

LESSON: In Katrina's Wake

Summary: Students read the article "In Katrina's Wake," review geographic information system (GIS) maps of the region identifying locations for hazardous materials, and discuss the variety of environmental health hazards resulting from Hurricane Katrina. Students then write an essay stating whether they think it is safe for people to return to live in this region before cleanup is complete and whether they believe individuals or the government should make the choice about if and when to return. Integrated Lesson—This lesson extends beyond traditional science content and can be used in other academic subjects.

EHP Article: "In Katrina's Wake"
EHP Student Edition, April 2006, p. A32–A39
<http://ehp.niehs.nih.gov/members/2006/114-1/focus.html>

Objectives: By the end of this lesson, students should be able to

1. summarize information provided in the article and raised in discussion;
2. identify environmental health issues linked with the aftermath of Hurricane Katrina; and
3. compose an articulate opinion essay based on the information provided in the article, lesson, and discussion.

Class Time: 2.5–3 hours

Grade Level: 9–12

Subjects Addressed: Environmental Science, Environmental Health, Biology, Earth Science, Health, Social Studies, Language Arts

► Prepping the Lesson (15 minutes)

INSTRUCTIONS:

1. Download the entire April 2006 *EHP Student Edition* at <http://www.ehponline.org/science-ed/>, or download just the article "In Katrina's Wake" at <http://ehp.niehs.nih.gov/members/2006/114-1/focus.html>.
2. Review the Student Instructions and Background Information.
3. Make copies of the Student Instructions and the handout "Hurricane Katrina GIS Maps."

MATERIALS (per student):

- 1 copy of the *EHP Student Edition* article "In Katrina's Wake"
- 1 copy of the Student Instructions
- 1 copy of the two-page handout "Hurricane Katrina GIS Maps" (maps could also be provided per group)

VOCABULARY:

- geographic information system (GIS)
- potable

BACKGROUND INFORMATION:

All of the information needed to complete this assignment is contained within the lesson and the handouts. However, there are a few points of which to be aware. On p. A36–A37 the article discusses differences in the testing results from the U.S. EPA and the Natural Resources Defense Council (NRDC). Unfortunately we do not know three things: 1) how the samples were collected, 2) the actual concentrations of toxicants found in the samples, and 3) the effects of complex mixtures.

First, the way in which the samples were collected can affect results. For example, were water samples taken three feet down (where few contaminants may exist) or on the surface (where some of the petroleum products actually are)? How many samples were taken? Where were they taken? And were the samples mixed in a way that is reasonable and that characterizes a specific area, or would the sample mixture dilute the results?



Second, in the article we are not given actual concentrations of contaminants and are thereby limited by the information and wording used in the article. It is difficult to accurately interpret "loose" wording such as "volatile and semivolatile organic compounds, pesticides, and metals including aluminum were found, but at levels below what the ATSDR and CDC consider to be immediately hazardous to human health." There is a significant difference between chemical concentrations considered to be "immediately hazardous to human health" and those that are hazardous to human health after long-term exposure. Although this statement is made within the context of immediate threats to emergency responders, it is important to consider the potential long-term impact to the health of residents exposed to the chemicals. On page A37, the article also provides a quote from the EPA website:

The low level of volatile pollutants is not surprising as contaminants may be bound in sediment. Monitoring data directly around the Murphy Oil spill reveal some slightly elevated levels of benzene and toluene that are associated with petroleum release. Long-term exposure (a year or longer) at the levels measured would be required for health effects to be a concern.

The wording of this statement leaves the reader with the impression that health risks from these chemicals are not really a concern. Government officials who may know very little about environmental health are making decisions about whether or not citizens should return. Long-term health risks from exposure to toxicants should be at the forefront of any conversations and decisions.

Lastly, health effects from complex chemical mixtures are not explicitly addressed in the article. Although this is one area of toxicology research that is sorely lacking data, our ignorance of the subject should not preclude its consideration. Scientists are beginning this work, and discovering that in some cases mixtures can compound health effects (i.e., the chemicals can become more toxic in a particular mixture). People who return to the region, particularly New Orleans, may be exposed to mixtures of chemicals from the water they drink, the air they breathe, and the local seafood they eat. Unless the soil/sediment is removed, residents will continuously inhale and ingest chemical mixtures from the dust (imagine a child digging in the dirt in his backyard, or the dust you clean off the floor when you mop). Exposures from these sources can be high. (For more information and a class activity on chemical mixtures, refer to the September 2005 *EHP Student Edition* lesson "Three Is a Toxic Number," <http://ehp.niehs.nih.gov/science-ed/lessons2005.html#sep>.)

RESOURCES:

Environmental Health Perspectives, Environews by Topic page, <http://ehp.niehs.nih.gov>. Choose Hazardous Waste, Marine and Coastal Science, Risk Assessment

National Institute of Environmental Health Sciences, Environmental health science data resource portal, <http://balata.ucsd.edu:8080/gridsphere/gridsphere?cid=gisimages>. Choose Maps

National Library of Medicine, Hurricanes: links to health information including toxicology and environmental health, <http://sis.nlm.nih.gov/enviro/hurricane.html>

► Implementing the Lesson

INSTRUCTIONS:

1. Instruct students to read the article and either highlight or write down specific hazards or sources of hazards described in the article.
2. Have students share examples of the hazards or sources and write them on the board, dividing them into the following categories: petroleum, biological hazards, household hazards, industrial/business hazards, other hazards. Some specific chemical hazards will be placed in several categories.

Encourage students to write down specific numbers where provided (e.g., over 8 million gallons of petroleum products were spilled along the coast.) You may want to mention to the students that the *Exxon Valdez* spilled 11 million gallons of oil, which was considered a huge natural disaster!

Below is a list of hazards and sources for you to refer to during the class discussion.



Petroleum	Biological Hazards	Household Hazards	Industrial/Business Hazards	Other Hazards
Oil spills from refineries and tank farms (140 oil and gas platforms damaged, 8 million gallons spilled along the coast; polycyclic aromatic hydrocarbons, benzene, toluene, and ethylbenzene)	Sewage from more than 200 sewage treatment plants Bacteria— <i>E. coli</i> , cholera Mosquitoes	More than 354,000 homes destroyed or damaged 300,000 refrigerators (Freon) Computer monitor has 4.5 pounds of lead and other metals Propane tanks, household pesticides, asbestos (collected 1 million pounds of household hazardous waste in Louisiana alone) Mold	Hundreds of businesses use or produce fuel or chemicals 400 sites identified as needing cleanup prior to Katrina Pesticides, dioxins, 54 Superfund sites	Lead, arsenic (30 times the EPA safety levels), chromium, aluminum Pesticides, dioxins, 54 Superfund sites 39.9 million cubic yards of debris Formaldehyde and acrolein from burning debris More than 6 million dead animals Carbon monoxide poisoning from generators Waste from automobiles (oil, antifreeze, transmission fluid, metals), "orphan" tanks and drums Physical hazards (glass, sharp objects, etc.)

- Encourage the students to look at the photos in the article and ask questions such as:
 - Do the photos provide perspective as to the enormity of the situation?
 - Are there any hazards you see in the photos that can be added to the list? (e.g., "orphan" tanks and drums).
 - Do the photos show how individual people are being exposed to hazards? You could discuss the woman swimming—the sheen in the water is from petroleum products, which could be absorbed through the skin. The two women cleaning up in the moldy house have no respiratory protection; mold is an inhalation hazard.
- Give students a few minutes to complete Step 2 on the Student Instructions. Highlight or circle the statistic that over 354,000 homes have been destroyed or damaged beyond repair. Ask the students to share examples of toxic items they know are in their homes (paint, including the possibility of leaded paint on homes older than 1978, oven cleaner, drain cleaner, oil, antifreeze, asbestos, pesticides, batteries, computer monitors, TVs, mercury in old thermostats, etc.). Now help the students envision multiplying that out across all of the homes that were flooded. Every home has the potential of being a mini toxic waste site. This is in addition to all of the hazardous chemicals that came from other places.
- Hand out the handout "Hurricane Katrina GIS Maps" for the students to review (Step 3). Ask the following questions to guide the discussion:
 - What do the maps show?
 - Imagine flooding and Category 4 hurricane force winds impacting each and every one of these sites. Do you think the potential is high for extensive contamination? Why or why not?
- Instruct students to complete Step 4. You may brainstorm with the class and generate a list of issues that relate to the questions in Step 4. This is an opportunity to help students with their writing. You may consider one-on-one or small group discussions to share ideas about how to approach the writing or help students identify details and arguments to use in their essay. Students should be given several opportunities to rewrite drafts until their essay is at a score of 70% or better. Students could provide peer review as one of the revision steps and then be assessed on the feedback they provide during the peer-review process.



NOTES & HELPFUL HINTS:

- You could divide the students into groups and have them read sections of the article and identify hazards or sources of hazards, then share them with the class.
- Students could independently investigate soil and water testing results from various federal agencies, community organizations (such as the NRDC), and universities. Some of these results can be found online.
- Students could debate whether or not New Orleans should be resettled.

▶ Aligning with Standards

SKILLS USED OR DEVELOPED:

- Classification
- Communication (notetaking, oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Reading maps and legends

SPECIFIC CONTENT ADDRESSED:

- Environmental health and hurricanes
- Protection of human health
- Decision making at the individual and government levels

NATIONAL SCIENCE EDUCATION STANDARDS MET:**Science Content Standards****Unifying Concepts and Processes Standard**

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement

Science As Inquiry Standard

- Abilities necessary to do scientific inquiry

Science in Personal and Social Perspectives Standard

- Personal and community health
- Environmental quality
- Natural and human-induced hazards

▶ Assessing the Lesson

Step 1: As you read "In Katrina's Wake," write down any possible types or sources of hazards listed in the article. Be prepared to provide examples in a class discussion.

Students could turn in their list or be assessed on their participation in the class discussion.

Step 2: List three items you have in your house or garage that are toxic. Be prepared to share your list with the class.

Students could turn in their list or be assessed on their participation in the class discussion.

Step 3: Look at the two-page handout titled "Hurricane Katrina GIS Maps." These maps show the locations of petroleum industries, companies that release, store, or produce toxic chemicals, and known toxic waste sites (such as Superfund, or National Priorities List, sites, which are the worst of the worst pollution sites). Discuss these maps with the class.

Students could be assessed on their participation in the class discussion.

Step 4: Write a 1- to 2-page essay answering these questions:

- Based on the information presented in the article and this lesson, do you think it is safe for people to return to live in this region before cleanup is complete? Be sure to consider all of the different possible sources of exposure (air, food, water, soil) and exposure to fetuses, infants, children, elderly, and people who are sick (e.g., have cancer or asthma).



- Do you believe individuals or the government should make the choice about if and when to return? Justify your reasoning and refute at least one specific argument from the "other side" (i.e., some people argue that... but I believe... because...).

The essays should be turned in with several rough drafts showing a series of edits and revisions. The writing should be grammatically correct, clear, and concise, and should present a logical sequence. Students need to provide information to support their opinions.

Students should be given additional points for complex or abstract thinking that is relevant to the topic, and in-depth discussions of their reasoning. For example, the second question of the essay gives students the opportunity to go beyond a superficial answer such as "individuals should make the choice because it is their body." A more thought-out answer may include caveats, such as "if testing has been done on the water, air, and soil at or near a person's home" or "if the person is fully aware of the potential health risks of returning" and then follow with an explanation of that caveat.

Students also need to provide an argument for the "other side" and then logically refute that argument. This encourages the students to consider more than one angle and think through their response. A student arguing for the individual right to make the decision may acknowledge that individuals may not be fully aware of the extensive health risks associated with returning, and should find a way to address that issue.

► Authors and Reviewers

Author: Stefani D. Hines, University of New Mexico, College of Pharmacy, Community Environmental Health Program

Reviewers: Susan Booker, Erin Dooley, Liam O'Fallon, Lisa Pitman, Wendy Stephan, Kimberly Thigpen Tart, Heather Valli



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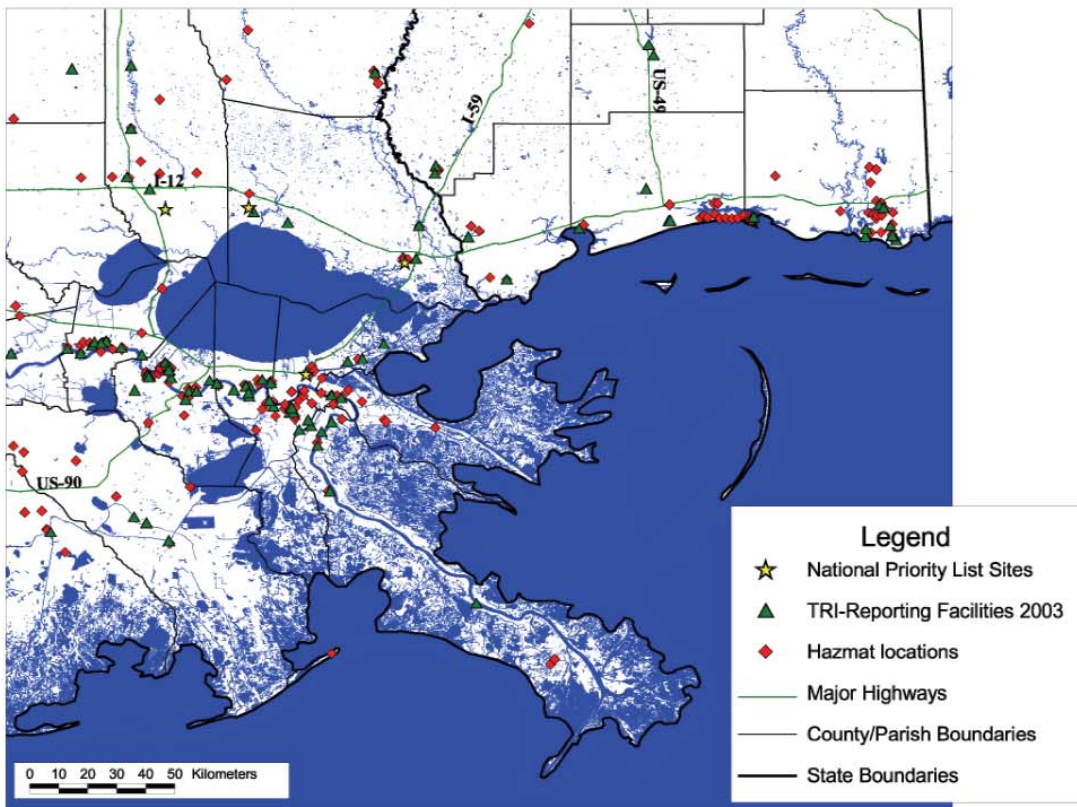
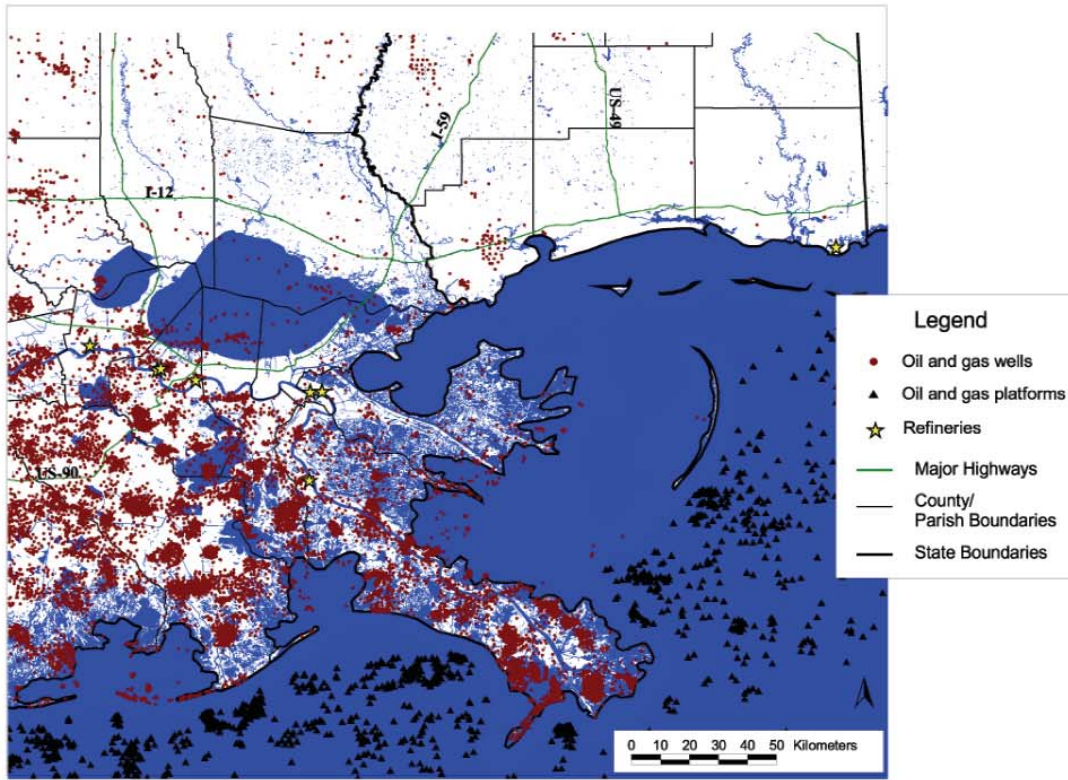
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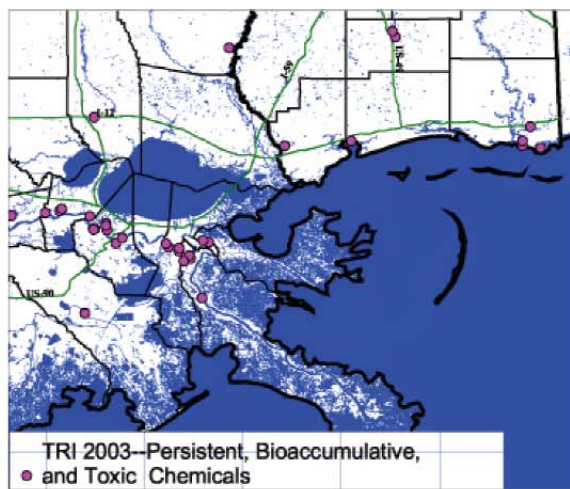
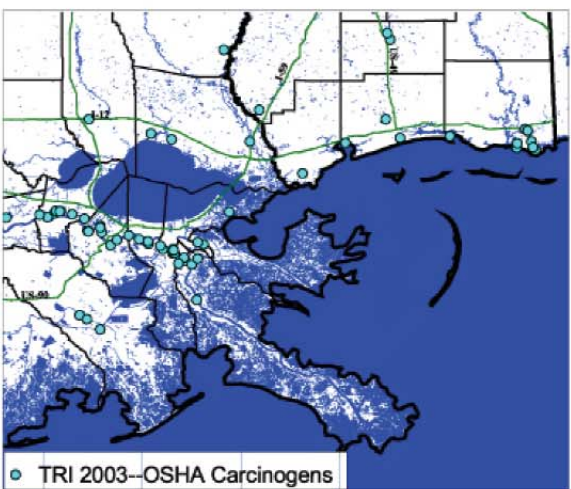
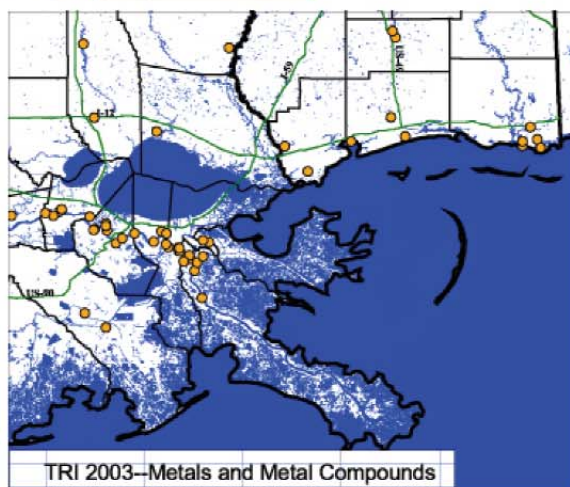
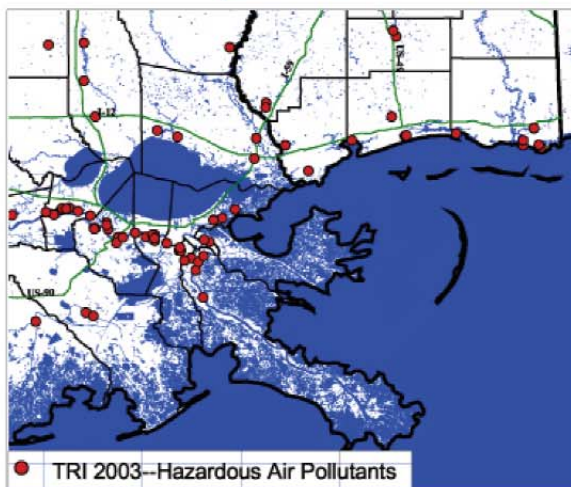
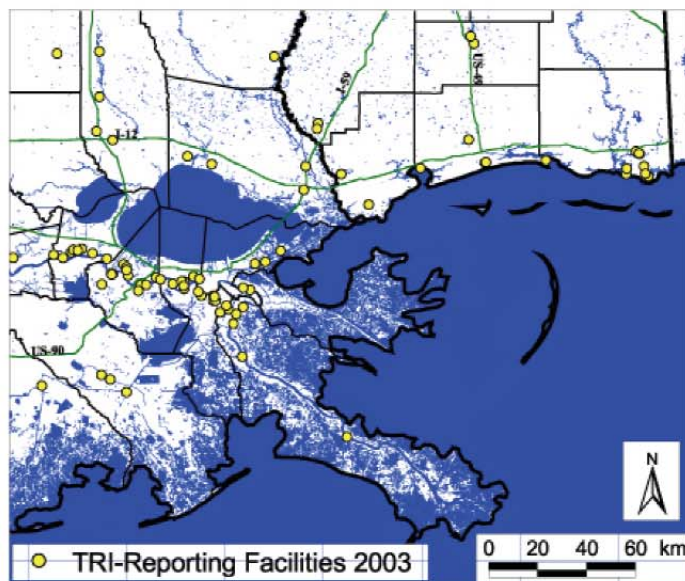
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Hurricane Katrina GIS Maps





Source: Maps courtesy of the NIEHS (for further information, contact hurricane@niehs.nih.gov).

