

SI Microbiology - Full Discipline Demo

Catalase and Oxidase Testing

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Microbiology - Full Discipline Demo
Course	SI Microbiology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Categorize each phrase or term as applying to catalase or oxidase testing.

⚡ Positive test produces bubbles	⚡ Positive test results in color change
⚡ Hydrogen peroxide	⚡ Cytochrome c
Catalase Testing	Oxidase Testing
1	2

Correct answers:

1 Hydrogen peroxide Positive test produces bubbles

2 Cytochrome c Positive test results in color change

Determine whether each statement is true or false.

True	False
1	2

⚡ The catalase test is useful for quickly distinguishing between aerobic and obligate anaerobic bacteria.

⚡ Most bacteria that live in anoxic environments produce catalase.

⚡ The oxidase test is used to identify bacteria that produce cytochrome c oxidase.

⚡ Obligate anaerobes produce oxidase enzymes.

Correct answers:

1

The oxidase test is used to identify bacteria that produce cytochrome c oxidase.

The catalase test is useful for quickly distinguishing between aerobic and obligate anaerobic bacteria.

2

Most bacteria that live in anoxic environments produce catalase.

Obligate anaerobes produce oxidase enzymes.

Exploration

In the absence of cytochrome c oxidase, the oxidase test reagent remains ____.

- ☐ red
- ☒ colorless
- ☐ purple
- ☐ green



Catalase testing is performed by adding a drop of ____ to an active bacteria colony.

- ☒ hydrogen peroxide ✓
- ☐ glucose
- ☐ water
- ☐ bleach

Exercise 1

How does the oxidase test performed in this exercise detect the presence of cytochrome c oxidase?

The oxidase test detects the presence of cytochrome c oxidase by using a colorless reagent that turns dark blue or purple when it is oxidized by the enzyme. In the absence of cytochrome c oxidase, the oxidase test reagent remains colorless.

Why are oxidase test results that turned purple after 90 seconds in this exercise considered negative results?

Oxidase results that turn purple after 90 seconds are considered negative because moistened oxidase reagent is unstable and easily oxidized by other substances when exposed for periods longer than 90 seconds.

Based on the results from this exercise, what can you conclude about the metabolic pathways of *B. subtilis*, *E. coli*, and *S. epidermidis*? Reference Data Table 1 and Photo 1 in your explanation.

E. coli and *S. epidermis* are oxidase negative as recorded in Data Table 1 and Photo 1 and do not produce cytochrome c for use in aerobic cellular respiration. *B. subtilis* is oxidase

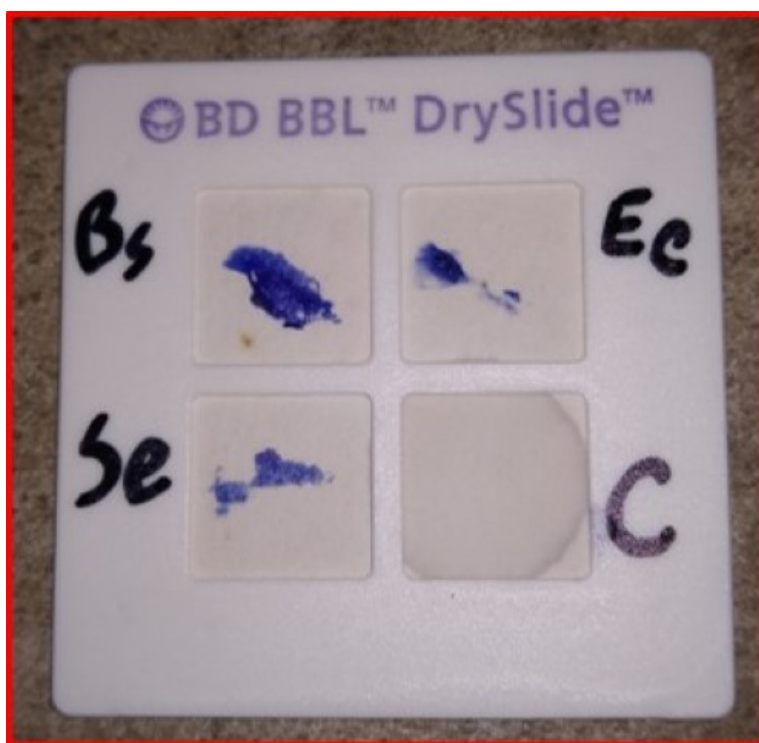
variable/delayed and exhibits either cytochrome c composition, variability in cytochrome oxidases, and/or overall oxidative phosphorylation variability.

Data Table 1: Oxidase Testing
(SAMPLE ANSWER BELOW)

Microbe	Observation	Interpretation
<i>E. coli</i>	Purple streak after 2 minutes	Negative
<i>S. epidermidis</i>	Purple streak after 2 minutes	Negative
<i>B. subtilis</i>	Purple streak at 60 seconds	Delayed/variable positive
Control	Colorless	Negative

Photo 1: Oxidase Test Results
(SAMPLE ANSWER BELOW)

Note to instructors: The photo uploaded by students will likely display streaks for each bacteria tested but is not considered positive due to the time required (20+ seconds) for the streaks to develop.



Exercise 2

How does the catalase test performed in this exercise indicate the presence of catalase enzyme?

Hydrogen peroxide is broken down into oxygen and water by the catalase enzyme. The oxygen is visualized as bubbles within the hydrogen peroxide solution. When hydrogen peroxide is added to bacteria colonies that produce catalase, rapid bubbling occurs due to the breakdown of hydrogen peroxide.

Based on the results from this exercise, what can you conclude about the metabolic pathways of *B. subtilis*, *E. coli*, and *S. epidermidis*? Reference Data Table 1 and Photo 1 in your explanation.

B. subtilis, *S. epidermidis*, and *E. coli* are catalase positive as recorded in Data Table 2 and Photos 2-4. The results suggest these microbes can respire aerobically and can live in oxygen rich environments.

Data Table 2: Catalase Test Results
(SAMPLE ANSWER BELOW)

Microbe	Observation	Result
<i>B. subtilis</i>	Rapid bubbling	Positive
<i>E. coli</i>	Rapid bubbling	Positive
<i>S. epidermidis</i>	Rapid bubbling	Positive

Photo 2: *B. subtilis* Catalase Results
(SAMPLE ANSWER BELOW)

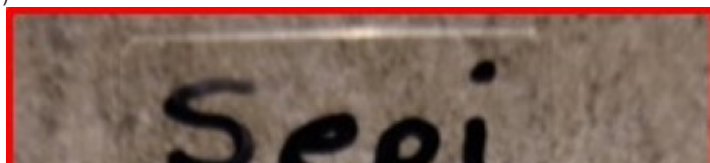


Photo 3: *E. coli* Catalase Results
(SAMPLE ANSWER BELOW)





Photo 4: *S. epidermidis* Catalase Results
(SAMPLE ANSWER BELOW)





Competency Review

Oxidase test reagent turns purple when oxidized by ____ oxidase.

- ☐ cytochrome a
- ☒ cytochrome c ✓
- ☐ ATP
- ☐ NADH

All aerobic prokaryotes utilize cytochrome c for reducing oxygen during cellular respiration.

- ☐ True
- ☒ False ✓

Catalase facilitates the breakdown of ____ into oxygen and water.

- ☐ cytochrome c
- ☐ glucose
- ☐ carbon dioxide
- ☒ hydrogen peroxide ✓

Most bacteria that live in oxygenated environments and respire aerobically produce catalase.

- ☒ True ✓
- ☐ False

Positive oxidase results occur within ____ seconds of applying a colony to the test cassette.

- ☒ 20 ✓
- ☐ 60
- ☐ 90
- ☐ 120

Catalase testing is performed on a blank glass microscope slide.

☐ True



☐ False

***E. coli* and *S. epidermidis* use oxidase enzymes other than cytochrome c when respiring aerobically.**

☐ True



☐ False

Based on catalase testing results, ____ lives in oxygenated environments and has the ability to respire aerobically.

☐ *B. subtilis*

☐ *E. coli*

☐ *S. epidermidis*

☐ All of the above



Extension Questions

A facultative anaerobe is a microbe that can switch between aerobic and anaerobic respiration pathways based on oxygen availability and other factors. Apply your knowledge of catalase and oxidase testing to predict the results for each test when using a facultative anaerobe. (SAMPLE ANSWER BELOW)

A facultative anaerobe would be expected to test positive for catalase because it can respire aerobically. A facultative anaerobe could produce either positive or negative oxidase test results as the microbe could use either cytochrome c oxidase or other oxidase enzymes to reduce oxygen during aerobic respiration.