# Effect of Chemicals in Ecosystem


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## SUBJECT/GRADE LEVEL

**Subject Area**: Life Science

**Grade Level**: High School

## Materials

- *Daphnia sp.*
- Various household chemicals (caffeine, rubbing alcohol, etc.)
- Post it
- Markers
- Poster paper/butcher paper

## STANDARDS

### Next Generation Science Standards

- HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

### English Language Arts Standards | Common Core State

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to Important distinctions the author makes and to any gaps or inconsistencies in the account.
- WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including self-generated questions) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain
- WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research

## LESSON OBJECTIVE(S)

Students will investigate how chemicals affect ecosystems through trophic cascades and biomagnification.

## CAREER CONNECTION(S)

**Mentor Background:** Dr. Gust works in the Environmental Toxicology lab at ERDC in Vicksburg, Mississippi where he investigates the consequences of toxins in the environment.

**STEM Careers:** Ecologist, Environmental Scientist, Conservation Biologist, Wildlife Biologist, Environmental Engineer

## ENGAGEMENT

**Brief Description:** Students will work in groups using the informational card to create a food chain of the Puget Sound Ecosystem.

**Procedures:**

Have students watch "Yellowstone Wolves". While watching, having students jot down what happened when Yellowstone wolves were removed and what happened with their reintroduction into Yellowstone. Have students "think-pair-share".

Ask students how many of them eat fish. As a class, attempt to draw a food chain. Have students explain what would happen if you were to remove the primary consumer, secondary consumer, etc.

Pass out or post directions. Pass out informational cards to each group to complete the task of creating food web of The Puget Sound Ecosystem. Have students analyze what would happen if species were removed from the food web.

## EXPLORATION

**Brief Description:** Students will look at how biomagnification can affect an ecosystem.

**Procedures:**

Discuss how chemicals are not always intentionally released into the ocean. Show this video and discuss hormones in the ecosystem or the increase of caffeine and its effect on aquatic ecosystems.

Introduce students to the idea of Biomagnification with this activity, or by watching Amoeba Sisters.

Have students get into groups and discuss a chemical compound that they are concerned with. Define "chemical" to students, that it does not necessarily mean bad. Have the students research current literature on the effects of the chemical compound on living organisms, if there are any. Let students know that it is okay if there is no current research.

## EXPLANATION

**Brief Description:** Students learn about trophic cascades with HHMI click and learn.

**Procedures:**

Watch and discuss "How Some Species Are More Equal than Others:"(HHMI). Discuss the difference between bottom-up and top-down trophic cascade.

Have students complete HHMI Click and Learn (worksheet 2 or worksheet2).

Have students revise their background information about long term effects of their chemical and the larger picture.

## Elaborate

**Brief Description:** Students will research which chemical they want to use on *Daphnia* and how it will affect the ecosystem.

**Procedures:**

Provide the following scenario:

In the last decade, there has been a significant increase in chemicals released into the environment, whether intentionally or not. For example, the use of birth control have released excess estrogen in the water system which has both behavioral and genetic consequences.[1] The issue is not just with pharmaceutical drugs but with everyday consumables such as caffeine found in energy drinks. Trace amounts of caffeine can cause major circulatory problems resulting in a stress response in aquatic organisms.[2] Filter feeders and feeder fish, which serve as primary consumers for the aquatic ecosystem, are more sensitive to chemical changes in the water. This poses a major threat as the declining population of these organisms will lead to a bottom-up trophic cascade. Furthermore, the issue of biomagnification for fat-soluble compounds is particularly alarming as humans are apex predators.

The scientists at the Army Research Environmental Toxicology Lab have asked you, the students, to test the effect of various everyday consumables (and compounds) and their consequences on the ecosystem. Daphnia magna will be used as a bioassay as they are good bioindicators of a healthy ecosystem.

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Allow students to research and explore Daphnia and its environmental contributions. Have them present why Daphnia is a good testing subject and its environmental significance. Students will have to come up with their inquiry plan to include: Background information (2 minimum research citation), research question, hypothesis, and experimental plan with sketch of set up/diagram which will be put together in a presentation poster. Students discuss and present their inquiry for peer-review. Peers will add post it with "I like….", "I recommend…" and "I have a question about…"

Have students complete the lab changing ethanol for the appropriate chemical of choice.

## EVALUATION

**Brief Description:** Students present to the class.

**Procedures:**
Students present their findings using one slide with C.E.R.

## REFERENCES


- https://www.frostburg.edu/fsu/assets/File/clife/mscenter/FinalPapers/2015Daphnia.pdf - This one shows that the effects of caffeine caused the heart rates of Daphnia to decrease (??), which seems counterintuitive -- am I understanding this research correctly?
- http://www.nuffieldfoundation.org/practical-biology/investiagating-factors-affecting-heart-rate-daphnia - this research seems to indicate that Daphnia's heart rates were increased because of the presence of caffeine..

- [1]https://www.sciencedaily.com/releases/2016/03/160304092230.htm
- [2]https://www.loe.org/shows/segments.html?programID=12-P13-00032&segmentID=2