growth on agar.

4. Recognize the following growth characteristics in broth cultures: turbidity, pellicle, flocculent, and sediment.

## Key Terms

pigment, extracellular, intracellular, mucoid, dry (friable), turbidity, pellicle, flocculent, sediment

## Introduction

As bacteria grow on agar or in broth cultures, they exhibit specific growth characteristics. Different bacteria have different growth characteristics. These characteristics provide information that can help with the identification of bacteria and can indicate the presence of more than one type of organism in a sample.

### Agar Slant Culture Characteristics

#### Pigment:

Many bacteria do not produce a definite pigment. When they grow to millions of cells in a colony, they become visible. Many other bacteria produce a definite pigment. Pigments are not simply colorful but serve a variety of purposes and functions for bacteria. Some of these purposes and functions are: photosynthesis, pathogenesis (virulence factors), UV protection, toxicity to predators, antioxidants to reduce oxidative stress, and antibiotics to compete with other bacteria. These pigments have potential human applications as antibiotics, antioxidants, anti-cancer drugs, and coloring agents for cosmetics and textiles. If bacteria produce a definite pigment, that pigment is typically either contained within the cells (intracellular) or the pigment is secreted to the external environment. There are some exceptions like *Serratia marcescens* strain D1 whose red pigment is both intracellular and extracellular. When observing agar cultures, if the growth on the surface of the agar has the color, the pigment is intracellular. If the color is found in the agar, the pigment is extracellular.

In the image below, all of the organisms produce a definite pigment. They are all extracellular except for *Pseudomonas aeruginosa* which produces a green extracellular pigment. The green pigment is difficult to see in this image.


Consistency:

As bacteria grow on agar, their appearance is most often mucoid. Mucoid growth is shiny, slimy, wet looking. Some bacteria are not mucoid. The have a dry texture. The growth may appear brittle, rough, and crumbly (friable).

Broth Culture Characteristics

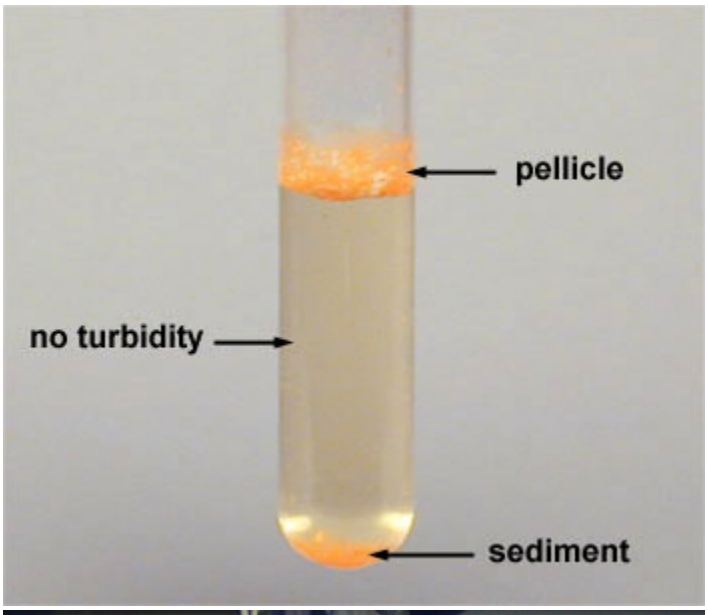
Turbidity – a common name for turbidity is cloudiness. Bacterial growth in broth makes the broth turbid (cloudy). More cells equal more turbidity but any degree of cloudiness means the broth is turbid.

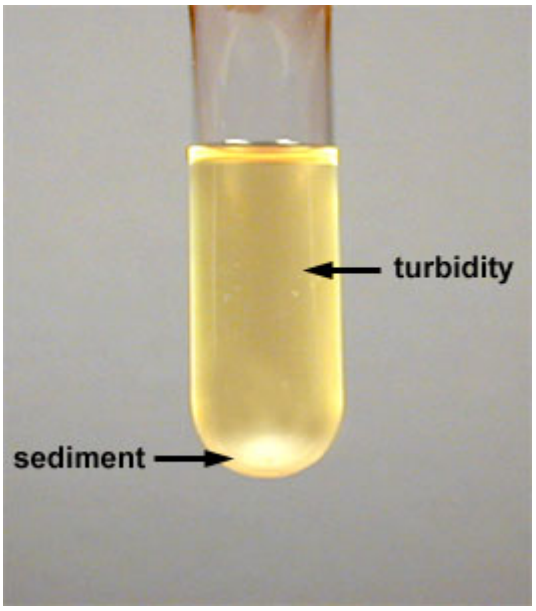
Sediment – when bacteria die, they fall to the bottom of a broth tube. The accumulation of bacterial cells at the bottom of the tube is sediment. Some bacteria do grow as sediment but any cells at the bottom of the tube, alive or dead, is considered sediment.

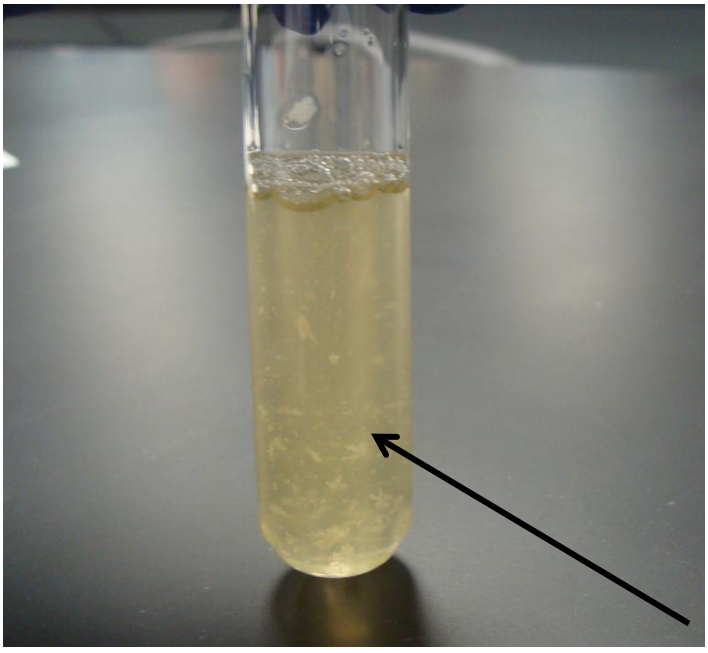
Pellicle – some bacteria form a layer of growth across the top of the broth in a tube. This layer of growth is called a pellicle. A ring of bacteria around the inside of the tube is not a pellicle. The pellicle should not be confused with a meniscus. A meniscus

occurs when a liquid, usually water, bends in a glass tube.  A meniscus is usually concave and appears darker than the rest of the liquid.

Flocculent – some bacteria form clusters of growth that are either floating in the broth or stuck to sides of the tube.



**flocculent**

A broth culture may have more than one characteristic.  Recognize the broth characteristic when you see it.

## Materials

Live Organisms: *Pseudomonas aeruginosa, Bacillius cereus, Micrococcus luteus, Mycobacterium phlei, Klebsiella pneumoniae, Chromobacterium violaceum*

Per Table: Each table has a set of agar slant cultures and broth cultures.

## Procedure

1. **This is an Observation-Only Exercise.**

2. You will make observations and take pictures or make drawings of the slants and broth cultures. **Do Not Pick Up Broth Cultures! You will destroy the characteristics in the tubes if they are mishandled.**

3. Note that the same organisms are used for the slant and broth cultures.

4. Pay particular attention to the slant cultures. Some of these organisms may be used for the morphological unknown.

## Safety and Disposal

1. Do not discard any of the demonstration tubes. Return slants to the rack and leave on the table.

2. Aprons must be worn. Hair must be tied back and shoes must cover the entire foot.

## Observations

Slant Cultures

| Organism | Pigment (Y/N) | Color | Location (intra- or extracellular) | Consistency (Mucoid or Dry) |
|---|---|---|---|---|
| *Bacillius cereus* | | | | |
| *Chromobacterium violaceum* | | | | |
| *Klebsiella pneumoniae* | | | | |
| *Micrococcus luteus* | | | | |
| *Mycobacterium phlei* | | | | |
| *Pseudomonas aeruginosa* | | | | |

Broth Cultures

| Organism | Turbidity | Sediment | Pellicle | Flocculent | Pigment |
|---|---|---|---|---|---|
| *Bacillius cereus* | | | | | |
| *Chromobacterium violaceum* | | | | | |
| *Klebsiella pneumoniae* | | | | | |
| *Micrococcus luteus* | | | | | |
| *Mycobacterium phlei* | | | | | |
| *Pseudomonas aeruginosa* | | | | | |

**Concept Check**

1. Some bacteria exhibit very specific cultural characteristics in or on artificial media. Some of these characteristics can be used to help identify and classify bacteria.

2. You must be able to recognize the above characteristics not for specific organisms but if given a slant or broth culture you must be able to state the characteristics displayed.

3. Do all bacteria produce a definite pigment? If a pigment is produced, where can the pigment be found?

4. Why do some bacteria produce pigments? How can pigments be beneficial to the bacteria? How can pigments be beneficial to humans?

5. What are the two growth consistencies? Describe them.

6. Describe the four bacterial broth characteristics.