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**Teacher Innovation Project**

# Food Borne Pathogens

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## **Teacher Innovation Project**

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## **Major Contaminates Lesson Plan**

- Objectives:**
- a. The student will predict the mode of microbiological contamination through participation in a class activity.
  - b. Using the Internet as well as other forms of research materials, the students will describe the history and the effects of five major food contaminants.
- Engagement:** *Part one:* PowerPoint presentation that will be used as the “hook” to get students interested in the effects of food borne pathogens and their effects. There will then be a class discussion on the causes and effects of food borne pathogens to increase student interests on the subject.

*Part two: “Spreading Germs”* - in this activity a small amount a florescent lotion is smeared on a common class object. Using an ultra violet light ask the students to hold out their hands. If they have contracted the “germs” the lotion will glow on their skin. Explain to the students how easy it is to spread pathogens.

**Exploration:** Students will be divided in to small groups in order to complete the “Strive for Five, Pathogens Are Not For Me” research round up. Each student in the group will select five food borne pathogens to research and using the statements provided as a guideline, complete the research round up.

**Explanation:** In each of the formed groups, the students will use the information they have gathered about food borne illnesses to determine which pathogen(s) was the cause and explain why they chose the pathogen(s).

**Elaboration:** While in small groups the students will be presented with samples of case studies to review. The students will be asked to use both their research and the case studies to explain of the pathogen responsible in each case study.

**Evaluation:** Informal assessment:  
The students, based on their experiences in class, will verbally discuss how food may become contaminated in transport from the farm to the kitchen table.

Formal assessment:

- a. Using the Internet and other research materials the student’s groups will produce a brief summary, and a written review of each case study. This summary and review will be graded with the aid of a rubric.

b. Students will prepare a formal presentation. (see “Research Presentations”)

## **Strive For Five, Pathogens Are Not For Me**

### **Engagement:**

During spring break, you and your classmates will be working with several scientists from the Center of Disease Control (CDC) as student interns in the pathology lab. After a recent presentation on food borne pathogens you and your team were asked to review several case studies involving food borne pathogens. In order to do this you and your panel group will need to conduct further research on food borne pathogens. Your group has decided to divide up the list with each of you choosing five to gather further information. After your group has conducted the research of the selected food borne pathogens you will review the cases to determine which food borne pathogen(s) are the cause. From your observations and research, you and your panel group will compose a brief summary of your findings. This will be placed along with the written review of each case study. However, before you and your group can begin to compose your reviews you must develop an in-depth understanding of food borne pathogens. The following task should assist you in completing your investigation on food borne pathogens.

### **Explanation:**

Select five of the food borne pathogens from the list below for further study. Use the seven statements below and the rubric as guidelines in order help you to locate, gather, and display the appropriate information needed to complete the case study reviews.

Food borne pathogens

<i>Bacillus cereus</i>	<i>Campylobacter jejuni</i>	<i>Clostridium botulinum</i>	<i>Escherichia coli (ETEC)</i>
<i>Escherichia coli (O157:H7)</i>	<i>Escherichia coli (EPEC)</i>	<i>Listeria monocytogenes</i>	<i>Salmonella enteritidis</i>
<i>Salmonella typhimurium</i>	<i>Shigella ssp.</i>	<i>Staphylococcus aureus</i>	<i>Vibrio cholerae</i>
<i>Vibrio parahaemolyticus</i>	<i>Yersinia enterocolitica</i>		

**Seven Statements to Guide You through**

1. Describe how this pathogen is transmitted to those who become affected.
2. State which areas of the world this pathogen can be found.
3. Describe the symptoms and/or effects related to the pathogen.
4. Describe any preventive measures that can be taken in order to reduce and/ or prevent this pathogen.
5. State the number of individuals affected by the disease caused by this pathogen each year.
6. State if the disease caused by this pathogen has increased or decreased within the past twenty years.
7. Explain why this disease is of importance and give the need for people to be concerned about it.

## **Food Borne Pathogen Research Rubric**

**Proficient 3** - The research information is well drafted. It is directed to the appropriate audience. The seven statements have been thoroughly addressed, and supported. The writing is neat and legible. The errors in spelling, grammar, and punctuation, do not impact the effectiveness of the research information gathered. Scientific terminology is used correctly. The research information is focused and on topic for each food borne pathogen.

**Emergent 2** - Six of the seven statements are addressed. Errors may occur in the use of scientific terminology. The organizational pattern of the seven statements is not followed. Minor errors in spelling, grammar, and punctuation are present, and do not impact the effectiveness of the research information of each food borne pathogen.

**Novice 1** - Only five of the seven statements of the guideline have been addressed. The organizational pattern of research is not well established. Science terminology is not used or used incorrectly. There are gross errors in spelling, grammar, and punctuation, do impact the effectiveness of the conclusion.

**O** - No Response

## Case Study #1

During the school year in a small town in Vermont five friends Tommy, Lisa, Mike, Chris, and Renée were getting together to plan their activities for the upcoming summer vacation. They decided to meet at Tommy's maple and milk farm to swim in the river and then decide on the activities that they could do during summer vacation.

After swimming Chris said “Hey, Tommy, do you have anything to eat, I’m starved?” Tommy replied, “There are some leftovers from the lunch my parents had yesterday.” “Let's order some pizza.” Tommy then ordered one large sausage and bacon pizza and one large vegetable pizza. While waiting for the pizza to arrive, Tommy invited them to help themselves to the leftovers in the refrigerator and to soda, apple cider or milk. Mike ate some chicken and drunk a glass of milk. Renée and Tom shared the vegetable dip and carrots from the leftover lunch. Chris and Lisa had the deviled eggs. The friends were too busy planning their summer vacation that they didn't notice the time. An hour had passed and the pizza still hadn't arrived.

When the pizza finally arrived the delivery boy apologized for being so late and explained that three of their employees had gone home sick. Causing the pizza parlor to fall behind in their delivery orders. The pizzas were barely warm, but the friends didn't pay much attention to it. Lisa had two slices of the vegetable pizza and one slice of sausage and bacon pizza. Chris had two slices of the sausage and bacon pizza. Tommy had four slices of vegetable pizza. Mike had three pieces of sausage pizza and two pieces of vegetable pizza. Renée had two slices of bacon and sausage pizza.

## Signs and Symptoms

The friends finished their plans for summer vacation and went home around 9:30 pm. At about midnight Tommy awoke and rushed to the bathroom to vomit. By morning he was running a fever and a bad case of diarrhea that she didn't go to school.

Lisa and Renée went to meet Mike, Chris, and Tommy before school to review their plans for the summer. They were surprised to only find Chris and Mike. "Where is Tommy?" asked Renée. "He's sick," said Chris. "It must have been something he ate because he woke up vomiting around midnight." Just then the bell rang and they hurried off to class.

During third period, Mike had to go to the bathroom and vomit. He left school early and ended up spending the rest of the day in bed with intermittent several trips to the bathroom with diarrhea.

By Sunday night both Tommy and Mike felt well enough to eat and return to school on Monday.

## **Questions For Panel Groups**

1. Identify possible sources of the illnesses that Mike and Tommy experienced.
2. Explain whether or not Mike and Tommy could be infected by different kinds of microorganisms?
3. State whether or not the other students or family members could be effected by this disease?
4. Describe the symptoms of food poisoning?
5. Explain why Lisa, Renée and Chris get sick?
6. Explain whether or not if this disease will spread to the other students in the school?
7. State the precautions that Mike and Tommy could have taken in order to have not gotten sick?
8. Explain whether or not if it possible to identify the source of infection?
9. State any other information that your panel group would believe to be helpful to know that was not presented in the case study?

## **General Information-use for research**



**SALMONELLA**



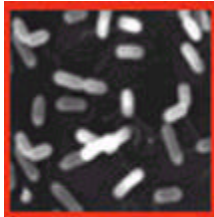
**E. COLI**



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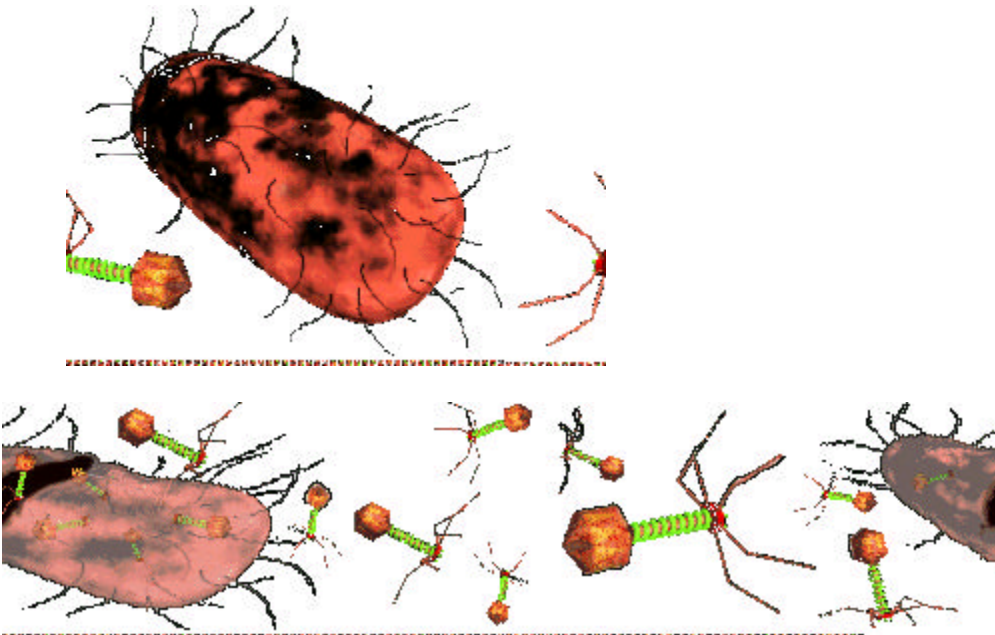
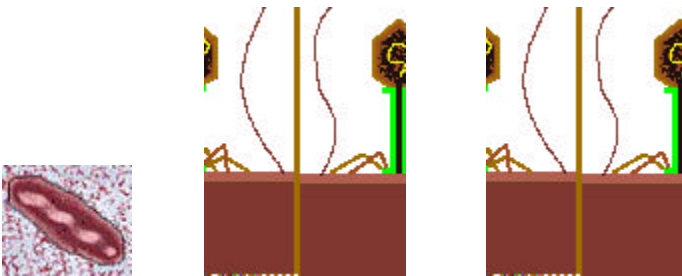
**SHIGELLA**



**LISTERIA**



**CAMPYLOBACTER**



[http://www.ucusa.org/food\\_and\\_environment/antibiotic\\_resistance/page.cfm?pageID=249](http://www.ucusa.org/food_and_environment/antibiotic_resistance/page.cfm?pageID=249)

**Pathogen and Effects**

<b>Organism</b>	<b>Incubation period in hours</b>	<b>Vomiting</b>	<b>Diarrhea</b>	<b>Fever</b>
<i>Bacillus cereus</i>	2 hours-16 hours	severe	moderate	none
<i>Campylobacter jejuni</i>	2 hours -10 hours	severe	severe	moderate
<i>Clostridium botulinum</i>	18 hours - 24 hours	mild to none	rare	none
<i>Escherichia coli (ETEC)</i>	24 hours - 72 hours	mild to none	moderate	none
<i>Escherichia coli (O157:H7)</i>	24 hours-72 hours	rarely	severe	mild
<i>Escherichia coli (EPEC)</i>	within 24 hours	mild/none	severe	none
<i>Listeria monocytogenes</i>	12 hours	moderate	mild	mild
<i>Salmonella enteritidis</i>	8 hours - 48 hours	mild to none	moderate	mild
<i>Salmonella typhi</i>	6-48 hours	mild to none	mild to none	moderate
<i>Shigella spp.</i>	24 hours - 72 hours	mild to none	moderate	mild
<i>Staphylococcus</i>	1 hours - 8 hours (rarely 18)	severe	mild	none
<i>Vibrio cholerae</i>	24 hours - 72 hours	mild	severe	none
<i>Vibrio parahaemolyticus</i>	6 hours - 96 hours	mild	moderate	mild/none
<i>Yersinia enterocolitica</i>	not known	moderate	moderate	mild

### Pathogen and Sources of Infection

Organism	Source of Infection
<i>Bacillus cereus</i>	Reheated foods. Bacteria deposits spores in food
<i>Campylobacter jejuni</i>	Can be contracted from foods, contaminated water, pasteurized milk and pets.
<i>Clostridium botulinum</i>	Smoked fish and canned vegetables can contain this bacteria. This is an anaerobic bacteria that can be found in any improperly cooked food that is stored in an anaerobic (no oxygen) environment.
<i>Escherichia coli (EPEC)</i>	Contaminated water, semi-soft cheeses, infected food from handlers.
<i>Escherichia coli (O157:H7)</i>	Can be found in foods such as raw beef, jerky and apple cider, etc.
<i>Escherichia coli (EPEC)</i>	Raw chicken, raw beef, and possible fecal contamination of food.
<i>Listeria monocytogenes</i>	Raw milk, ice cream, cheese, raw vegetables, raw and cooked poultry, raw and smoked fish, raw meats <i>Salmonella Enteritidis</i> . Can be found in eggs and/or dishes made with eggs.
<i>Salmonella typhimurium</i>	Can be found in raw meats, poultry, eggs, dairy products, fish, salad dressings, etc.
<i>Staphylococcus aureus</i>	Found in contaminated meats, dairy products (mayo) and bakery goods and other food items
<i>Shigella spp.</i>	Can be found in contaminated water, hand-to-hand contact or the oral fecal route.
<i>V. cholerae</i>	Can be found in contaminated water.
<i>VibriVibrio parahaemolyticus .</i>	Organisms grow in uncooked shellfish like sushi
<i>Yersinia enterocolitica</i>	Undercooked pork, foods that are refrigerated

### Pathogen and Clinical Features

Organism	Clinical Features
<i>Bacillus cereus</i>	Severe nausea, vomiting and diarrhea.
<i>Campylobacter jejuni</i>	Fever, headache and abdominal cramps, also bloody diarrhea.
<i>Clostridium botulinum</i>	Respiratory complication, double-vision, difficulty in swallowing, mortality rate is high.
<i>Escherichia coli</i> (ETEC)	Low grade fever, abdominal cramps associated with nausea, dehydration, and rice water stool. General malaise.
Escherichia coli (O157:H7)	Severe abdominal pain, blood diarrhea, mild to no fever, vomiting may occur.
<i>Escherichia coli</i> (EPEC)	Bloody diarrhea, destruction of lining of the intestines, dehydration.
<i>Listeria monocytogenes</i>	Flu like symptoms, diarrhea, nausea, vomiting with a continuous fever.
<i>Salmonella enteritidis.</i>	Nausea, abdominal pain, mucus and trace blood in stool, fever
<i>Salmonella typhimurium</i>	Fever, headache, abdominal pain, mimicking appendicitis, enlarged spleen, diarrhea and rose spot on the abdomen. Pass oral-fecal route.
<i>Shigella spp.</i>	Sudden bloody diarrhea with pus, abdominal cramps with tiredness.
<i>Staphylococcus</i>	Severe vomiting.
<i>Vibrio cholerae</i>	Liquid (rice water) diarrhea associated with nausea, cramping and vomiting. In severe cases shock can lead to death.
<i>Vibrio parahaemolyticus</i>	Chills, headache, and fever, abdominal cramps associated with nausea, diarrhea, and vomiting.
<i>Yersinia enterocolitica</i>	Acute abdominal pain, diarrhea, and fever (mimicking appendicitis).

## Research Presentations

Upon completion of your research activity, your group will be required to present the researched material to the class in one of the following formats.

- a. Perform a television public service announcement advising your audience of the dangers of improper food handling and ways to reduce the risk of food poisoning. (Skit must be between 1-3 minutes in length.)
- b. Create a PowerPoint presentation and a formal presentation explaining the results of your research. (Follow the guidelines outlined in the PowerPoint guidelines doc.) (Each member of the group must orally present a portion on the presentation)
- c. Design a bulletin board outlining the information of your research. Include history of the pathogens and general statistics about food poisoning. The number of groups able to choose this option will depend upon the number of bulletin boards available.
- d. Design a brochure to be distributed to your classmates (possibly other students in the school) that explains the dangers of improper food handling and ways to reduce the risk of food poisoning. The brochure should also provide general statistics discovered about your pathogen while doing your research.

## Powerpoint Guidelines

Your presentation is an important means of exchanging information with your fellow students. The guidelines provided here will make your presentation as effective as possible!

- **Use Powerpoint**  
*ALL* presentations should be prepared using Microsoft Powerpoint and will be posted on the course website.
- **Plan Your Talk**  
The time allotment for each talk is either 15 or 20 minutes. Plan your talk for 15 minutes, allowing 5 minutes for questions. Additionally, you should plan for approximately 1 minute per slide/overhead that you use for your talk. It's recommended that you plan for approximately 12 slides at a maximum. You should also have one viewgraph/slide that includes your talk title, your group name, and the members of your group. This should be your opening viewgraph.
- **Organize Content**  
Using your outline as a guide, decide how many slides to make for each topic. Organize the content of your slides to summarize the main points. Know the main point(s) for each slide before you prepare it.
- **Summarize Main Points**  
Do *NOT* write in complete sentences. Most people can read faster than you can speak. Reading your slides to the audience is guaranteed to put them to sleep. Use the slides as memory aids to help you organize the main points and then fill in the details during your talk.
- **Practice Makes Perfect**  
Due to the tight time constraints, it is extremely important that you practice delivering your presentation and time it to see how long it takes. Adjust the content accordingly while practicing to fill the time allotment.
- **Be Prepared!**  
Do *NOT* talk about any topic unless you have prepared a slide to go with it. *DO* talk about every slide you show. There is an ideal balance between including too much and too little information on each slide. It is desirable for the slides to require some explanation in order to hold the interest of the audience. Too much

verbal explanation leads to confusing "hand waving" which the listeners will not remember.

- **Layout and Fonts**

In order for viewgraphs to be legible from the back of the room, use large (16-18pt), well-spaced type and allow space for the border around the image. The maximum number of lines on your viewgraph or slide should be around 4-5 lines of text. Effective Powerpoint presentations contain topic sentences and bulleted points. As noted above, summarize and do *NOT* photocopy text passages from references.

- **Print Reduced Handouts**

Please bring a copy of your viewgraphs, reduced and printed 6 per page. Provide copies to the teacher the day before the presentation so that transparencies of your viewgraphs will be available in the event of projector or computer failure.

- **Save and Backup Files**

Finally, save your work frequently while working in Powerpoint and make a backup copy on a diskette to prevent losing your work. It is suggested that you send a copy of the files to your personal e-mail address in the event of disk loss or damage.

### **Contents of the PowerPoint Presentation.**

To complete an effective presentation it is recommended that you have the following in your PowerPoint presentation:

- Minimum of 10 slides
- Title slide
- Main menu slide with links to other slides

- Do NOT use complete sentences: use bullets, key words
- Links to the Internet
- One slide for each topic in your written report
- The end slide
- A picture on each slide (relevant to the topic or a cartoon to help animate the content)
- Colored and appropriate graphic background
- Extra-credit: Include music, sounds to assist with slide animation

## Student Sample



### ***Bacillus cereus***

#### **Infectious dose**

greater than 1 million ( $10^6$ ) organisms per gram in food

#### **Attack Rate**

Emetic (vomiting) illness

- rare
- 0.5 to 6 hours after consumption
- rice and other starchy foods
- nausea
- duration generally less than 24 hours
- low molecular weight emetic toxin, heat-stable peptide

Diarrheal illness

- 6 to 15 hours after consumption
- meats, fish, and vegetables
- nausea, abdominal cramps and/or diarrhea
- large molecular weight diarrhea-genic toxin

#### **Sequelae**

The symptoms usually subside in less than 24 hours.

Strain produces increased toxin linked to death caused by liver failure.

#### **Transmission**

normally present in many foods

must grow in the food to high numbers before it can cause illness.

Hot foods held at temperatures above  $130^{\circ}$  F

Cold foods held at temperatures below  $40^{\circ}$  F

## *Vibrio parahaemolyticus*

### **Infectious Dose**

### **Attack Rate**

#### **Sequelae**

Most persons recover after 3 days and suffer no long-term consequences. Bloodstream infections and death are uncommon and usually occur in persons with underlying medical conditions.

#### **Transmission**

Eating raw or undercooked shellfish, particularly oysters. Less commonly, wound infections may occur when wounds or soft tissues are exposed to warm seawater

#### **Risk Groups**

All persons.

## *Cholerae*

### **Infectious Dose**

### **Attack Rate**

Profuse watery diarrhea, vomiting, circulatory collapse and shock. Many infections are milder diarrhea or asymptomatic.

#### **Sequelae**

25-50% of typical cases (moderate to severe) are fatal if untreated.

#### **Transmission**

Contaminated drinking water or food. Large epidemics often related to fecal contamination of water supplies or street vended foods. Occasionally transmitted through eating raw or undercooked shellfish that are naturally contaminated.

#### **Risk Groups**

Virtually none in the United States.  
Travelers to developing countries.  
Persons living in poverty in the developing world.

## *Enterotoxigenic Escherichia coli (ETEC)*

### **Infectious Dose**

that produce special toxins which stimulate the lining of the intestines causing them to secrete excessive fluid, thus producing diarrhea

**Attack Rate**

different strands ETEC can secrete either one or both toxins, illness is similar

- ST - heat-stable toxin
- LT - heat-labile toxin

**Sequelae**

Most infected persons will recover within a few days, without requiring any specific treatment

Infection with ETEC can cause profuse watery diarrhea and abdominal cramping. Fever, nausea with or without vomiting, chills, loss of appetite, headache, muscle aches and bloating can also occur but are less common. Illness develops 1-3 days after exposure and usually lasts 3-4 days. Some infections may take a week or longer to resolve. Symptoms rarely last more than 3 weeks. Most patients recover with supportive measures alone and do not require hospitalization or antibiotics.

**Transmission**

Infection occurs when a person eats food, or drinks water or ice contaminated with ETEC bacteria. Human or animal wastes (e.g., feces) are the ultimate source of ETEC contamination.

**Risk Groups**

Travelers to developing countries.

Persons living in poverty in the developing world.

***Shigellosis*****Infectious Dose**

An inoculum of 10 to 200 organisms

**Attack Rate**

Four species of *Shigella*: *boydii*, *dysenteriae*, *flexneri*, and *sonnei*.

Watery or bloody diarrhea, abdominal pain, fever, and malaise.

**Sequelae**

Reiter's syndrome is a late complication of *S. flexneri* infection, especially in persons with the genetic marker HLA-B27. Hemolytic-uremic syndrome can occur after *S. dysenteriae* type 1 infection. Convulsions may occur in children; the mechanism may be related to a rapid rate of temperature elevation or metabolic alterations.

**Transmission**

A small inoculum (10 to 200 organisms) is sufficient to cause infection. As a result, spread can easily occur by the fecal-oral route and occurs in areas where hygiene are

poor. Epidemics may be food borne or waterborne. *Shigella* can also be transmitted by flies.

### **Risk Groups**

In the United States, groups at increased risk of shigellosis include children in child-care centers, contacts of children in child-care settings, and persons in custodial institutions, where personal hygiene is difficult to maintain; Native Americans; orthodox Jews; international travelers; men who have sex with men; and those in homes with inadequate supplies for hand washing

### **References:**

<http://www.cdc.gov/ncidod/dbmd/diseaseinfo/default.htm>

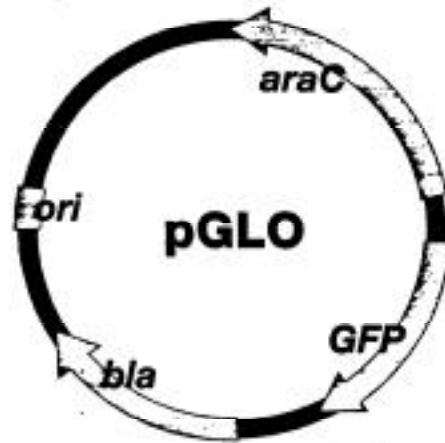
<http://vm.cfsan.fda.gov/~mow/chap12.html>

<http://www.iol.ie/~alank/CROHNS/RESEARCH/MILK/sequelae.htm>

[http://home.earthlink.net/~zinkd/b\\_cereus.htm](http://home.earthlink.net/~zinkd/b_cereus.htm)

Extension Lab Activity: DNA Transformation: pGLO Get a complete set of pGLO instructions in PDF format. [http://www.bio-rad.com/B2B/BioRad/product/br\\_category.jsp?BV\\_SessionID=@@@@0149518658.1038075029@@@@&BV\\_EngineID=cccdadcgkiejlifcngcfkmdhkkdfll.0&categoryPath=%2fCatalogs%2fLife+Science+Education%2fFree+Biotechnology+Explorer+Curricula%2f](http://www.bio-rad.com/B2B/BioRad/product/br_category.jsp?BV_SessionID=@@@@0149518658.1038075029@@@@&BV_EngineID=cccdadcgkiejlifcngcfkmdhkkdfll.0&categoryPath=%2fCatalogs%2fLife+Science+Education%2fFree+Biotechnology+Explorer+Curricula%2f)

[pGLO+Bacterial+Transformation+Kit+Curriculum%2fInstruction+Manual%2fComplete+Instruction+Manual+\(PDF\)&divName=Life+Science+Education&loggedIn=false&serviceLevel=Lit+Request](http://www.bio-rad.com/catalog/US/pGLO/Bacterial+Transformation+Kit+Curriculum%2fInstruction+Manual%2fComplete+Instruction+Manual+(PDF)&divName=Life+Science+Education&loggedIn=false&serviceLevel=Lit+Request)



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