

From Powder to Petri Dish: Building a Microbiology Growth Platform with LB Media An Introduction to Bacterial Culture Media Preparation and Plating Techniques

Lesson Plan Developed by Teresa Kagotho

Overview

Microorganisms require specific nutrients and environmental conditions to grow. In microbiology and biotechnology laboratories, scientists prepare specialized growth media that provide bacteria with the nutrients needed for reproduction and research applications.

In this lesson, students explore how **LB (Luria-Bertani) broth and LB agar** are prepared and used as standard growth media in microbiology. Students learn how scientists create liquid and solid environments that support bacterial growth and how agar plates are used to observe bacterial colonies.

Students will investigate the question:

"How do scientists create the environments needed to grow microorganisms?"

Through a simulated biotechnology laboratory activity, students will prepare LB media, practice measuring scientific quantities, and understand the role of ingredients such as **LB broth powder and agar**. Students will also be introduced to **calcium chloride (CaCl₂) as an optional additive used only in bacteriophage experiments**, where it helps bacteriophages attach to bacterial cells. Students learn how microbiologists use Petri dishes for bacterial culture studies and how these techniques support bacteriophage research.

The lesson emphasizes:

- Scientific measurement
- Laboratory safety
- Media preparation
- Aseptic technique
- Biotechnology applications
- STEM career connections

The lesson follows the **5E Instructional Model (Engage, Explore, Explain, Elaborate, Evaluate)**.

Key Search Words

Subject: Biology, Biotechnology, Microbiology, STEM Education

Grade: High School (Grades 9–12)

Topics:

Bacterial growth media, LB broth, LB agar, microbiology techniques, biotechnology laboratory skills, microbial culture, Petri dishes, aseptic technique, bacteriophage research

Critical Vocabulary:

LB broth, LB agar, agar, nutrient media, bacteria, microorganism, culture, Petri dish, colony, sterilization, autoclave, filtration, calcium chloride (CaCl₂), aseptic technique, contamination, biotechnology

Pedagogical Strategies:

5E Instructional Model, Hands-on Skills Development, Inquiry-Based Learning, Collaborative Learning, STEM Career Connections

Learning Objectives

Students will be able to:

- Explain the purpose of growth media in microbiology and biotechnology laboratories.
 - Describe the difference between liquid media (LB broth) and solid media (LB agar).
 - Calculate and measure quantities required to prepare laboratory media.
 - Explain the role of agar as a solidifying agent for bacterial growth plates.
 - Explain that calcium chloride (CaCl₂) is not a standard component of LB media but is added only when preparing media for bacteriophage experiments because it promotes phage attachment to bacterial cells.
 - Demonstrate proper laboratory safety and aseptic techniques.
 - Describe how Petri dishes are used to grow and observe bacterial cultures.
 - Connect microbiology laboratory skills to biotechnology careers.
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Curriculum Alignment

North Carolina Biology Standard Course of Study (2025)

LS.Bio.3.3 – Scientific Investigations and Laboratory Skills

Students use appropriate laboratory tools and techniques to collect biological data and conduct investigations.

Lesson Connection:

Students practice laboratory measurement, media preparation, and plating techniques used in microbiology.

LS.Bio.8.2 – Biotechnology Applications

Biotechnology applications have uses in medicine, agriculture, and environmental science.

Lesson Connection:

Students explore how bacterial culture methods support biotechnology applications such as bacteriophage research, medicine development, and microbiological studies.

Classroom Time Required

One 95-minute block period

Engage: Introduction to Microbial Growth Media

10 minutes

Explore: Preparing LB Media

35 minutes

Explain: Understanding Media Components

15 minutes

Elaborate: Plating and Petri Dish Applications

25 minutes

Evaluate: Reflection and Exit Ticket

10 minutes

Materials & Technology

Laboratory Materials

LB Media Preparation

- LB broth powder
- Granulated agar
- Distilled water/WFI/WPU
- **Calcium chloride (CaCl₂) solution (optional—used only for bacteriophage experiments)**
- Weighing boats or weighing paper
- Digital balance
- Spatula
- Graduated cylinders
- Bottles or flasks
- Stirring rod or magnetic stirrer
- Labels and markers

Plating Materials

- Prepared LB agar plates
- Sterile Petri dishes
- Transfer pipettes
- Sterile spreaders (if available)
- Gloves
- Paper towels

Low-Cost Alternatives

If laboratory equipment is limited:

- Measuring cups can demonstrate volume measurement.
 - Food coloring can simulate bacterial cultures.
 - Clear gelatin can model agar.
 - Plastic cups with lids can model Petri dishes.
 - Digital kitchen scales can demonstrate mass measurement.
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Technology

Teacher:

- Computer
- Projector
- Biotechnology videos
- Images of bacterial colonies

Students:

- Chromebooks/tablets
 - Digital worksheets
 - Google Classroom/Canvas
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Safety

Students must:

- Wear safety goggles and gloves.
- Wash hands before and after laboratory activities.
- Never consume laboratory materials.
- Avoid touching sterile materials.
- Use proper laboratory handling techniques.
- Handle hot liquids carefully.
- Use caution around heated equipment.
- Keep bottles labeled.
- Avoid opening prepared culture plates unnecessarily.
- Dispose of materials according to classroom procedures.

Teacher Note:

For a high school demonstration, use non-pathogenic teaching organisms or simulated cultures. Students should not grow unknown environmental bacteria.

Teacher Preparation for Activity

Before class:

- Prepare lesson slides explaining:
 - Microbial growth media
 - LB broth
 - LB agar
 - Bacteriophage research applications
- Prepare demonstration materials:
 - LB broth powder
 - Agar

- **Calcium chloride solution (demonstration only for phage applications)**
 - Petri dishes
- Prepare media calculations:
 - LB broth concentration
 - Agar concentration
 - CaCl₂ addition
- Set up student stations with:
 - Measuring tools
 - Labels
 - Media ingredients
- Demonstrate:
 - Safe weighing techniques
 - Mixing procedures
 - Proper labeling
 - Petri dish handling

Explain to students that:

- **Standard LB broth and LB agar used for bacterial culture do not contain calcium chloride.**
- **CaCl₂ is added only when the media will be used for bacteriophage experiments because calcium ions enhance phage adsorption to bacterial cells.**
- If CaCl₂ is required, it is added **after sterilization** to maintain solution quality and effectiveness.

Student Preparation for Activity

Students should:

- Review laboratory safety expectations.
 - Understand measurements using grams (g) and milliliters (mL).
 - Review concepts of solutions and concentrations.
 - Understand that microorganisms require nutrients to grow.
 - Review vocabulary:
 - Culture
 - Media
 - Agar
 - Sterile
 - Contamination
 - Colony
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Procedure (95 Minutes)

Engage: Why Do Scientists Grow Microorganisms?

Time: 10 minutes

Teacher Activity

Show images of:

- Bacterial colonies on agar plates
- Microbiology laboratories
- Bacteriophage research

Ask:

- "How do scientists grow microorganisms in a laboratory?"
- "Why can't bacteria simply grow anywhere?"
- "What nutrients might bacteria need?"

Introduce:

LB media is a nutrient-rich environment used by microbiologists to grow bacteria for research.

Explore: Preparing LB Media

Time: 35 minutes

Part 1: Preparing LB Agar

Teacher Demonstration

Explain:

LB agar contains:

- LB broth → nutrients
- Agar → solidifying agent

Students observe the preparation process.

Steps:

1. Measure the required amount of water.
2. Transfer water into a labeled bottle.
3. Add LB broth powder.
4. Add agar powder.
5. Mix thoroughly.
6. Heat until dissolved.
7. Prepare media for sterilization.

Teacher explains:

- Agar provides a solid surface for bacterial colonies.
 - LB broth provides nutrients.
 - Media must be sterilized to prevent contamination.
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Part 2: Preparing Double Strength LB Broth

Students calculate:

Normal LB broth:

20 g/L

Double strength:

40 g/L

For 400 mL:

Students calculate required amount:

8 g LB broth powder - $20\text{g/1L} \times 0.4\text{L} = 8\text{g}$

Discussion:

"Why might scientists prepare concentrated media?"

Explain: Why Each Component Matters

Time: 15 minutes

Teacher discussion:

LB Broth

Provides:

- Peptides
- Amino acids
- Vitamins
- Nutrients needed for bacterial growth
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Agar

Provides:

- A solid surface for bacterial growth
- Separation of individual bacterial colonies

Calcium Chloride

Students learn:

- Calcium chloride (CaCl_2) is not a standard component of LB media and is added only for certain bacteriophage experiments. Calcium ions help some bacteriophages attach to bacterial cells, improving the efficiency of phage infection, and can also help stabilize phage particles. CaCl_2 is added after sterilization to maintain its effectiveness and avoid unwanted precipitation.
 - CaCl_2 is added after sterilization because it should not be autoclaved.
 - Adding CaCl_2 at the wrong time can cause precipitation.
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Elaborate: Plating on Petri Dishes

Time: 25 minutes

Teacher Demonstration

Explain:

Petri dishes allow scientists to observe bacterial growth patterns.

Students practice simulated plating.

Student Activity:

1. Label Petri dish bottom:
 - Name
 - Date
 - Media type
 2. Observe prepared LB agar plate.
 3. Practice applying simulated sample using:
 - Colored water
 - Sterile technique demonstration
 4. Discuss:
 - Why must plates remain closed?
 - Why must labels be placed on the bottom?
 - Why is contamination a concern?
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Evaluate: Reflection and Exit Ticket

Time: 10 minutes

Students answer:

Students answer:

1. What is the purpose of LB broth?
 2. Why is agar added to LB media?
 3. **When would calcium chloride (CaCl₂) be added to LB media, and why?**
 4. What is the difference between LB broth and LB agar?
 5. Why are Petri dishes important in microbiology?
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Differentiation

Students with Learning Disabilities

- Provide step-by-step illustrated procedures.
- Use vocabulary cards.
- Provide guided calculations.
- Allow partner support.
- Use oral explanations instead of written responses.

Alternative Assessment:

Students demonstrate understanding by labeling media components and explaining their purpose.

English Language Learners

- Provide bilingual vocabulary sheets.
- Use pictures of:
 - Agar plates
 - Bacteria
 - Laboratory equipment
- Use sentence starters:

"LB agar is used for ____."

"Agar helps bacteria because ____."

Alternative Assessment:

Students explain concepts using diagrams and oral responses.

Advanced Learners

Students can:

- Calculate different media concentrations.
 - Research bacteriophage applications.
 - Compare different growth media.
 - Explore careers in microbiology.
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Assessment/Check for Understanding

Formative Assessment

Teacher observes students during:

- Measurement activities
- Calculations
- Media preparation discussions
- Plating simulation

Students should demonstrate:

- Understanding of media components
 - Safe laboratory practices
 - Ability to explain biotechnology applications
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Skills Assessment

Media Preparation Checklist

Students complete:

Media Preparation Checklist

- ✓ Identifies the purpose of LB broth
 - ✓ Identifies the purpose of agar
 - ✓ Calculates required quantities
 - ✓ Explains that CaCl_2 is used only for bacteriophage experiments
 - ✓ Demonstrates safe laboratory handling
 - ✓ Explains the purpose of Petri dishes
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Exit Ticket

1. Why do scientists use growth media?
 2. What is the difference between LB broth and LB agar?
 3. Why is agar used in Petri dishes?
 4. Why is sterilization important?
 5. Name one biotechnology field that uses bacterial cultures.
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Required Resources

- LB broth
- Agar
- Calcium chloride
- Petri dishes
- Measuring tools
- Laboratory safety equipment

Online Resources

Amgen Biotech Experience

<https://www.amgenbiotechexperience.com/>

Biotechnology laboratory education resources.

LabXchange

<https://www.labxchange.org/>

Virtual biotechnology and microbiology learning resources.

North Carolina Department of Public Instruction

<https://www.dpi.nc.gov/>

NC Biology standards.

Supplemental Resources

- Bacteriophage discovery programs
- Microbiology laboratory career videos
- Biotechnology manufacturing resources

Career connections:

- Microbiology Technician
 - Manufacturing Associate
 - Quality Control Microbiologist
 - Bioprocess Technician
 - Research Scientist
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Author Comments

This lesson introduces students to foundational microbiology techniques used in biotechnology laboratories. The activity was designed for high school students with limited laboratory experience and can be adapted for classrooms with different levels of equipment availability.

The lesson connects classroom biology concepts with real-world applications including bacteriophage research, pharmaceutical development, and biotechnology careers.

For limited-resource classrooms, the activity can be completed as a demonstration or simulation using safe classroom materials.

Sources (APA Format)

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<https://www.labxchange.org/>

Appendix: Student Worksheet

From Powder to Petri Dish: Preparing Microbial Growth Media

Name: _____ Date: _____

Vocabulary

Define:

LB broth:

Agar:

Culture:

Sterile:

Questions

1. Why do scientists prepare growth media?
2. What ingredient makes LB agar solid?
3. Why is LB broth considered a nutrient source?
4. Why must laboratory media be sterilized?
5. Why are Petri dishes useful for microbiologists?

Reflection

How do microbiology skills connect to careers in biotechnology and medicine?
