

Human Impacts on Water Quality: Coliform Contamination

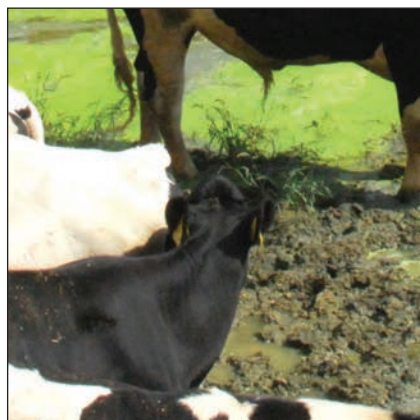
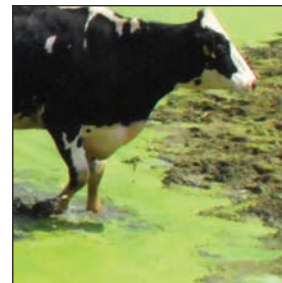
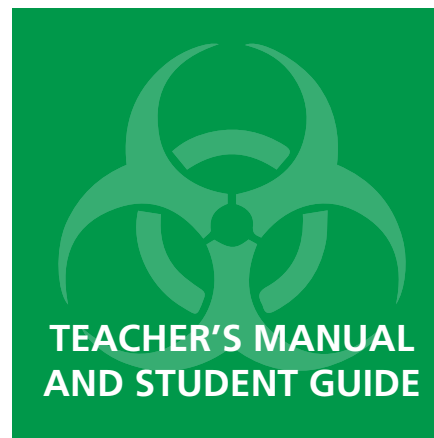


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Photocopy the Student Guide as needed for use in your classroom.

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Human Impacts on Water Quality: Coliform Contamination

Phenomenon

The contamination of water by coliform bacteria due to human activity is a major global health risk. Coliforms are a group of bacteria found mainly in the intestines of warm-blooded animals, and their presence in drinking water may indicate the presence of fecal material and pathogens the water supply. It is important that accurate methods are used to analyze water to assess the safety of water for human use.

In the first part of the investigation, students use selective chromogenic culture test to quantify and verify coliforms in water and to differentiate *E. coli* and other coliforms from non-coliform bacteria. They analyze their results and establish whether the water sources meet regulatory quality standards. During a second, inquiry-oriented lab, students test and evaluate prepared water samples from locations within a fictional municipality and propose design solutions to reduce the environmental impacts of human activities linked to bacterial contamination of water there. Students describe the importance of clean water to public health with the goal of answering the Driving Question, “How can we make sure our water sources are safe from organisms that cause disease?”

Related Performance Expectation

The activities in this kit build toward the following Performance Expectation of the Next Generation Science Standards*: **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Three-Dimensional Learning

The activities in this kit address the following dimensions of the Next Generation Science Standards.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
<p>Constructing Explanations and Designing Solutions</p> <ul style="list-style-type: none"> Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. 	<p>LS2.C: Ecosystem Dynamics, Functioning, and Resilience</p> <ul style="list-style-type: none"> Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. 	<p>Cause and Effect</p> <ul style="list-style-type: none"> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. <p>Scale, Proportion, and Quantity</p> <ul style="list-style-type: none"> The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

*“Next Generation Science Standards” is a registered trademark of WestEd. Neither WestEd nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and do not endorse it. **Source:** NGSS Lead States, 2013. *Next Generation Science Standards: For States, By States*. Retrieved from www.nextgenscience.org or ngss.nsta.org.

Lesson Performance Expectation

Lesson Performance Expectation	Lesson Component	Artifacts Generated
Quantify and differentiate indicator coliforms to determine whether human activity has caused contamination of water sources.	Introduction	<ul style="list-style-type: none"> • Introduction Questions 1 and 2 responses
	Investigation 1	<ul style="list-style-type: none"> • Investigation 1 Data Sheet • Photo of incubated petri dish
	Investigation 2	<ul style="list-style-type: none"> • Investigation 2 Data Sheet • Photo of incubated petri dish
Make a claim about whether water sources meet regulatory quality standards for bacterial contamination using empirical evidence.	Investigation 1	<ul style="list-style-type: none"> • Analysis question 2 responses
	Investigation 2	<ul style="list-style-type: none"> • Analysis question 2 responses
Explain the significance of coliform bacterial contamination, based on the quantity and types of indicator organisms in a sample.	Introduction	<ul style="list-style-type: none"> • Introduction Questions 1–4 responses
	Investigation 1	<ul style="list-style-type: none"> • Analysis questions 1–5 responses
	Investigation 2	<ul style="list-style-type: none"> • Analysis responses
	Conclusion	<ul style="list-style-type: none"> • Conclusion questions 1 and 5 responses
Identify possible sources of bacterial pollution due to human activity in a watershed.	Investigation 2	<ul style="list-style-type: none"> • Analysis questions 4 and 5 responses
	Conclusion	<ul style="list-style-type: none"> • Conclusion question 4 responses
Propose solutions to mitigate the effects of human activity on freshwater quality.	Investigation 2	<ul style="list-style-type: none"> • Analysis question 6 responses
	Conclusion	<ul style="list-style-type: none"> • Conclusion questions 6 and 7 responses
Determine the source and scale of bacterial contamination and design a solution to reduce the impacts of human activities linked to bacterial contamination, using information obtained from reliable sources and water analysis evidence from investigations.	Final Performance	<ul style="list-style-type: none"> • Final Performance responses

Prerequisite Knowledge and Skills

- an understanding of the water cycle and how water drains through a watershed into a body of water like a river, lake, or wetland
- an understanding of how microbial cultures are used to isolate and quantify bacteria from a sample

Safety

Use this kit only in accordance with established laboratory safety practices, including appropriate personal protective equipment (PPE) such as gloves, chemical splash goggles, and lab coats or aprons. Ensure that students understand and adhere to these practices. Know and follow all federal, state, and local regulations as well as school district guidelines for the disposal of laboratory wastes. Students should not eat, drink, or chew gum in the lab and should wash their hands after entering and before exiting the lab as well as after collecting any samples other than tap water.

- When working with bacteria, it is crucial to use sterile technique and proper laboratory practices to reduce contamination. Treat all microorganisms as potential pathogens.
- Keep inoculated plates shut with Parafilm®.
- Sterilize or disinfect equipment, materials, and work areas after use. Either autoclave waste materials (40 minutes at 121°C and 20 lb pressure) or disinfect them by covering them in a solution of 1 part chlorine bleach to 9 parts water and soaking them for 2 hours.

Download Safety Data Sheets (SDS) at carolina.com/sds or scan this code:



Time Requirements

Teacher Preparation (Total)	120 minutes
Previewing Videos and Interactive Lessons	30 minutes
The Day before the Investigations	75 minutes
The Day of Investigations	15 minutes
Introduction (Total)	45 minutes
Phenomenon Discussion	15 minutes
Introduction Questions	30 minutes
Investigation 1 (Total)	60 minutes
Student Collection of Water Samples	10 minutes
Culturing Sample (results require 24-48 hours)	20 minutes
Analysis	30 minutes
Investigation 2 (Total)	50 minutes
Culturing Sample (results require 24-48 hours)	20 minutes
Analysis	30 minutes
Conclusion	30 minutes
Final Performance	30 minutes



Activate Your Digital Resources

1. Visit CarolinaScienceOnline.com/activate
2. Log in or create an account
3. Enter or copy and paste code(s) received via “Your Carolina Digital Resources” email

Need help? Call Customer Service at 800.334.5551
or email csupport@carolina.com

What Teachers Are Saying

The digital access was amazing!!!

Biology Teacher, NC

I love the resources and the support this lab gives. It takes the standards and creates a framework that allows teachers to support their students in their inquiry investigation.

Chemistry Teacher, CA

GREAT! I can use this for students to follow on their digital devices, and not have to waste paper.

Chemistry Teacher, CA

It's always great to incorporate technology in the classroom, I think this is powerful for any level of learner.

Biology Teacher, TX

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science
ONLINE®

Time-Saving Digital Resources



Digital Teacher's Manual

A convenient, digital version of your teacher's manual that can be viewed on any device.



Downloadable Resources

Save a tree! These resources can be downloaded, printed, and emailed to your students.

Student Guide (PDF)

Fill-in Answer Sheet (PDF)

Editable Assessment Questions (Doc)

Whiteboard Resources (PDF)

Instructional Support (PDF)



Videos

Save time, engage students, and review procedures with these videos:

Reactivating MicroKwik Cultures

Managing Pathogens in a River Watershed



Interactive Lessons and Simulations

Engage your students with interactive lessons that can be assigned and used on any device.

Bacterial Counting and Treatment

Waterborne Bacterial Diseases

How Human Activity Affects Ecosystems