Products, Organisms, and Our Environment

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Summary: This lesson will provide students with the chance to think critically about current environmental issues. It includes information relating to Bisphenol A as an endocrine disruptor to marine life. Students will learn background information about the environmental issue, read scientific research, and investigate the issue by participating in a related class discussion.

Grade: 11 - 12 multidisciplinary

Time required: 2.5 hours / 3 class periods

- Products, Organisms, and Our Environment: 50min
- Advocacy Group Activity: 50min
- Fishbowl Activity: 50min

Keywords: Bisphenol A, endocrine disrupting chemicals, environmental awareness coastal development, primary literature

Objectives:

- Students will discuss how BPA affects marine life
- Students will review a scientific article and form an opinion of the issue
- Students will write and report an explanation of a peer reviewed scientific research article
- Student groups will create, design, and present an advertisement representing their interpretation of findings in a scientific article

Materials: Introductory Questions worksheet, accompanying PowerPoint, copies of scientific articles, 8x10 or poster sized sheets of paper for drawing, colored pencils, markers

This program relates to the following educational standards:

Georgia Performance Standards (Grades:9-12)

Biology
- SB4. Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.

English
- ELA12W1 the student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.
- ELA12C1 the student demonstrates understanding and control of the rules of the English language, realizing that usage involves the appropriate application of conventions and grammar in both written and spoken formats.
- ELA12LSV1 the student participates in student-to-teacher, student-to-student, and group verbal interactions.

Environmental Science
- SEV2. Students will demonstrate an understanding that the Earth is one interconnected system. SEV4. Students will understand and describe availability, allocation and conservation of energy and other resources.
- EV5. Students will recognize that human beings are part of the global ecosystem and will evaluate the effects of human activities and technology on ecosystems.

Habits of Mind
- SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
- SCSh6. Students will communicate scientific investigations and information clearly.

Oceanography
- SO6. Students will identify how humans use the oceans for food, commerce, and energy and will evaluate the potential for abuse in the absence of responsible stewardship.

The Nature of Science
- SCSh7. Students analyze how scientific knowledge is developed.
- SCSh8. Students will understand important features of the process of scientific inquiry.
- SCSh9. Students will enhance reading in all curriculum areas.

Ocean Literacy (Grades:9-12)

- 1G all major watersheds on Earth drain to the ocean
- 6D much of the world's population lives in coastal areas
- 6E humans affect the ocean in a variety of ways
- 6G everyone is responsible for caring for the ocean
- 7B exploration, inquiry, and study are required to better understand ocean systems and processes
- F ocean exploration is truly interdisciplinary

National Science Education Standards(Grades:9-12)

Unifying Concepts and Processes
- Systems, Order and Organization
- Change, constancy and Measurement
- Evolution and equilibrium

Personal and Social Perspectives
- Personal and Community Health
- Population Growth
- Natural Resources
- Environmental Quality
- Natural and Human-Induced Hazards
- Science and Technology in Local, National, and Global Challenges

Science and Technology
- Understanding about science and technology

Procedures:

Activity 1: Introductory Questions (15 – 30 minutes)
Objective: Students think about common plastic products and how each might affect the environment.

- Pass out the Introductory Questions: You and Your Surroundings (p. 6)
- Allow time for students to answer the three questions
- Discuss answers with class

Activity 2: PowerPoint presentation: (15 – 30 minutes)
Objective: To present students with information about Bisphenol A and Endocrine disruptors.

- Present slides (see information in "notes to teacher")
- Give students opportunity to actively discuss the open-ended questions included on the slides

Activity 3: Advocacy Group Activity: (50 minutes)
Objective: Using assigned scientific research article, students collaborate to design an advertisement that represents the environmental issue and findings of the article. Students prepare to present their article and ad as part of the Fishbowl Activity.

Materials**:**

- 8x10 or poster sized sheets of paper
- colored pencils
- markers
- 6 reading articles (p. 4,suggested articles and access links to abstracts)

Procedure:

1. Assign 3 – 4 students to 6 or more advocacy group. Assign one article per group
2. Give each student a copy of the scientific research article
3. Students read article and discuss article within group
4. Using an 8x10 or poster sized sheet of paper, students create an advertisement representing their interpretation of findings in a scientific article
5. The advertisement should be appealing, organized, and include:
   - A name and mission statement for the advocacy group
   - Illustrations
   - Main points or findings of the article
6. Ad will be used and graded with Fishbowl Activity

Note to teachers**:** Following is a list of suggested peer reviewed scientific research articles to use. Follow the links to access abstracts of the articles. Please note that many of these articles are part of private databases that may require passwords to access the full information. If you cannot access the publication in its entirety, the students can read several abstracts instead.

Breton, R. L., Teed. R. S., Moore, D. R. J. (2003). An Ecological Risk Assessment of Phenol in the Aquatic Environment. *Human and Ecological Risk Assessment: An International Journal, 9, 549 568.*
doi: 10.1080/713609922
http://www.informaworld.com/smpp/content~db=all~content=a713609922~frm=titlelink

Jobling, S., Casey, D., Rodgers-Gray, T, Oehlmann, J., Schulte-Oehlmann, U., Pawlowski, S., Baunbeck, T., Turner, A.P., Tyler, C.R. (2003). Comparative responses of molluscs and fish to environmental estrogens and an estrogenic effluent. *Aquatic Toxicology*, *65, 205-22.*
doi:10.1016/S0166-445X(03)00134-6
http://www.ncbi.nlm.nih.gov/pubmed/15046010

Kang, J., Aasi, D., Katayama, Y. (2007). Bisphenol A in the aquatic environment and its endocrine disruptive effects on aquatic organisms. *Critical Reviews in Toxicology*, *37. 607-625.*
doi:10.1080/10408440701493103
http://www.ncbi.nlm.nih.gov/pubmed/17674214

Mandich, A., Bottero, S., Benfenati, E., Cevasco, A., Erratico, C., Maggioni, S., Massari, A., Pedemonte, F., Vigano, L. (2007). *In vivo* exposure of carp to graded concentrations of bisphenol A. *General and Comparative Endocrinology, 153,15-24.*
doi:10.1016/j.ygcen.2007.01.004
http://www.ncbi.nlm.nih.gov/pubmed/17320878

Mihaich, E.M., Friederich, E., Caspers, N., Hall, A.T., Kelcka, G. M., Simond, S. S., Staples, C. A., Ortego, L. S., Hentges, S. G. (2009). Acute and chronic toxicity testing of bisphenol A with aquatic invertebrates and plants. *Ecotoxicology and Environmental Safety, 72, 1392-1399.*
doi:10.1016/j.ecoenv.2009.02.005
http://www.ncbi.nlm.nih.gov/pubmed/19327838

Mills, L. J., &Chichester, C. (2005). Review of evidence: Are endocrine-disrupting chemicals in the aquatic environment impacting fish populations?. *Science of the total environment, 343, 1-34.*
doi:10.1016/j.scitotenv.2004.12.070
http://www.ncbi.nlm.nih.gov/pubmed/15862833

Oberdörster, E. & Cheek, A. O. (2001). Gender benders at the beach: endocrine disruption in marine and estuarine organisms. *Environmental Toxicology and Chemistry, 20, 23-36.*
http://www.ncbi.nlm.nih.gov/pubmed/11351412

Oehlmann, J., Schulte-Oehlmann, U., Kloas, W., Jagnytsch, O., Lutz, I., Kusk, K. O., Wollenberger, L., Snatos, E. M., Paull, G. C., Van Look, K. J. W., Tyler, C. R. (2009). A critical analysis of the biological impacts of plasticizers on wildlife. *Philosophical transaction of the Royal Society Biological Sciences, 364, 2047-2062.*
doi:10.1098/rstb.2008.0242
http://rstb.royalsocietypublishing.org/content/364/1526/2047

Activity 4: Fishbowl Activity: (50 minutes)
Objective: To encourage students to actively listen to the experiences and perspectives of a specific group of people. Students take notes on information presented by various fishbowl groups to assist with the written assignment.

Preparation: Arrange chairs in a semi-circle to create the "fishbowl"

Procedure:

1. Establish ground rules
   - During the course of the fishbowl, observers are **not allowed** to speak
   - Observers listen, take notes, and learn from the fishbowl students who represent a certain advocacy group
   - Observers sit on the outside of the circle. Each advocacy group stands inside the circle for 5 minutes and presents assigned article and designed advertisement
   - All participants will discuss as a class after all fishbowls are completed
2. 5 minute fishbowl conducted by each group
   - Fishbowl group provides enough information so observers can understand the article. All members of the group should participate
   - Questions to guide this discussion include:
     a. What was the main idea of your article? What was the source of the scientific journal article?
     b. What were some problems mentioned in your article about BPA and the environment?
     c. What animals affected in the study? How were they affected?
     d. What was the concentration of BPA found in the water?
3. Final Class Discussion
   - Allow 15-20 minutes for students to ask any questions formed during fishbowls
   - Questions to guide this discussion include:
     a. Have you heard of this environmental issue before? How?
     b. Were there any questions that you have about a certain article? Did you hear anything from the fishbowl that surprised you?
     c. Have you ever seen products labeled BPA free? What did you think that meant and why?
     d. Do you think there is enough awareness on this topic? Why?

Activity 5: Written Assignment:
Objective: Using information from the article and classroom discussion, students write a response expressing opinions concerning the environmental issue.

- Assign included Writing Assignment (p. 7)

Introductory Questions: You and Your Surroundings

Student Name: _____

Please answer the following questions in the space below. Answer the questions as thoroughly as possible and to the best of your ability!

1. List 10 plastic items or products that you use on a daily basis, at school, home, etc..

2. List 5 chemicals that you use regularly.

3. How do you think the items and chemicals listed above could affect the environment? Have you ever considered this question before, why or why not?

Response Writing Assignment

Student Name: _____

Write a one page response answering all of the following questions:

- What are your views on the issue of BPA and its effect on the coastal environment?
- Do you think this problem will increase with a further increase in coastal development?
- What are possible management techniques to mitigate or address the issue?

Consider the following for an effective response:

- Use examples presented during the fishbowl exercise
- Possible management techniques do not have to be realistic or proven; all science starts with an idea!
- Proper organization and grammar will factor into your final score

Assessment:

Advocacy Group Ad and Fishbowl Activity Rubric:

Student Name: _____

CATEGORY	4	3	2	1	**Points (/20)**
Group Work	The group functioned exceptionally well. All members listened to, shared with and supported the efforts of others. The group (all members) was almost always on task.	The group functioned pretty well. Most members listened to, shared with and supported the efforts of others. The group (all members) was almost always on task.	The group functioned fairly well but was dominated by one or two members. The group (all members) was almost always on task.	Some members of the group were often off task AND/OR were overtly disrespectful to others in the group AND/OR were typically disregarded by other group members.	
Accuracy of Facts	All supporting facts are reported accurately (3 of 3).	Almost all facts are reported accurately (2 of 3).	One fact is reported accurately.	No facts are reported accurately OR no facts were reported.	
Graphics	Graphics include some original material and are clearly related to the material being presented.	Graphics are clearly related to the material being presented, but none are original.	Graphics include some original material but are only somewhat related to the material being presented.	Graphics are not related to the material being presented.	
Required Elements	The ad includes all required elements as well as additional information.	All required elements are included on the ad.	All but 1 of the required elements are included on the ad.	Several required elements were missing.	
Use of Class Time	Used time well during each class period. Focused on getting the project done. Never distracted others.	Used time well during each class period. Usually focused on getting the project done and never distracted others.	Used some of the time well during each class period. There was some focus on getting the project done but occasionally distracted others.	Did not use class time to focus on the project OR often distracted others.	

Writing Response Rubric:

Student Name: _____

CATEGORY	4	3	2	1	**Points (/20)**
Grammar & Spelling	Writer makes no errors in grammar or spelling that distracts the reader from the content.	Writer makes 1-2 errors in grammar or spelling that distract the reader from the content.	Writer makes 3-4 errors in grammar or spelling that distract the reader from the content.	Writer makes more than 4 errors in grammar or spelling that distracts the reader from the content.	
Focus on Topic	There is an answer to each of the three questions. Main idea stands out and is supported by detailed information.	There is an answer to two of the three questions. Main idea is clear but the supporting information is general.	There is a clear answer to only one of the three main questions. There is a need for more supporting information.	The main idea is not clear. There is a seemingly random collection of information. None of the three questions were clearly answered.	
Conclusion	The conclusion is strong and leaves the reader with a feeling that they understand what the writer is "getting at." Student has included proposed management techniques.	The conclusion is recognizable and ties up almost all the loose ends. Student has included proposed management techniques.	The conclusion is recognizable, but does not tie up several loose ends. The writer fails to include proposed management techniques.	There is no clear conclusion, the paper just ends.	
Sequencing	Details are placed in a logical order and the way they are presented effectively keeps the interest of the reader.	Details are placed in a logical order, but the way in which they are presented/introduced sometimes makes the writing less interesting.	Some details are not in a logical or expected order, and this distracts the reader.	Many details are not in a logical or expected order. There is little sense that the writing is organized.	
Commitment	The writer successfully uses several reasons/appeals to show that they have taken a stance and understand the topic. The writer is particularly strong in stating their opinion based on the information provided from the Fishbowl activity.	The writer successfully uses one or two reasons/appeals to show that they have taken a stance and understand the topic. Student has attempted to use information gathered from the Fishbowl activity	The writer attempts to show that they understand the topic and have taken a stance, but is not really successful. Student does not include relevant information from the Fishbowl activity.	The writer did not show that he/she understands the topic.	

Classroom Extensions:

1. Repeat lesson using a different chemical that is present in the environment: eg. Tributyltin, petroleum hydrocarbons, PCBs, heavy metals, etc.

2. Research activity:
   Allow a class period to attend your school's library. Introduce students to the process of searching for a scientific article. Then, advocacy groups look up their own article from a scientific journal using keywords like: Bisphenol A, toxicity, waste water effluent, and endocrine.

3. Class discussion about primary literature:

- Define peer-reviewed, primary and secondary literature.
  Peer review is literature reviewed and evaluated by other scientists.

  Primary literature is based on original observations and experiments, and includes detailed information about how those observations or experiments were made or conducted. eg. articles published in a peer review journal

  Secondary literature is based on summaries of the primary literature. eg. textbooks, magazine articles, encyclopedia entries

- Why is primary literature necessary in science?
  Primary literature provides information that permits the reader to ask new questions, evaluate and interpret the information, and conduct further studies. These skills are necessary in upper-level science courses and in science careers.

- How does primary literature differ from text books or websites?
  Secondary literature provides information about what is already known. Primary literature allows you to discover the basis for the information, and explore the limits of current knowledge.

The above definitions were taken from:

Pachenik, J. 2010*. A Short Guide to Writing About Biology*, 7th edition. Pearson Education Inc.

Additional resources:
http://www.nalgene-outdoor.com/technical/bpainfo.html
http://www.bisphenol-a.org/index.html
http://www.environmentalhealthnews.org/
http://www.kleankanteen.com/about/bpa.php

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