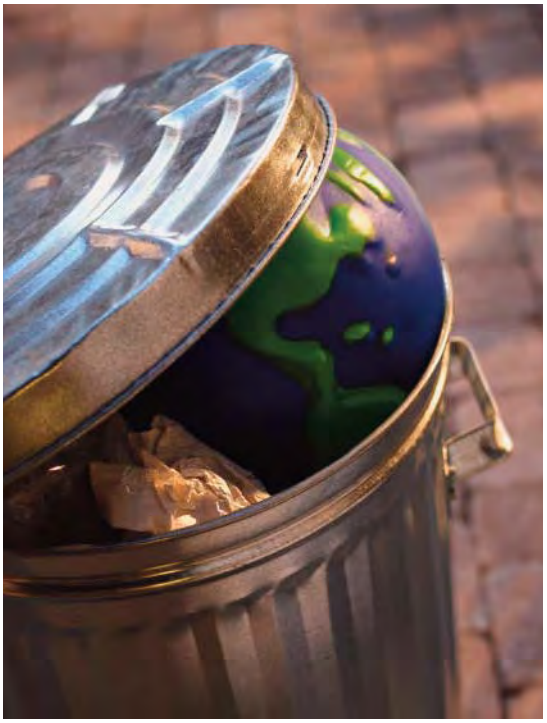
Environmental Health Education



Lesson Plans For All Grade Levels!

IDAHO DEPARTMENT OF
HEALTH & WELFARE

Environmental Health Lesson Plans

As a result of advances in technology, today's children will be exposed to more chemicals over their lifetimes than previous generations. That's why teaching kids about protecting the environment from air, water, and soil pollution is essential for safeguarding their health, as well as protecting their health if contamination exists.

The Environmental Health Education and Assessment program has developed award-winning environmental health lesson plans for Idaho school kids, kindergarten through 12th grade. These plans address multiple subject areas across all grade levels and are aligned with Idaho's exiting standards.

*** Plans and related materials may be reproduced and distributed without restriction.**

Tab #	Title	Grades	Related Idaho Content Standards
1	Identify Sources of Pollution	K-5	1.H.1.1.11 3.H.1.1.10 3.S.5.1.1 5.S.5.1.1
2	Virtual Pollution Fieldtrip	K-12	1.H.1.1.11 3.H.1.1.10 3.S.5.1.1 5.S.5.1.1 6.S.5.5.11
3	Pollution Pictionary	K-12	1.H.1.1.11 3.H.1.1.10
4	Pollution Mobiles	K-8	1.H.1.1.11
5	Pollution in Fish	K-12	1.H.1.1.11 3.H.1.1.10
6	Bioaccumulation of Selenium in the Food Chain	K-12	2.H.2.1.1 3.S.3.2.4 3.H.1.1.10
7	Find the Safe Route to School	K-5	1.H.1.1.3 2.H.1.1.3 3.H.1.1.3 4.H.1.1.3
8	Identifying Toxic Chemicals	K-12	3.H.4.1.2 3.S.5.1.1 5.S.5.1.1 6.S.5.1.1
9	Hazardous Substance Poster	K-12	1.H.1.1.6 3.S.5.1.1 5.S.5.1.1 6.S.5.1.1
10	Health Hazards of Toxic Household Products	K-12	1.H.1.1.6 4.H.4.1.2 3.H.4.1.2
11	Identifying Pathways of Exposure to Toxic Chemicals	K-12	1.H.1.1.6 3.H.4.1.2
12	Hazardous Substance Exposure and Treatment	6-12	7-8.H.1.1.9 9-12.H.1.1.6 6.S.5.1.1 9-10.B.5.1.1 8-9.ES.5.1.1
13	Health Effects of Sulfur Dioxide	9-12	9-12.H.1.1.6 9-10.B.5.1.1 8-9.ES.5.1.1
14	Chemicals in Drinking Water	9-12	9-12.H.1.1.6 9-10.B.5.1.1 8-9.ES.5.1.1
15	Part Per Million	6-12	9-12.H.1.1.6
16	Perceived Versus Actual Risk	6-12	9-12.H.1.1.4
17	Mercury Exposure Investigation	9-12	9-12.H.1.1.6 9-10.B.5.1.1 8-9.ES.5.1.1

18	**Protesting Pollution Sources**	6-12	9-12.H.1.1.6 9-10.B.5.1.1 8-9.ES.5.1.1 6.S.5.1.1
19	**Health and Environmental Agency Overview**	9-12	9-12.H.4.1.2 9-10.B.5.1.1
20	**Superfund in Idaho**	9-12	8-9.ES.5.1.1 9-10.B.5.1.1 9-12.H.1.1.6 8-9.ES.5.1.1
21	**Educational Brochure**	9-12	All of the above

Identify Sources of Pollution

Grades

Elementary

Subject

Science and Health

Type of Lesson Plan

Activity

Duration

45 minutes to 1 hour

Materials

- Markers
- White Board
- Pencils
- Paper
- Tangible reward for winning group

Objectives

TLW…

- Work successfully in cooperative groups to brainstorm sources of pollution.
- Come to a group consensus in order to identify sources of pollution.
- List multiple sources of pollution.
- Appreciate that pollutants are bad for the environment and human health.

Set

Read The Lorax by Dr. Seuss or other short story dealing with pollution.

Instructional Input

Introduce the subject and define pollution in an age appropriate manner.

1. Ask Students to take out their own paper and list as many sources of pollution as they can.
2. Set up the group activity by going over rules for cooperative groups and your expectations for this exercise. Transition students into groups. The group should have at least one recorder.
3. Groups will brainstorm as many possible sources of pollution as possible (must understand the process of cooperative grouping and brainstorming first).

4. After brainstorming period, come to a consensus about each example. Is it a source of pollution or not?
5. Groups then share their list one at a time in round robin fashion, each group giving one example. Students/teacher keeps track on the board. Have 2 columns, Source of Pollution and "possible sources".
6. Groups know that if they supply 3 that end in the "possible sources" column, they are knocked out. Of course, duplicate answers don't count, all answers must be original.
7. As groups run out of responses, they are knocked out.
8. The winning group is the one that is able to supply the most viable examples of pollution. They win some type of tangible reward, appropriate for your classroom.
9. Go through and discuss/clarify the "possible sources" examples for the class. Make sure each team has the chance to share their entire list.

Checks for understanding

The number of "possible sources" will indicate level of student understanding. Reteaching will take place at the end of the lesson when the teacher explains/clarifies the misconceptions that led to the "possible sources" answers.

Guided Practice

Takes place in the activity → brainstorming and listing.

Extended Practice

Assign students the task of asking an adult (their parents are acceptable) what they think the most serious source of pollution is in their community and why.

Students should be prepared to share their "interview" results with the class tomorrow.

Closure

Review the list on the board. Reiterate the definition of pollution.

Follow Up

Allow students to share the results of their interviews. If time will not allow a sharing of all results, list as many different sources as the students came up with and then take a poll to see which source was cited the most. Discuss these issues as appropriate, especially if there are misconceptions or multiple results for the same source.

Log on to the IDHW, IDEQ, USEPA, and ATSDR web sites for additional information
http://www.healthy.idaho.gov
http://www.deq.state.id.us
http://www.epa.gov
http://www.atsdr.cdc.gov/

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Identify Sources of Pollution Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are sources of pollutants? *(circle all that apply)*

Car exhaust	Lawn mowers	People's waste
Factories that produce smoke	Riding a motorcycle	Riding a bike
Lawn and agricultural fertilizers	Trees	Markers

2. Which of the following are ways to decrease sources of pollutants in your community? *(circle all that apply)*

Recycle	Walk or bike instead of driving	Plant and keep trees healthy
Use less electricity	Leave lights on in the house all the time	Drive your car more

3. Who is responsible for minimizing the sources of pollution in our communities?

Teachers	Parents	Students	Everyone in community

4. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. What do you think is the most serious source of pollution in your community?

_____
_____
_____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Identify Sources of Pollution Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of pollution and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Overall did the interviews with adults help students identify the major sources of pollution in their community?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned ways to reduce pollution in their own environment?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Virtual Pollution Fieldtrip

Grades

Any

Subject

Science, Health, Art, History, Geography, Cultural

Type of Lesson Plan

Project

Duration

1 hour per week

Materials

Choose materials to construct a polluted city. For this classroom model you will need:

- Construction paper
- Cardboard
- Recyclable products (e.g. milk cartons)
- Felt
- Crayons
- Colored Pencils
- Any materials that give the model the desired effect.

Suggestions for pollution literature to read aloud are as follows: *The Berenstain Bears Don't Pollute (Anymore)* by Jan and Stan Berenstain; Random House, 1991, *The World That Jack Built* by Ruth Brown; Dutton, 1991, *Where Does Pollution Come From?* By Cast C. Vance; Barron's Educational Series, Incorporated, 1994, *The Wump World* by Bill Peet; Houghton Mifflin Company, 1991, *One Child* by Christopher W. Cheng; Group, Incorporated, 1999.

Objectives

TLW…

- Understand the definition of pollution and how it can affect your health.
- Identify different sources of pollution.
- Understand the cycle of pollution i.e. human actions affect the environment, the environment affects primary receptors (plants and animals), the primary receptors then affect the secondary receptors (grazers, predators, humans).
- Learn how to make a difference in your own environment.

Set

Before presenting the lesson, prepare a simulated city in either a portion of the classroom or in another room altogether. Design the model as big as you like and use whatever materials you choose to create this polluted city. Due to the possible amount of preparation (depending on how detailed/big you choose to make it), if an additional teacher is interested in the lesson, join together in your efforts to design the basic structures and details of the model (e.g. stores, parks with no trees, several buildings, houses, streets). You have the option of doing a joint presentation with the other class or using the same model at separate times. Making it 3-D, and touring through the "streets" might make it more exciting!

Next, prepare cut-outs of pollution-producing agents. Include the following and any other sources that come to mind: factories emitting smoke/fumes, houses- some with lights on and no one home, others with lights on and people home in the daytime (maybe a skylight to show natural light), lots of cars driving, not a lot of (healthy) trees. You can also make clouds (construction paper or your choice of material) and hang them on clear string from the ceiling. Hanging them low and possibly giving them a dirty tint can demonstrate an inversion caused by pollution. Set these aside.

Also create cut-outs or replacements for each pollution-producing agent and use these later to improve the city. For example, make lots of healthy trees/vegetation, cut out black squares to "turn out the lights" in the homes where energy is being wasted, replace many of the cars with bikes or people walking. Set these aside.

The students will eventually color/design all of these items and bring them on the tour of the city. Encourage the class to make additional items, in either category, on their own.

Instructional Input

1. Introduce the subject and ask the class what they think pollution is. Define pollution in an age appropriate manner. This would also be a good time to incorporate one of the pollution stories from the suggested reading list.

2. Divide the class in half. Half of the class will be the residents of "Pollutionville" and half will be the rescuers. Distribute the pollution cut-outs to the residents and the improvement cut-outs to the rescuers. Provide a variety of art supplies and let the kids color their items. When everyone is finished, go through each of the residents' pollution-producing agents and ask students what kind of pollution it is? Where does it come from? After each one, ask the class what would help to get rid of this type of pollution. Brainstorm solutions as a class and then ask which rescuer would be of help. For example, after talking about a big truck with lots of smoke, prompt the rescuer with a bike or someone walking to show their cut-out. Encourage everyone to participate.

3. Explain to the class that you are about to go on an imaginary field trip. You are going to visit a city that is extremely polluted. Call it "Pollutionville," create your own name, or have the kids

come up with ideas. Explain that those with the pollution items will be the residents of the city and those with the improvements will be the rescuers of the city. However, although the class is divided in half, everyone is responsible for brainstorming in both categories.

4. Walking through the town, have each resident place their cut-outs around the city. Go through each type of pollution and explain the result of each (e.g. using electricity is using energy which comes from power plants and when we waste it we are hurting the environment).

5. Next, ask the kids how they would like to see this city look? What would make it look better? Is there any vegetation? How can they get rid of all the fumes? For each suggestion, let the rescuers take one of their pre-made cut-outs and make their own improvements.

Checks for understanding

When the city is cleaner, congratulate the entire class on making a healthier environment and brainstorm a new name for the improved city. Explain that although this place was imaginary, the examples of pollution were real. Ask if the improvements they made could be helpful in their environment. Have the class brainstorm things they can do for their own community/environment to reduce pollution (e.g. walking to school, turning off lights and water whenever possible, planting a tree).

Closure

Review what pollution is, where it comes from, and some of the ways to reduce it.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Virtual Pollution Fieldtrip Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are pollutants? *(circle all that apply)*

Smog	Rain	Car exhaust
Factory smoke	Noisy cars	Bleach
Trees in a park		

2. Put the pollution cycle steps in order from 1 to 4 starting with environmental pollution.

___ Environment affects plants and animals
___ Human actions create environmental pollution
___ Plant and animal supply affect humans
_1_ Environmental pollution

3. Please match the sources of pollution with a way to reduce pollution in your community?

Source of pollution	*Ways to reduce pollution*
Gas lawn mower	Recycle
Car exhaust	Push lawn mower
Plastic butter container	Ride bike

4. Which of the following are ways to decrease pollutants in your community? *(circle all that apply)*

Recycle	Walk or bike instead of driving	Plant and keep trees healthy
Use less electricity	Leave lights on in the house all the time	Drive your car more

5. Who is responsible for keeping our community clean?

Teachers	Parents	Students	Everyone in community

6. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Virtual Pollution Fieldtrip Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of pollution and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand the cycle of pollution?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned how to make a difference in their own environment?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations in the addressed, postage-paid envelope and deposit in the mail.

Pollution Pictionary

Grades

Any

Subject

Science and Health

Type of Lesson Plan

Activity

Duration

45 minutes to 1 hour

Objectives

TLW…

- Work in cooperative teams to identify sources of pollution through imagery.
- Recall types and sources of pollution.

NOTE – This lesson serves as an assessment and evaluation of student learning with regard to being able to recall and identify sources of pollution. It is recommended that this lesson follow the cooperative group activity, brainstorming sources of pollution (Lesson #1).

Materials

- Pieces of paper *(blank table provided to list sources/types of pollution to be cut out)*
- Receptacle for drawing cards
- Timer
- Markers
- White board
- Die
- Reward for winning team

Set

Rules:

1. Have kids list examples of pollution that could be drawn.
2. Teacher will assign teams and team numbers. Each team will take turns selecting folded cards with topics for a team member to draw. *With younger kids the teacher can draw the pictures.*
3. Teams are to guess within the 30 second or 1 minute (you choose) time frame.
4. No other team is allowed to guess other than the team whose turn it is.
5. If the guessing team runs out of time, the teacher will role a die. The number that comes up will correspond to a team number. That team gets to attempt to "steal" the guess. In the event of a "steal" the team must provide one answer only. If the number of the die that comes up is the same as the number of the team that just had their turn, roll the die again. If the "stealing" team misses, roll for the next team until

the answer is guessed, or all teams guess wrong. If the stealing team guesses correctly, they get a point and DO NOT lose their turn in the rotation.

6. Score a point for each correct guess. Proceed to the next team after each round.
7. At the end of _____ rounds, the team with the most number of points wins.
8. Teams that shout out guesses when it is not their turn, lose a point! This rule is good for reinforcing proper behavior.
9. Winners get…(you choose). Make it appropriate for your classroom.

Instructional Input

Includes the directions and student ability to follow them.
Set up the teams.
Play.
Reward.

Guided Practice and Assessment

These are built in to the game.

Closure

Have students write a journal entry (3-minute essay) about a source of pollution that they think should be eliminated.

Sample Topics

Younger Topics

- Garbage Dumps
- Construction
- Oil
- Sewage
- Cans
- Paper
- Plastic
- Paint
- Garbage
- Smoke

Older Topics

- Radioactive Waster
- Particulate matter
- Solvents
- Chemicals
- Jets/ Airplanes
- Fossil Fuels
- Leaking Storage Tanks
- Gasoline Engines
- Dairy Waster

Older Topics

- Land/Noise/Water/Air Pollution
- Pesticides
- Ozone
- Agriculture
- Cooling Water
- Herbicides
- Industrial Smokestacks
- Landfills
- Fertilizer
- Heavy Metals
- Hazardous Waste

Have students write topics in squares and cut out.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Pollution Pictionary Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are sources of pollutants? *(circle all that apply)*

Car exhaust	Lawn mowers	People's waste
Factories that produce smoke	Riding a motorcycle	Riding a bike
Lawn and agricultural fertilizers	Trees	

2. Which of the following are ways to decrease sources of pollutants in your community? *(circle all that apply)*

Recycle	Walk or bike instead of driving	Plant and keep trees healthy
Use less electricity	Leave lights on in the house all the time	Drive your car more

3. Who is responsible for minimizing the sources of pollution in our communities?

Teachers	Parents	Students	Everyone in community

4. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Pollution Pictionary Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of pollution and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel the students learned how to make a difference in their own environment?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Pollution Mobiles

Grades

Elementary and Middle School

Subject

Science and Art

Type of Lesson Plan

Activity

Duration

30 – 40 min to set up and go over expectations/review pollution
60 – 90 min to create the mobile
30 min to write paper
60 min to present
10 – 20 min to self assess

COULD BREAK OUT OVER A COUPLE OF DAYS

Materials

- Magazines
- Tape
- Glue
- Pamphlets
- Hangers
- Construction paper (colors)
- Markers
- Wood dowels
- Crayons
- Scissors
- Paper clips
- Colored pencils

Objectives

TLW…

- Identify sources of air, water, land, and noise pollution and construct a mobile showing how the source is related to the type of pollution.
- Write a paper describing why the various sources of pollution in the mobile should be stopped or controlled.
- Present the mobiles to the class, orally.
- Appreciate the role pollution plays in human health and their local community.

Set

Do a review of sources/causes of pollution (see "Identify Sources of Pollution" lesson plan).

Instructional Input

Explain the concept of a mobile for students who have not constructed one. Have examples on hand. Next, discuss the requirements and expectations.

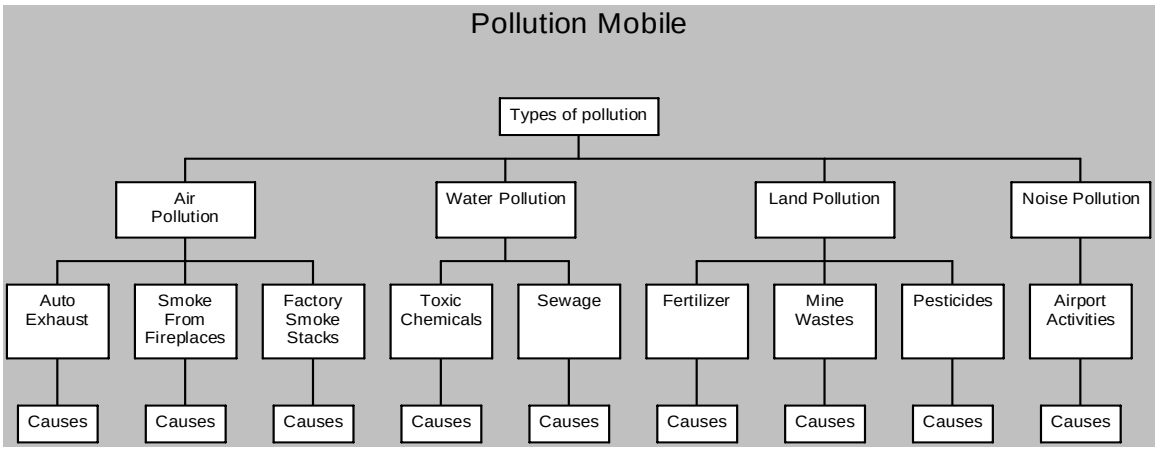
Mobiles will illustrate the integration of air, water, land, and noise pollution as the four main branches under pollution with the sources hanging off the bottom. Beneath these should be the toxins associated with the source of pollution and below these, the adverse health effects these pollutants can cause.

***** ***IMPORTANT*** → Students should focus on only one or two examples in order to prevent the mobile from being too large and complicated. If you prefer, you can assign specific sources of pollution to specific students in order to avoid repetition of sources. Use the brainstormed list of sources from "Identify Sources of Pollution."

Students should use actual objects, magazine/pamphlet cut outs, drawings, computer graphics, and text to represent each level of the mobile. *Art tie in.*

Before constructing mobiles:
1. Go over the grading requirements. See evaluation below.
2. Stress proper use and sharing of materials.
3. STRESS clean up!

***** As you can see from the sample below, too many examples lead to an unwieldy mobile.



Try and direct the students to cover examples/issues according to depth rather than breadth.

Evaluation

Evaluation will be based on the student's mobile, a paper explaining the various aspects of the mobile, and a short oral presentation of the mobile to the class. *Tie in to English.* Rubrics for the three requirements are included with this lesson. However, you may choose to develop your own or, better yet, develop them with the class.

Pollution Mobile Rubric

Category	Excellent _____ *points*	Good _____ *points*	Room for Improvement _____ *points*
Neatness	Well constructed. Papers glued down neatly. Coloring and cutouts are neat.	Some of the string or pictures are peeling off. Coloring and cutouts are well done, not perfect.	Mobile shows signs of falling apart. Coloring and cutouts were not carefully completed.
Legibility	All words can be easily read from a distance of 2 feet.	Most words can be easily read from a distance of 2 feet.	Many words can not be read from a distance of 2 feet.
Examples	All examples of pollution and sources are correct and connected.	Most examples of pollution and sources are correct and connected.	Many examples of pollution and sources are not correct or are connected incorrectly.
Graphics	All graphics are neat and correctly represent pollution or sources.	Most graphics are neat and correctly represent pollution or sources.	Few graphics are neat and most incorrectly represent pollution or sources.

Pollution Mobiles Paper Rubric

Category	Excellent _____ *points*	Good _____ *points*	Room for Improvement _____ *points*
Neatness	Paper is written or typed neatly with no correction marks.	Paper is written or typed neatly with few (<5) correction marks.	Paper is not written or typed neatly. Writing should be neater, or there are many (>5) correction marks.
Spelling and Grammar	No spelling or grammar mistakes.	Few (<5) spelling or grammar mistakes.	Many (>5) spelling or grammar mistakes.
Length	Paper is the proper length, as assigned by the teacher.	Paper is <5 sentences longer/shorter than the proper length.	Paper is >5 sentences longer/shorter than the proper length.
Explanation of Mobile	Paper explains every aspect of the mobile clearly. The reader knows how each piece of the mobile relates to the piece above and below it.	Paper explains most aspects of the mobile. The reader knows how most pieces of the mobile relate to the pieces above and below it.	Paper explains few aspects of the mobile. The reader doesn't know how the pieces of the mobile relate to the pieces above and below it.

Pollution Mobile Presentation Rubric

Category	**Excellent** _____ *points*	**Good** _____ *points*	**Room for Improvement** _____ *points*
Poise	Stands with proper posture. Does not shuffle or fidget.	Posture is good. Speaker fidgets or moves around some.	Stands with poor posture. Excessive fidgeting or movement.
Annunciation and Volume	Speaker can be heard from the back of the room. All words are clearly spoken and easily understood.	Speaker can be heard from the back of the room most of the time. Most words are clearly spoken and easily understood.	Speaks too softly and/or many words are difficult to understand.
Explanation of Mobile	Speaker explains every aspect of the mobile clearly. The reader knows how each piece of the mobile relates to the piece above and below it.	Speaker explains most aspects of the mobile. The reader knows how most pieces of the mobile relate to the pieces above and below it.	Speaker explains few aspects of the mobile. The reader doesn't know how the pieces of the mobile relate to the pieces above and below it.

It is considered good practice to provide examples of mobiles and let the students use the rubric to judge the examples. This helps them to assess their own work using the rubric. If you wish, the students can peer critique each other's mobiles and papers prior to finalizing and handing them in. Additionally, they may want to pick partners and practice their presentation before presenting in front of the class.

Closure

Hang up the mobiles either in your classroom or the library. As appropriate, encourage discussion about how pollution affects people's health using specific examples from the mobiles. Examples with local relevancy are extremely valuable here.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Pollution Mobiles Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are sources of pollutants? *(circle all that apply)*

Car exhaust	Lawn mowers	People's waste
Factories that produce smoke	Riding a motorcycle	Riding a bike
Lawn and agricultural fertilizers	Trees	

2. Which of the following are ways to decrease sources of pollutants in your community? *(circle all that apply)*

Recycle	Walk or bike instead of driving	Plant and keep trees healthy
Use less electricity	Leave lights on in the house all the time	Drive your car more

3. Who is responsible for minimizing the sources of pollution in our communities?

Teachers Parents Students Everyone in community

4. What are the four main branches of pollution?

_____
_____
_____

5. Why should communities be concerned about minimizing the sources of pollution?

_____
_____
_____

6. Give one example of how pollution harms people's health.

_____
_____
_____

7. Do you think this activity was fun?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Pollution Mobiles Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of pollution and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students can usually identify sources of pollution in their immediate environment?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned how to reduce the amount of pollution in our environment?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Pollution in Fish - Bioaccumulation

Grades

Any

Subjects

Science, Health, Biology, Ecology and Math

Type of Lesson Plan

Activity

Duration

20 minutes

Materials

- Napkins or sheets of paper

Objective

TLW…

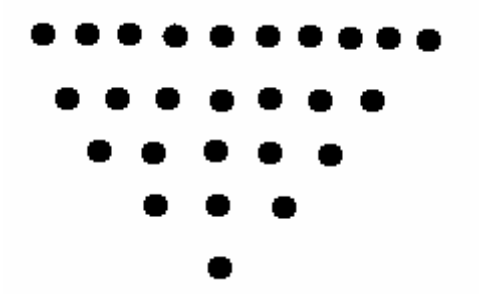
- Learn how toxins can bioaccumulate through the food chain.
- Understand the bioaccumulation of toxins in food can harm humans that consume the contaminated food.

Set

Introduce, or review the concept of the food chain/web.

Instructional Input

You will be using the class to actively demonstrate the mechanics of the food chain as well as the mechanics and effects of bioaccumulation.



Plant

Insect

Minnow

Trout

Human

Arrange the students in the above formation. The formation is based on a class of 26. Adjust the formation to suit your class size.

Place a sheet of paper or napkin in the hands of each student in the front row ("plants"). Instruct the students in the row behind ("insects") to take the paper from the students in front of them and place in their own hands. This represents insects feeding on plants. Next, have the "minnows" feed on the "insects", and then the "trout" should feed on the "minnows." The human should feed on all of the trout, and should have accumulated all of the napkins. *This can be done with pennies and cups with younger kids. The kids can then decorate their cup as what they are (plant or trout). With older kids, colored pieces of paper with each color representing plants, insects, etc. will work. The plants or insects that are contaminated can have a black "X" placed on the back. The students can then see the build-up in chemicals only at certain levels because everything would not be contaminated. Fact sheet should only be used at the secondary level.*

Next, explain that the sheets of paper or napkins represent pollutants called dioxins. The dioxins made their way from a nearby source (a pulp and paper mill, waste and drinking water treatment plant, organic chemical manufacturer, municipal solid waste and industrial incinerator) into the sediment of the stream in which the plants live. The dioxins entered the plants from the sediment. When the insects ate the dioxin contaminated plants, the dioxin entered and stayed in their bodies. When the minnows ate the insects, they also accumulated the dioxins present in the insects. When the trout ate the minnows, the dioxins concentrated in the minnows were transferred to the trout. When the trout were consumed by the human, the entire load of dioxins from all the plants that served as the food for the insects, which fed the minnows, which fed the trout were transferred to the humans.

This phenomenon is called bioaccumulation. If each plant contained only one unit of dioxin, then the amount of dioxin that the human ingested was 10 units (1 unit for each of the primary producers that were consumed by all the organisms below the human on the food chain). Point out that even small amounts of pollution in the environment can be concentrated into amounts that are harmful to humans due to bioaccumulation.

Resources

Agency for Toxic Substances and Disease Registry (ATSDR) public health statement fact sheet for Dioxins which can be obtained at http://www.atsdr.cdc.gov/tfacts104.pdf .

Closure

Using the ATSDR fact sheet on dioxins, point out the sources of dioxin pollution as well as the human health effects of dioxins to the class.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

CHLORINATED DIBENZO-p-DIOXINS (CDDs)

Agency for Toxic Substances and Disease Registry ToxFAQs **February 1999**

This fact sheet answers the most frequently asked health questions (FAQs) about chlorinated dibenzo-p-dioxins (CDDs). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chlorinated dibenzo-p-dioxins (CDDs) (75 chemicals) occurs mainly from eating food that contains the chemicals. One chemical in this group, 2,3,7,8-tetrachlorodibenzo-p-dioxin or 2,3,7,8-TCDD, has been shown to be very toxic in animal studies. It causes effects on the skin and may cause cancer in people. This chemical has been found in at least 91 of 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are CDDs?

CDDs are a family of 75 chemically related compounds commonly known as chlorinated dioxins. One of these compounds is called 2,3,7,8-TCDD. It is one of the most toxic of the CDDs and is the one most studied.

In the pure form, CDDs are crystals or colorless solids. CDDs enter the environment as mixtures containing a number of individual components. 2,3,7,8-TCDD is odorless and the odors of the other CDDs are not known.

CDDs are not intentionally manufactured by industry except for research purposes. They (mainly 2,3,7,8-TCDD) may be formed during the chlorine bleaching process at pulp and paper mills. CDDs are also formed during chlorination by waste and drinking water treatment plants. They can occur as contaminants in the manufacture of certain organic chemicals. CDDs are released into the air in emissions from municipal solid waste and industrial incinerators.

What happens to CDDs when they enter the environment?

- When released into the air, some CDDs may be transported long distances, even around the globe.
- When released in waste waters, some CDDs are broken down by sunlight, some evaporate to air, but most attach to soil and settle to the bottom sediment in water.
- CDD concentrations may build up in the food chain, resulting in measurable levels in animals.

How might I be exposed to CDDs?

- Eating food, primarily meat, dairy products, and fish, makes up more than 90% of the intake of CDDs for the general population.
- Breathing low levels in air and drinking low levels in water.
- Skin contact with certain pesticides and herbicides.
- Living near an uncontrolled hazardous waste site containing CDDs or incinerators releasing CDDs.
- Working in industries involved in producing certain pesticides containing CDDs as impurities, working at paper and pulp mills, or operating incinerators.

How can CDDs affect my health?

The most noted health effect in people exposed to large amounts of 2,3,7,8-TCDD is chloracne. Chloracne is a severe skin disease with acne-like lesions that occur mainly on the face and upper body. Other skin effects noted in people exposed to high doses of 2,3,7,8-TCDD include skin rashes, dis-

coloration, and excessive body hair. Changes in blood and urine that may indicate liver damage also are seen in people. Exposure to high concentrations of CDDs may induce long-term alterations in glucose metabolism and subtle changes in hormonal levels.

In certain animal species, 2,3,7,8-TCDD is especially harmful and can cause death after a single exposure. Exposure to lower levels can cause a variety of effects in animals, such as weight loss, liver damage, and disruption of the endocrine system. In many species of animals, 2,3,7,8-TCDD weakens the immune system and causes a decrease in the system's ability to fight bacteria and viruses. In other animal studies, exposure to 2,3,7,8-TCDD has caused reproductive damage and birth defects. Some animal species exposed to CDDs during pregnancy had miscarriages and the offspring of animals exposed to 2,3,7,8-TCDD during pregnancy often had severe birth defects including skeletal deformities, kidney defects, and weakened immune responses.

How likely are CDDs to cause cancer?

Several studies suggest that exposure to 2,3,7,8-TCDD increases the risk of several types of cancer in people. Animal studies have also shown an increased risk of cancer from exposure to 2,3,7,8-TCDD.

The World Health Organization (WHO) has determined that 2,3,7,8-TCDD is a human carcinogen.

The Department of Health and Human Services (DHHS) has determined that 2,3,7,8-TCDD may reasonably be anticipated to cause cancer.

How can CDDs affect children?

Very few studies have looked at the effects of CDDs on children. Chloracne has been seen in children exposed to high levels of CDDs. We don't know if CDDs affect the ability of people to have children or if it causes birth defects, but given the effects observed in animal studies, this cannot be ruled out.

How can families reduce the risk of exposure to CDDs?

- ❑ Children should avoid playing in soils near uncontrolled hazardous waste sites.
- ❑ Discourage children from eating dirt or putting toys or other objects in their mouths.
- ❑ Everyone should wash hands frequently if playing or working near uncontrolled hazardous waste sites.
- ❑ For new mothers and young children, restrict eating foods from the proximity of uncontrolled sites with known CDDs.

Is there a medical test to show whether I've been exposed to CDDs?

Tests are available to measure CDD levels in body fat, blood, and breast milk, but these tests are not routinely available. Most people have low levels of CDDs in their body fat and blood, and levels considerably above these levels indicate past exposure to above-normal levels of 2,3,7,8-TCDD. Although CDDs stay in body fat for a long time, tests cannot be used to determine when exposure occurred.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.00003 micrograms of 2,3,7,8-TCDD per liter of drinking water (0.00003 µg/L). Discharges, spills, or accidental releases of 1 pound or more of 2,3,7,8-TCDD must be reported to EPA. The Food and Drug Administration (FDA) recommends against eating fish and shellfish with levels of 2,3,7,8-TCDD greater than 50 parts per trillion (50 ppt).

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Toxicological profile for chlorinated dibenzo-p-dioxins. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 404-498-0093. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Pollution in Fish – Bioaccumulation Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following can be sources of pollution that can contribute to bioaccumulation? *(circle all that apply)*

Paper Mill	Waste & Drinking water treatment plant
People's waste	Chemical Manufacturer
Lawn and agricultural fertilizers	Trees

2. What are the pollutants called that bioaccumulate in fish? *(circle all that apply)*

Free radicals	Decibels
Dioxins	Carbon Compounds

3. True or False…
   _____90% of the home intake of dioxins comes from meat, dairy & fish.
   _____Humans can be exposed to dioxins just by coming in contact with pesticides.
   _____CDD concentrations may build up in the food chain, resulting in measurable levels in animals.

4. Explain bioaccumulation?

_____
_____
_____

5. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Pollution in Fish - Bioaccumulation Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of pollution and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand the concept of bioaccumulation in fish?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned what effect dioxins have?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Bioaccumulation of Selenium in the Food Chain

Grades

Any

Subjects

Science and Health

Type of Lesson Plan

Activity

Duration

20 – 30 minutes

Materials

- Small squares of paper (white and yellow)
  - 20 pieces of white paper per "grasshopper"
  - 10 pieces of yellow paper per "grasshopper"
- Handout
  - *Health Effects of Selenium*
- Paper bags for all grasshoppers

Objective

TLW…

- Increase their understanding of how the food chain/web functions.
- Understand how toxins can accumulate through the food chain.
- Understand how they can be exposed to toxins by consuming other animals and plants which have been exposed to toxins.
- Be able to obtain information from a government fact sheet.

Set

Review of the food chain/web. This is an excellent closure activity for the concept of the food chain/web.

Instructional Input

Break down students into groups of animals. Note: the following grouping assumes a class size of 26. Adjust your groups accordingly. *This lesson can be merged with "Pollution in Fish" for older grades.*

18 grasshoppers
6 lizards
2 hawks

Distribute the white and colored pieces of paper (food) on the floor and give the paper bags to the "grasshoppers." The pieces of paper represent plants (producer).

Instruct the "grasshoppers" to collect as many pieces of paper as they can. Tell them not to worry about whether they collect white or colored paper. The idea is for them to collect as much food as possible or they will starve. Allow the students 30-45 seconds to collect as much "food" as they can, placing it in their paper bags.

The "lizards" will prey on the lower order consumers, the grasshoppers, thereby collecting their food. Allow only 5-10 seconds for the lizards to prey upon the grasshoppers. If a lizard touches a grasshopper on the shoulder, that grasshopper has been consumed and must surrender their food bag to the lizard. Lizards with fewer than 2 grasshopper bags starve and die.

Finally, allow the hawks to prey upon the lizards in the same manner the lizards preyed upon the grasshoppers. Allow only 5 seconds for the hawks to predate. If a hawk has less than 2 bags, they starve and die.

Now, read the following scenario:

While feeding on plants, grasshoppers consumed plants which grew in soils with large amounts of the element selenium. Selenium is a naturally occurring element essential for many living creatures. However, too much selenium can cause animals to become unhealthy. The colored pieces of paper in this exercise represent plants high in selenium. Any grasshopper with 10 or more high selenium pieces of food will be unhealthy for lizards to eat. Any lizard that has 25 or more high selenium pieces of food will become sick. Any hawk with 40 or more pieces of selenium will lose their appetite, will stop drinking water, and suffer from paralysis.

This example is an extreme case of what scientists call bioaccumulation. Bioaccumulation occurs when plants or animals are exposed to toxins in the environment. Consumers, or predators then eat these animals and plants. As the food is digested, the toxins are absorbed into the system of the animal eating the contaminated food. Since each successive predator must eat a certain number of prey, the toxins start to accumulate more in the predators. Higher order predators are exposed to the greatest amounts of toxins because their prey has accumulated the toxins and the predator must eat a sufficient number of prey. So, if a hawk eats 3 lizards which have 30 units of toxins each, the hawk now has 90 units of toxins. Even if an area has low levels of toxins, the higher order predators can still become sick because those toxins can concentrate in their prey. Higher order predators must consume a large amount of food. If this food is contaminated, those contaminants can build up in dangerous amounts in the predator's body.

The same holds true for humans. Imagine that elk, sheep, or deer were feeding on contaminated vegetation. Humans, preying on the elk, sheep, or deer could be exposed to unhealthy levels of selenium.

Closure

Share the *Health Effects of Selenium* fact sheet with the class if age appropriate. You can read the whole thing or certain sections, or read it as a class.

Ask the class to write a brief essay (5 minutes) about how they think bioaccumulation of toxins can affect human health. Challenge them to come up with an example of their own using a contaminant of their choice and their understanding of food chains/webs.

IDAHO DEPARTMENT OF HEALTH & WELFARE

Bureau of Community and Environmental Health

HEALTH EFFECTS OF SELENIUM

What is selenium?

Selenium is an essential nutrient for humans and animals. Selenium, however, is harmful to humans and animals when eaten in amounts that are much higher than the amounts needed for good nutrition. Selenium is a naturally occurring substance that is widely, but unevenly, found in the rocks and soil of the earth. It is not often found in its pure form. It is usually combined with other substances. In the western states, the soils contain rather high levels of selenium compounds.

Selenium is most commonly produced as a byproduct of copper refining. Selenium compounds can be produced by roasting copper ore "slimes" with soda ash or sulphuric acid. Burning coal and oil also releases selenium into the environment. What happens to selenium when it enters the environment?

- Small selenium particles in the air settle to the ground or are taken out of the air in rain.
- Selenium compounds deposited in agricultural fields from fertilizer use can be carried in irrigation drainage water.
- Plants easily take up selenium compounds from water and concentrate them. Selenium can build up in animals that eat plants or other animals with high levels of selenium. It can also build up in animals that live in water containing high levels of selenium.

How might I be exposed to selenium?

- By eating food, drinking water, or taking dietary supplements that contain it.
- By living near a selenium-rich area.
- By living near a hazardous waste site that contains selenium.
- By breathing air that contains selenium.

Many people take daily selenium supplements. The Food and Drug Administration recommends that adults eat 55 micrograms of selenium a day. Selenium activates antioxidant enzymes. Some supplement manufacturers claim selenium can boost the immune system and prevent cancer. These claims have not been scientifically proven.

Humans are exposed daily to selenium in their food. Generally, the levels in food are enough to protect against diseases that may result from too little selenium. Most of the daily intake of selenium comes from eating grains, cereals, seafood, and animal organs.

The human body easily absorbs selenium from foods that are eaten. Selenium in drinking water is easily absorbed in the digestive tract. It is not easily absorbed through the skin. The human body can change selenium into forms the body can use. However, selenium can build up in the human body, leaving mainly in the urine.

Some plants can build up selenium to levels that are harmful to livestock and humans feeding on these plants. In these cases, humans can be exposed to too much selenium if they eat locally grown grains, vegetables, or animals that have built up high levels of selenium.

In fresh water containing high levels of selenium, fish may contain selenium at high levels. Humans also can be exposed to selenium in drinking water. Most of the water sources in the United States contain levels of selenium that are very low compared with levels found in food. Less than 1% of the daily intake of selenium is estimated to come from drinking water. At hazardous waste disposal sites, selenium can be washed from the soil into streams and lakes or flow into groundwater. This raises the amount of selenium in water above normal levels.

Humans normally are not exposed to large amounts of selenium in the air. People who work in metal industries, selenium-recovery processes, painting, and ore processing may be exposed to airborne selenium.

How can selenium affect my health?

Selenium can be harmful at daily dietary levels 5–10 times higher than the daily requirement. The seriousness of the effects of excess selenium depends on how much is eaten and how often. Accidentally swallowing a large amount of selenium (for example, a very large quantity of selenium supplement pills) could be fatal without immediate medical treatment. The exact levels at which these effects occur are not known.

If amounts of selenium only somewhat higher than needed were eaten for a year or more, several health effects could occur. These effects include brittle hair, deformed or discolored nails, loss of hair, tooth decay and discoloration, fatigue, liver and spleen damage, and, in extreme cases, loss of feeling and control in arms and legs.

Currently, we do not know the exact exposure levels at which these effects may occur. Short-term exposure, 14 days or less, to selenium from inhalation of dust results in irritation of the mucous membranes in the nose and throat, producing coughing, nosebleeds, bronchial spasms, and chemical pneumonia. Short-term exposure from inhalation of hydrogen selenide, a highly toxic selenium compound, results primarily in respiratory effects, such as irritation of the mucous membranes, pulmonary edema, severe bronchitis, and bronchial pneumonia.

Indigestion, nausea, headaches, dizziness, and irritation of the eyes also were reported in humans who inhaled selenium compounds. No information is available on the chronic (long-term) effects of selenium in humans from inhalation exposure. Upon contact with skin, selenium compounds have caused rashes, swelling, and pain.

What are the effects of selenium on livestock?

"Blind staggers" is a disease in livestock that results from short-term consumption of plants high in selenium. It is characterized by impaired vision, aimless wandering behavior, reduced consumption of food and water, and paralysis. "Alkali disease" is a disease in livestock resulting from long-term consumption of high levels of selenium. It is characterized by hair loss, deformation and sloughing of the hooves, erosion of the joints of the bones, anemia, and effects on the heart, kidney, and liver.

How likely is selenium to cause cancer?

The U.S. Department of Health and Human Services has determined that selenium sulfide may cause cancer. Selenium sulfide is used in some anti-dandruff shampoos. It is not present in foods and is very different from selenium compounds found in foods and in the environment. Because selenium sulfide is not easily absorbed through the skin, use of shampoos containing this compound is considered safe unless a person has open cuts or sores on the scalp or hands.

Studies of laboratory animals and people show that most selenium compounds probably do not cause cancer. In fact, some studies of human populations showed that not enough selenium in the diet might increase the risk of cancer. But diets high in selenium do not reduce the risk of developing cancer and may increase the risk of selenium poisoning.

Has the federal government made recommendations to protect human health?

The federal government has developed standards and guidelines to regulate exposure to selenium in the environment and to protect individuals from possible adverse health effects. The Environmental Protection Agency maximum contaminant level for selenium in drinking water is 50 parts of selenium per billion parts of water (50 ppb). The Food and Drug Administration maximum allowable level of selenium in bottled water is also 50 ppb.

The Occupational Safety and Health Administration exposure limit for selenium compounds in workplace air is 0.2 milligrams of selenium per cubic meter of air for an 8-hour day over a 40-hour work week.

For more information

The *Bureau of Community and Environmental Health* (BCEH), Idaho Division of Health, works with the *Agency for Toxic Substances and Disease Registry* to protect human health from dangerous substances in the environment. BCEH has an Environmental Health Education and Assessment Program to inform and educate the citizens of Idaho about these substances at hazardous waste sites and the activities being conducted at these sites. This fact sheet has been created to assist you in understanding the potential health effects of exposure to selenium in the environment. For more information, contact:

Bureau of Community and Environmental Health (BCEH)
Environmental Health Education and Assessment
450 W. State St. 6th Floor, Boise, Idaho 83720-0036
Toll Free: 1-866-240-3553
(208) 334-5927
BCEH@dhw.idaho.gov

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Bioaccumulation of Selenium in the Food Chain Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following is NOT true about Selenium? *(circle all that apply)*
   Essential nutrient for humans and animals Found in rocks and soil
   Naturally occurring
   Is excreted by our bodies after consumption and is not stored in our bodies

2. Which of the following is NOT a way to be exposed to large amounts of selenium? *(circle all that apply)*
   Breathing air with high concentrations Swimming in a pool
   Living near a selenium-rich area Taking vitamins
   Living near a hazardous waste site that contains selenium

3. Which one of the following is most at risk for accumulating toxins?
   Field mouse grasshopper rabbit red-tail hawk

4. Explain bioaccumulation?

_____
_____
_____

5. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Bioaccumulation of Selenium in the Food Chain Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand how selenium affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand how people and animals are exposed to selenium?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned how to limit their own exposure to selenium?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Find the Safe Route to School

Grades

Elementary

Subjects

Science and Health

Type of Lesson Plan

Activity

Duration

1 – 2 hours plus extensions

Materials

Mapping handout (school area map)
Additional materials

- School area map overhead
- Overhead projector
- Colored overhead pens
- Other maps for comparison
- Colored pens or pencils for in class mapping

Objectives

TLW…

- Identify safe routes to and from school.
- Identify dangers students might encounter on their route to school.
- Identify places that are not safe to play or walk.
- Understand the dangers of industrial sites, traffic, large equipment, rail roads, and other hazards on their route to school.

Set

Introduce this activity by discussing how much time students spend going to and from school and playing on and near the school grounds. Ask students how they get to and from school, to or from their friends house, or to and from the store. Do they usually go by themselves or with someone? Do they walk, get rides from their family members or friends, ride their bikes, scooter or skateboard or take the bus. Do they follow a road or take short cuts?

Instructional Input

Mapping Activity

Instruct students to use the map provided to best trace their route to school using a colored pen or pencil.

Students will probably have more than one route because they rely on different modes of transportation. Many people drive some days and walk or ride other days. Use different colors for each route and create a key. For example:

Yellow= driving route
Red= biking route
Green=walking route

After students have finished mapping their routes to school, ask them if they think it is a safe route to school. At this point, you may want to ask students to share with the class situations that they think are dangerous and make them feel afraid as well as situations in which they feel safe. *You could also include stranger, "unsafe/bad" parts of town, or methamphetamine labs here.*

Write a list on the board of things that could be dangerous to students while going to or from school. Ask the students to come up with ideas to add to the list. The items in the list should apply to the students' daily commute. Ask them to think about their daily trip to school while coming up with ideas for the list.

List items might include:

1) Crossing a busy street
2) Cars going too fast
3) Railroad tracks
4) Big trucks
5) A barbed wire fence
6) A bull dozer or other heavy equipment
7) A big dog
8) No sidewalks
9) No bike paths
10) Shortcuts (can sometimes be dangerous depending on the route)
11) A factory, industrial site or dump
12) A dump
13) A big cliff or steep hill
14) A river

Ask students if they encounter any of the dangers on the list on their way to school and ask them to elaborate on why they are dangerous. Then ask students to come up with a list of things that help make their trip to school safer.

List items might include:

1) Asking a parent or sibling to accompany them to school
2) Avoiding dangerous places like industrial sites, rivers, dumps, big cliffs, railroad tracks, and busy streets.
3) Using a crosswalk
4) Walking on the side walk or following a street
5) Avoiding houses with big dogs
6) Using a bike path
7) Staying away from big trucks

8) Avoid taking shortcuts
9) Safe Place/McGruff Houses

Safe routes matching game

Explain to the students that you will be playing a matching game to help them find a safe route to school. Tell students that they should discuss how their behaviors and actions can make some situations dangerous. Students can play in groups of 2 or 4.

Place all of the cards face down on the table one by one. During their turn, each student can turn over two cards. The object of the game is to find a danger card and a safety card that decreases the danger.

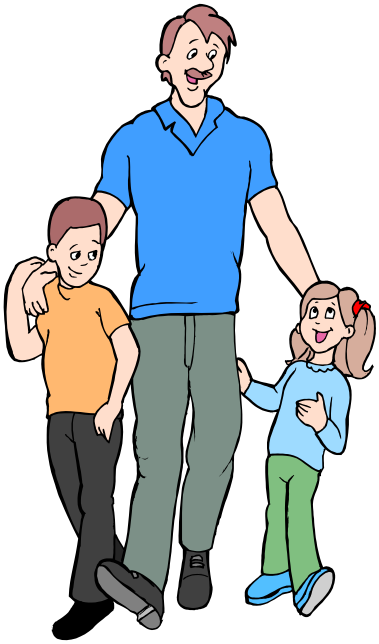
If the student turns over a pair during her/his turn, s/he can keep the pair. If not, the cards should be turned face down again in the same spot. The next student then turns over two cards to try to find a matching pair. During the game, students should discuss whether the picture represents a danger or a safety feature and whether or not they make a danger/safety pair. There are many possible combinations for danger and safety pairs, since some dangers can be solved in multiple ways. At the end of the game, the student with the most pairs wins.

Closure

Instruct students to draw the dangers that they encounter on their way to school to their original map and to look for routes that avoid these dangers.

Bring in pictures taken at a child's eye level of dangers and safety features around the school and nearby neighborhoods. Have students create a "Safe route to school" collage with these pictures to display in the classroom.

Busy street



Go with an adult

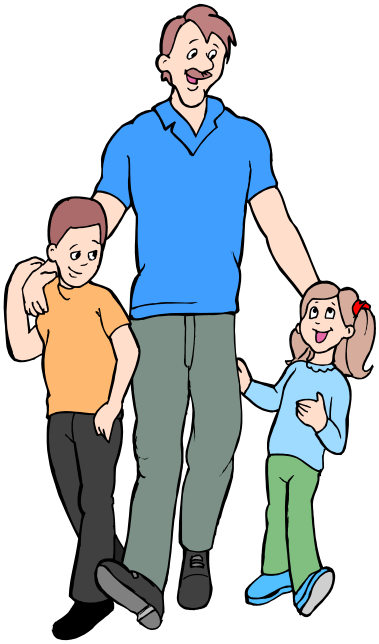
Busy street

Use a crosswalk

Bike in traffic

Bike on a path

Big Dog



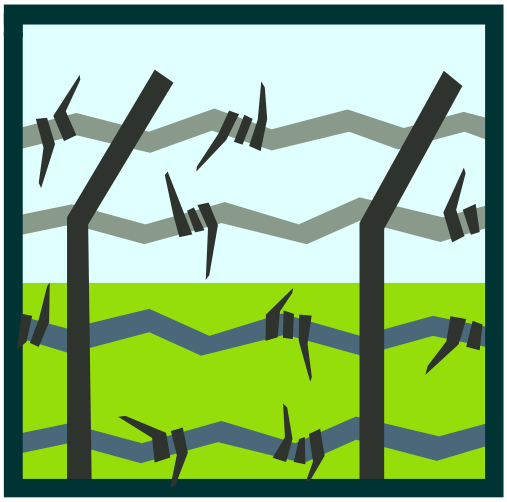
Go with an adult

Busy street

Use a crosswalk

Train tracks

Watch for Trains



Barbed wire fence

Do not enter

Factory

Do not enter

Construction site

Do not enter

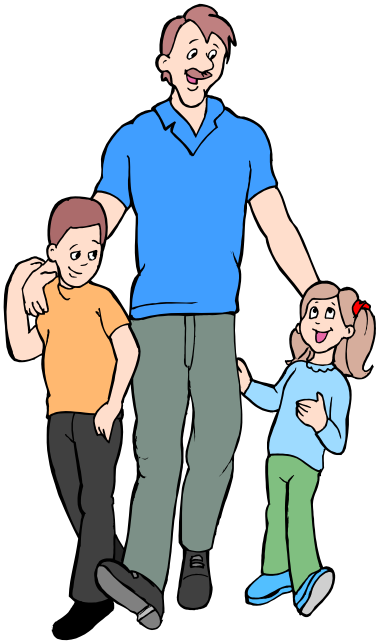
Big trucks and machines

Be careful

Big trucks

Be careful

Danger card



Go with an adult

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Find the Safe Route to School Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following is NOT dangerous to students while going to and from school? *(circle all that apply)*

Railroad tracks	Sidewalks	Busy Streets
Crosswalks	A River	Construction Site

2. Which of the following is NOT way(s) to make their trip to school safer? *(circle all that apply)*

Using a bike path	Know the "Safe Place" symbol
Using sidewalks	Using crosswalks
Ask parent or sibling to accompany them	Walk through alleys to find short cuts

3. List three different things that can help make your trip to school safer?

1._____
2._____
3._____

4. After doing this activity, do you think you can do a better job of avoiding dangers while traveling to and from school? Yes No

5. Do you think this activity was fun?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Find the Safe Route to School Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students are better able to identify dangers they face while traveling to and from school?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel the students learned how to avoid most of the dangers identified during this lesson?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Identifying Toxic Chemicals

Grades

Any

Subjects

Science and Health

Type of Lesson Plan

Activity

Duration

1 hour

Materials

- Mr. Yuck stickers
- Examples of warning signs and symbols and product labels
- Pictures of toxic chemicals or things that produce toxic chemicals such as frogs, spiders, plants, cleaning chemicals, cigarettes, alcohol, automobile exhaust, incinerators, factories
- A Ziploc bag containing three fruit-flavored Tums
- A Ziploc bag containing three Sweet Tarts
- A Ziploc bag containing three Red Hots
- A Ziploc bag containing three Advil
- A clear bottle containing Pine Sol
- A clear bottle containing apple juice

Objectives

TLW…

- Understand that our world is composed of chemicals.
- Understand the definition of toxic chemical.
- Understand that it is not easy to know if a chemical is toxic.
- Learn how to identify toxic chemicals by reading labels.
- Identify toxic chemicals that are used in the home.

Set

Begin the class by asking the students if they know what a chemical is and ask them to "brainstorm" a list of chemicals or things that are made up of chemicals. This list might include chemicals like drugs they take when they are sick, bug spray that people put on themselves and on their gardens to get rid of bugs (e.g. pesticides), and cleaners that they use at home. Then move on to compounds that students might not think of as chemicals, such as the food we eat and water we drink. Ask students what our bodies are made of and point out that there is nothing in

this world that is not composed of chemicals. Explain that the human body is made up of many organs and cells all of which are made up of small "pieces" that cannot be seen but are called chemicals. The point of this exercise is to demonstrate that everything in the world, including our bodies is made up of chemicals.

Instructional Input

Ask the students to think of some good uses of chemicals. Ask the class if they think some chemicals can harm them and if so, what kinds of chemicals can harm them and how.

Explain to the class that when a chemical causes harm, it is called a toxic chemical. Have a student write the word "toxic" on the black board. Ask the students if they have ever heard the word toxic used before. Ask the students if they think all chemicals are toxic, including chemicals found in foods that are necessary for human life.

Explain to the class that all chemicals can be toxic or cause harm to people, animals, and plants if too much is taken in. Use an example of a child that eats too much candy—he feels sick afterwards. Explain to the class that many chemicals when used in the right amounts can be beneficial. Some examples are prescription medicine, when taken in the right amounts they can make you feel better, but if you take to much you can get even sicker.

Explain to students that some chemicals are more toxic than others. For example, if a person eats an entire bag of candy, s/he will feel sick. If a person eats a handful of mothballs, s/he could die.

Show students photos or examples of the following and ask them which ones they think might be toxic. Some examples include: *Household chemicals, cleaning supplies; Pesticides, fertilizers, bug sprays; Pollution (air, water, soil, hazardous waste); Alcohol, cigarettes; Salt; Metals (iron, lead, etc); Poisonous plants like poison ivy or oak; A snake or spider.* Tell the students that all of the things you showed them are examples of or contain toxic chemicals.

Show students poison ivy/oak, snake and spider photos. Explain that in nature some plants make toxic chemicals or poisons as a natural defense against their predators (bugs or other animals). These poisons make them taste bad to animals or bugs that want to eat them and in some cases can make the animals or bugs sick and may even kill them. Some animals and insects use poisons as a defense against other animals that threaten them. Some of the toxic chemicals found in nature can make people sick too.

<u>How can you tell its bad for you?</u>

Ask the students if they think toxic chemicals are easy or difficult to recognize.

Show students the following 1) a bottle containing apple juice next to one containing Pine Sol, 2) a jar of Tums next to jar of Sweet Tarts, 3) a bag containing Red Hots next to a bag containing Advil. Explain that one of each of the containers holds something that could make them sick if they ingested it. Ask if they can tell which jar contains something that might harm them if they ate or drank it. Ask to discuss ways that they can tell if something is toxic.

If students suggest taking the cap off of the bottle in order to smell the chemical to see if it smells toxic explain to them that many toxic chemicals have no smell or taste. In some cases they can get sick just from smelling a toxic chemical, so it is <u>never</u> a good idea to smell or taste something to see if it is toxic.

Show students a picture of Mr. Yuk, the skull and cross bones symbol and flammable, corrosive and explosive symbols. Ask them if they have ever seen these symbols before and if so where. Ask the class what they think the symbols mean. Show students some of the following words and have them read them aloud. Caution, Warning, Poison, Toxic, Danger. Ask them if they recognize any of the words and what they mean. Explain what the symbols and words mean and how they can be helpful in recognizing whether or not something is a toxic or dangerous chemical. If you can find household product labels with these symbols on them, show them to the class as examples.

Closure

Have students take home and complete a *Toxic Household Products Survey*. When the students have completed the survey, discuss how they recognized that something in their home was possibly a toxic chemical. Have students look at what chemicals might need to be stored in a safer place.

Additional resources

Mr. Yuk stickers and other poison prevention materials can be ordered from:
EMS/StateComm
700 S. Stratford Dr., Bldg. #7
Meridian, ID 83642
Phone: (208) 334-4013
Fax: (208) 846-7618
Or order online by going to http://www.healthy.idaho.gov and then click on "Poison Prevention." There is a Poison Prevention Materials Order Form PDF on this page.

Toxic Household Products Survey

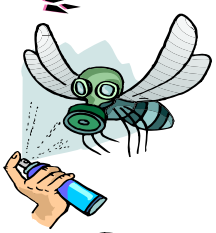
Name_____ **Date**_____

Place an X in the blank if the product is used in your home.
Place an X in the blank beneath each product you think is toxic. Remember, something is toxic if it can harm you or make you sick. It does not have to be life threatening to be toxic!

Window cleaner

_____ This product is used in our home.

_____ I think it is toxic.



Insect spray

_____ This product is used in our home.

_____ I think it is toxic.

Air freshener / room deodorizer

_____ These products are used in our home.

_____ I think they are toxic.

Laundry detergents

_____ These products are used in our home.

_____ I think they are toxic.

Furniture Polish

_____ This product is used in our home.

_____ I think it is toxic.

Floor cleaners

_____ These products are used in our home.

_____ I think they are toxic.

Drain cleaners

_____ These products are used in our home.

_____ I think they are toxic.

Health Hazards of Toxic Household Products

Product	Toxic Effects
Window cleaner	Window cleaner can cause skin, eye, nose, throat, sinus, and lung irritation. It can even cause sores on the liver and kidneys.
Insect spray	Insect spray (pesticide) can cause skin, eye, nose, throat, sinus, and lung irritation. It can also damage the heart, lungs, liver, kidneys, spleen, and central nervous system (brain and nerves).
Air freshener / room deodorizer	Air fresheners and room deodorizers can cause skin, eye, nose, throat, sinus, and lung irritation. They may also cause nausea, headaches, nose bleeds, dizziness, and shortness of breath. They are even more toxic if they contain formaldehyde. Formaldehyde can cause cancer.
Laundry detergents	Laundry detergents can cause skin, eye, nose, throat, sinus, and lung irritation. They may also cause vomiting or coma if they are ingested (eating and drinking).
Furniture Polish	Furniture polish is usually flammable. Furniture polish can cause skin, eye, nose, throat, sinus, and lung irritation. If the polish contains mineral spirits or petroleum distillates, it may cause skin and lung cancer.
Floor cleaners	Floor cleaners can cause skin, eye, nose, throat, sinus, and lung irritation. Floor cleaners can also cause sores on the kidneys and liver. Floor cleaners with petroleum solvents are flammable and have been linked to skin and lung cancer.
Drain cleaners	Drain cleaners are usually caustic and or corrosive. That means they can eat through materials and skin. Drain cleaners cause skin, eye, nose, throat, sinus, and lung irritation. They can damage the kidneys, liver, digestive system, skin, and central nervous system. Drain cleaners are poisonous if swallowed and can cause severe tissue damage.

To avoid the toxic effects of common household products:

- Follow product directions
- Wear gloves and other protective clothing
- Safely store products so they are inaccessible to children or pets
- Provide adequate ventilation when using toxic products
- Find a non-toxic alternative
- Do not mix cleaning products together

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Identifying Toxic Chemicals Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Circle the best way to identify if a substance is a toxic chemical.
   Smell it Take it out of the packaging and look at it
   Read the label Look at it under a microscope

2. When a chemical causes harm it is called a _____ chemical?

3. What does this symbol mean?

_____
_____
_____

4. Name 1 toxic chemical that you found when completing your toxic household products survey._____

5. Is it easy to always identify toxic chemicals? Yes No

6. Name 3 toxic chemicals that can cause harm to humans or animals if they ingest too much.

1._____
2._____
3._____

7. True or false, some of the chemicals found in nature can make people sick? T F

8. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

9. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Identifying Toxic Chemicals Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of toxic chemicals and how they affect their health?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

3. Do you feel students understand how to identify toxic chemicals?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

4. Do you feel the students learned how to protect themselves from toxic chemicals?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

6. Was the lesson plan clear?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

7. What is your overall impression of the lesson plan?

Poor Neutral Good Comments: _____
1 2 3 4 5 _____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Hazardous Substance Poster

Grades

Any

Subject

Science, Health and Art

Type of Lesson Plan

Activity

Duration

2-3 class periods. Two class periods if students are allowed to work on the posters in Art.

Materials

- Magazines
- Tape
- Glue
- Pamphlets
- Poster board
- Colored pencils
- Markers
- Butcher paper
- Construction paper (colors)
- Scissors
- Crayons
- List of Hazardous Substances

Objectives

TLW…

- Design a poster intended to educate others about the harmful health effects of a hazardous substance.

Set

Discuss how various chemicals are classified as hazardous substances. Discuss, in general, how hazardous substances can impact human health. Ask students if they can identify any hazardous substances that might be in their community or region of the state.

Instructional Input

Explain the purpose of the poster (to educate the public in order to protect human health). Have examples on hand. Next, discuss the requirements and expectations. Students should use actual objects; magazine/pamphlet cut outs, drawings, computer graphics, and text to explain the main concepts of their poster. *Art tie in.*
Before creating posters:

1. Go over the grading requirements. See evaluation below.
2. Stress proper use and sharing of materials.
3. STRESS clean up!

Evaluation

Evaluation will be based on the educational quality of the student's poster, as well as aesthetic aspects of the poster's layout. *Tie in to Art.* Rubrics for the requirements are included with this lesson. However, you may choose to develop your own or, better yet, develop them with the class.

Concepts to include:

- Identify the substance with its correct name and chemical symbol.
- Discuss what the substance looks, feels, smells, and tastes like (physical properties).
- Where does it come from? What types of activities produce it?
- How can humans be exposed?
- How can human health be affected?
- How can humans protect against exposure to this hazardous substance?

Poster Rubric

Category	**Excellent** _____ *points*	**Good** _____ *points*	**Room for Improvement** _____ *points*
Neatness	Well constructed. Papers glued down neatly. Coloring and cutouts are neat.	Some of the pictures are peeling at the corners. Writing, coloring, and pictures are well done, not perfect.	Writing, coloring, and pictures were not carefully completed. Pictures are peeling off.
Legibility	All words can be easily read from a distance of 2 feet.	Most words can be easily read from a distance of 2 feet.	Many words can not be read from a distance of 2 feet.
Spelling and Grammar	No spelling or grammar mistakes.	Few (<5) spelling or grammar mistakes.	Many (>5) spelling or grammar mistakes.
Graphics	All graphics are neat and help explain main concepts.	Most graphics are neat and help explain some of the poster's concepts.	Few graphics are neat and most do not explain concepts in the poster.
Concepts	All concepts are correctly addressed.	Most concepts are addressed correctly.	Few concepts are addressed correctly.

Provide examples of posters and let the students use the rubric to judge the examples. This helps them to assess their own work using the rubric. If you wish, the students can peer critique each other's posters prior to finalizing and handing them in.

Closure

Hang up the posters in your classroom, the hall, or the library. As appropriate, encourage discussion about how hazardous substances affect people's health using specific examples from the posters. Examples with local relevancy are extremely valuable here.

For elementary students, submit copies of the most outstanding posters to the Idaho Division of Health. Students will receive a mailed certificate.

Resources

Here are some excellent sites for identifying and listing hazardous substances. These sites also contain information that will be useful for older students as they research the substance of their choice.

Excellent links to many hazardous substances identified by the EPA.
http://www.epa.gov/ebtpages/pollutants.html

ATSDR's ToxFAQs – extensive fact sheets on many hazardous substances.
http://www.atsdr.cdc.gov/toxfaq.html

Top 20 Hazardous Substances.
http://www.atsdr.cdc.gov/cxcx3.html

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Hazardous Substance Poster Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Circle the easiest way(s) to identify if a substance is hazardous.*(circle all that apply)*
   Smell it Take it out of the packaging and look at it
   Read the label Look at it under a microscope

2. When a chemical causes harm it is called a _____ chemical?

3. Name one creditable website you used to find information about the hazardous substance you chose?

_____
_____

4. What are the harmful effects of the hazardous substance you chose for your poster?_____
   _____
   _____

5. How can people limit their exposure to this hazardous substance you chose for your poster?_____
   _____
   _____

6. Name three harmful chemicals or substances that you learned about during this activity:

1._____
2._____
3._____

7. Do you think this activity was fun?

No Neutral Yes Comments: _____
1 2 3 4 5 _____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Hazardous Substance Poster Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of hazardous substances and how they affect their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students learned how to identify hazardous substances on their own??

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned how to protect themselves from hazardous substances?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Health Hazards of Toxic Household Products

Grades

Any

Subjects

Science and Health

Type of Lesson Plan

Activity

Duration

20 – 30 minutes

Materials

- Copies of the Toxic Household Products Checklist
- Alternative to Hazardous Household Chemicals Table

Objectives

TLW…

- Be able to identify substances used in their home as toxic or non-toxic.
- Learn to appreciate the potential health hazards of household chemicals.

Set

Orally quiz students about why household cleaners are effective. What kinds of things are being cleansed? If students bring up germs, ask how the chemicals kill germs. Steer the conversation so that students understand that many household products are actually designed to kill things (bacteria, insects). That means these substances are toxic. Other household products, such as air fresheners or deodorant, may cause living things to become sick or die, even if that is not the intended purpose of the product.

Instructional Input

Define **toxic substance** - any substance that is capable of harming a person if it enters the body in a large enough dose.

Make sure that the students understand the routes of human exposure to a toxic substance:

- **ingestion** - eating, drinking
- **inhalation** – breathing
- **absorption** - skin contact

Point out that a substance, while toxic, will not harm a person if they are not exposed to it. Also, even if a person is exposed to a toxic substance, they may not become sick unless they are exposed to a sufficient quantity.

Toxic substances may have different health effects depending on the duration of the exposure:
Acute – less than 2 weeks
Intermediate - > 2 weeks but < 1 year
Chronic – 1 yr or more

Handout the *Household Hazardous Chemicals Checklist*. Explain to the students that this Checklist contains many common household products. Ask them whether or not they use these products in their home. Record the results of the students in a matrix on the board or an overhead. You may want to work in a percent or fraction lesson here, if appropriate. Discuss each product. Hand out the Alternatives to Hazardous Household Chemicals Table.

Evaluation

Discuss what should be done to reduce exposure to hazardous household chemicals.

1. Follow product directions
2. Safely store products where they are not accessible to children or pets
3. Provide adequate ventilation when using hazardous products
4. Find an non toxic alternative

Guided Practice

Have the students pick an area of their home and inventory the household products and chemicals in that room. Determine whether or not they are toxic. How are they stored? Is there a non-toxic alternative?

Extended Practice

Have the students discuss the results of their inventory with their parents. The students should then write a brief essay describing their parents' reactions, attitudes, and plan of action for dealing with toxic products in their house and garage.

Closure

Have students share their essays and action plans with the class. Research alternative, non-toxic products.

Resources

There are many helpful sites on the Internet which are designed to educate consumers about safe alternatives to popular household products. These sites list non-toxic alternatives for many cleaning supplies and pesticides.

The Idaho Department of Health and Welfare, Division of Health, Bureau of Community and Environmental Health developed a brochure detailing healthy alternatives to common household products. A copy can be viewed, downloaded, and printed at http://www.healthy.idaho.gov, click on "Indoor Air Quality" and then click on "Healthy Homes Brochure" under resources.

Household Hazardous Chemicals Checklist

Before starting, ask your parent to help you look through your house to find the products that are used in each of the following areas. Read the label and look for words like **Corrosive, Flammable, Explosive, Toxic, Poison, Danger, Hazardous, Caution,** and **Warning**. These words are clues that the product is hazardous. If the product is hazardous, put a check in the blank to the left of the item. Circle products that you use.

KITCHEN	BATHROOM
_____Oven cleaner	_____Tub or tile cleaner
_____Floor cleaner & wax	_____Drain cleaner
_____Ammonia	_____Toilet bowl cleaner
_____Scouring powder	_____Medicine
_____Bleach	_____Air freshener
_____Other	_____Nail polish remover
	_____Other
LIVING ROOM	**GARAGE, BASEMENT, SHED**
_____Rug cleaner	_____Oil
_____Furniture polish	_____Antifreeze
_____Air freshener	_____Gasoline or other fuel
_____Other	_____Paint
	_____Varnish
LAUNDRY ROOM	_____Glue
_____Bleach	_____Paint thinner
_____Spot remover	_____Moth balls
_____Detergent	_____Other
_____Other	
GARDEN, LAWN	**OTHER PLACES & ITEMS**
_____Weed killers	
_____Bug killers	
_____Fertilizers	
_____Other	

*Adapted from: BAGS, BEAKERS, AND BARRELS: An Action Curriculum Toward Resolving Hazardous Materials. Industrial State Policy Center and the School of Natural Resources of Michigan, Cleveland, Ohio: 1987.

Non-Toxic Alternatives to Hazardous Household Chemicals

Did you ever wonder what people used before fancy household cleaners were invented? Like, what did your great-great-grandparents use to clean out a clogged drain? Maybe they used some of the cleaning concoctions below. They may take a little more elbow grease and might seem kind of goofy, but they are better for your health and for the environment than some other household chemicals. Remember to use caution even when using "less-toxic" chemicals.

FOR THIS	TRY THIS
Ants in the house	Red chili powder at point of entry, seal off entry
Brass polish	Salt and vinegar or Worcestershire sauce
Carpet cleaner (to remove fresh food stains)	Club soda
Chrome polish	Cider vinegar
Copper cleaner	Lemon juice with a little salt
Disinfectant	Pine oil or dilute chlorine bleach solution
Drain cleaner	1/2 cup baking soda, 1/2 cup vinegar and 2 quarts boiling water
Fertilizer	Compost your fruit and vegetable scraps
Furniture polish	1 tablespoon lemon oil in 1 pint mineral oil
Hand cleaner (to clean off paint or grease)	Baby oil
Floor cleaner	1 cup white vinegar mixed with 2 gallons water
Mosquito repellent	Cedar chips or Citronella candles
Oven cleaner	For baked-on spills, use 2 tablespoons soap plus 2 tablespoons borax plus warm water and steel wool
Paint: oil-based, stains, and sprays	Water-base, non-aerosol paints
Rust stain remover (to get stains out of clothing)	Lemon juice and salt plus sunlight
Clear shoe polish	Banana peel
Silver polish	1 quart warm water, 1 tablespoon baking soda, a piece of aluminum foil and 1 tablespoon salt
Spot remover	Club soda, lemon juice and salt
Window cleaner	2 tablespoons vinegar mixed in 1 quart water

Source: Sally McDole, WSU-Cooperative Extension, Jefferson County, Washington

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Health Hazards of Toxic Household Products Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are routes of human exposure to toxic substances? *(circle all that apply)*

Ingestion	Touching	Inhalation
Observation	Absorption	Qualitative Analysis

2. Which one of the following exposure durations is considered an acute exposure?

6 weeks	4 weeks	3 weeks	1 week

3. Which one of the following exposure durations is considered an intermediate exposure?

18 months	14 months	10 months	1 week

4. Which one of the following exposure durations is considered a chronic exposure?

18 months	10 months	6 months	1 month

5. Please list 3 or 4 hazardous household products that you found in your home while performing your inventory:

1._____
2._____
3._____
4._____

6. Please match the following toxic hazardous substances with their non-toxic alternative:

Hazardous Substance	*Non-toxic Alternative*
Brass polish	Vinegar and water
Window Cleaner	Compost your fruit and vegetable scraps
Oven cleaner	Salt and vinegar
Fertilizer	Bleach
Disinfectant	soap, borax, warm water, and steel wool

7. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Health Hazards of Toxic Household Products Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students can effectively conduct a household inventory of hazardous substances?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand why hazardous home products are harmful?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Identifying Pathways of Exposure to Toxic Chemicals

Grades

Any

Subjects

Science and Health

Type of Lesson Plan

Lab

Duration

1-2 hours

Materials

- *Household Hazardous Chemicals Checklist*
- *Non-Toxic Alternatives to Hazardous Household Chemicals*
- Mr. Yuk stickers
- Skull and crossbones
- Black light
- Fluorescent lotion
- A dark colored paper cup
- A dark colored cloth napkin
- A carrot
- A black plastic fork

Objectives

TLW…

- Understand the definition of a toxic chemical.
- Identify toxic chemicals that are used in the home.
- Understand how toxic chemicals can get into the body.
- Learn how to reduce exposures to toxic chemicals.
- Identify nontoxic alternatives to hazardous household chemicals.
- Identify sources of toxic chemicals outside the home.

Set

Toxic chemical in our homes

A day or two before the lesson, explain to students that they will identify different types of hazardous chemicals that they use in their home. Send home a hazardous household chemicals checklist with the

students and instruct them to have their parents help them complete it. Remind them to look for the following words or symbols that might indicate that a chemical is hazardous:

- Mr. Yuk symbol
- Skull and crossbones symbol
- Words or symbols indicating that the chemical is flammable, corrosive or explosive
- Caution, Warning, Poison, Toxic, Danger.

When the students have completed their checklists, ask them to share their list with the class. Write the five most common hazardous household chemicals on the board. Have students answer the following questions: What are these chemicals used for? Why are they dangerous? What are some non-hazardous or non-toxic alternatives that they could use instead?

Instructional Input

Chemical Pathways into our Bodies

Ask students if they think using toxic chemicals in their homes is bad for their health and how toxic chemicals can affect the environment and human health. Answers may be that toxic chemicals are sources of pollution that get into our air, water and food and then into our bodies.

Explain to the students that there are three major pathways through which toxic chemicals can get into our body: ingestion (through the mouth), inhalation (through the lungs), and absorption (through the skin). Everyday we inhale oxygen in the air we breathe, however we may also inhale things that are bad for us, like toxic chemicals and air pollution. These toxic chemicals pass through our lungs into our bloodstream.

An example is someone using a spray cleaner to clean the kitchen counters. When sprayed, the chemical cleaner can get into the air and be breathed in. It can also get onto a person's skin. We can also absorb toxic substances through our skin. Some chemicals can destroy skin cells causing rashes and burns and some can even enter our bloodstream by passing through the skin. It is also possible that some of the chemical can get into our food (since it is being sprayed in the kitchen) and accidentally get eaten with the food.

Show students how something can be absorbed, ingested, or inhaled. Ask students to think of how one of the chemicals on their hazardous household chemicals checklist might get into their bodies if they used it at home. Have students share their ideas with the class.

Pathways Demonstration

Explain to students that they will participate in an activity that will show them how a hazardous chemical can get onto their hands, into their food and possibly into their bodies without their knowledge.

Before class, set up three identical workstations (A, B and C) that has a drinking cup, a napkin, a carrot, a fork and a pen.

At the start of the activity, invite three students to participate in the demonstration. Ask the three students to come to the front of the class. Explain to the class that the three students have just finished helping their parent fertilizer the lawn. Tell the class that one of the students was wearing gloves while working in the yard. Ask one student (student C) to put on a pair of plastic, disposable gloves. Then instruct each student to put some lotion (which will fluoresce under a black light) on his or her hands.

Explain to the class that this lotion represents the fertilizer that they were spreading on the lawn. The student with the gloves on will put some lotion on the gloves.

One by one, read a set of instructions to each student and have them follow them exactly. Ask the class to keep track of the differences between the three sets of instructions. The student with gloves must be given instructions C. *(See instructions A, B and C below).* At the end of the demonstration, ask each of the students to use the black light to view their workstation, their hands, their face and the items on their work station to see how much fertilizer (fluorescent lotion) got onto their food and body.

Instructions A.

It is time to have a snack. I want you to follow these instructions exactly.

1. Pick up the cup.
2. Take a sip from the cup.
3. Wipe your mouth with your hand.
4. Pick up the carrot with your hand.
5. Take a bite of the carrot.
6. Wipe your mouth with your hand.
7. Wipe your hands on your napkin.

Instructions B.

It is time to have a snack. I want you to follow these instructions exactly.

1. Go to the sink and wash your hands with soap and water.
2. Dry your hands.
3. Go back to your workstation.
4. Pick up the cup.
5. Take a sip from the cup.
6. Wipe your mouth with your napkin.
7. Use your fork to pick up your carrot.
8. Take a bite of the carrot.
9. Wipe your mouth with your napkin.
10. Wipe your hands on your napkin.

Instructions C.

It is time to have a snack. I want you to follow these instructions exactly.

1. Take off your gloves.
2. Pick up the cup.
3. Take a sip from the cup.
4. Wipe your hands on your napkin.

After the demonstration, ask students how a hazardous chemical might get into their bodies while they are using it. Answers include 1) through accidental ingestion, 2) inhalation, or 3) skin contact. Ask the class to identify the workstation which is most contaminated with fertilizer (fluorescent lotion). Ask them to explain why one workstation was more contaminated than the other was. Based on their observations, ask them to identify things they can do to avoid getting hazardous chemicals on their hands, skin, and food and into their bodies. Answers might include wearing gloves when using toxic chemicals, washing hands before eating, using nontoxic alternatives to toxic chemicals or not using them at all, and using hazardous chemicals outdoors or in the garage.

Closure

Non-toxic alternatives activity

Ask students to come up with alternatives to hazardous household chemicals. They can brainstorm in groups or ask an adult (their parents or grandparents may be good sources). Hand out the information sheet *Non-Toxic Alternatives to Hazardous Household Chemicals*. Ask the students if any of them use any of the alternatives on the list and challenge them to try some of the alternatives to test how well they work.

Toxic chemicals beyond the home

Ask students to list five places that they might find toxic chemicals besides in their homes. Sources of toxic chemicals might include the school cleaning closet, the chemistry classroom, a local industrial site or factory, or a grocery store cleaning product aisle. Challenge students to think of ways that they can reduce contact with or use of toxic chemicals in their lives.

Additional Resources

Glitterbug® Potion fluorescent lotion can be ordered from:

Brevis Corporation
225 West 2855 South
Salt Lake City, Utah 84115
Phone: 1-800-383-3377
http://www.brevis.com/

Household Hazardous Chemicals Checklist

Before starting, ask your parent to help you look through your house to find the products that are used in each of the following areas. Read the label and look for words like **Corrosive, Flammable, Explosive, Toxic, Poison, Danger, Hazardous, Caution,** and **Warning**. These words are clues that the product is hazardous. If the product is hazardous, put a check in the blank to the left of the item. Circle products that you use.

KITCHEN	BATHROOM
_____Oven cleaner	_____Tub or tile cleaner
_____Floor cleaner & wax	_____Drain cleaner
_____Ammonia	_____Toilet bowl cleaner
_____Scouring powder	_____Medicine
_____Bleach	_____Air freshener
_____Other	_____Nail polish remover
	_____Other
LIVING ROOM	**GARAGE, BASEMENT, SHED**
_____Rug cleaner	_____Oil
_____Furniture polish	_____Antifreeze
_____Air freshener	_____Gasoline or other fuel
_____Other	_____Paint
	_____Varnish
LAUNDRY ROOM	_____Glue
_____Bleach	_____Paint thinner
_____Spot remover	_____Moth balls
_____Detergent	_____Other
_____Other	
GARDEN, LAWN	**OTHER PLACES & ITEMS**
_____Weed killers	
_____Bug killers	
_____Fertilizers	
_____Other	

*Adapted from: BAGS, BEAKERS, AND BARRELS: An Action Curriculum Toward Resolving Hazardous Materials. Industrial State Policy Center and the School of Natural Resources of Michigan, Cleveland, Ohio: 1987.

Non-Toxic Alternatives to Hazardous Household Chemicals

Did you ever wonder what people used before fancy household cleaners were invented? Like, what did your great-great-grandparents use to clean out a clogged drain? Maybe they used some of the cleaning concoctions below. They may take a little more elbow grease and might seem kind of goofy, but they are better for your health and for the environment than some other household chemicals. Remember to use caution even when using "less-toxic" chemicals.

FOR THIS	TRY THIS
Ants in the house	Red chili powder at point of entry, seal off entry
Brass polish	Salt and vinegar or Worcestershire sauce
Carpet cleaner (to remove fresh food stains)	Club soda
Chrome polish	Cider vinegar
Copper cleaner	Lemon juice with a little salt
Disinfectant	Pine oil or dilute chlorine bleach solution
Drain cleaner	1/2 cup baking soda, 1/2 cup vinegar and 2 quarts boiling water
Fertilizer	Compost your fruit and vegetable scraps
Furniture polish	1 tablespoon lemon oil in 1 pint mineral oil
Hand cleaner (to clean off paint or grease)	Baby oil
Floor cleaner	1 cup white vinegar mixed with 2 gallons water
Mosquito repellent	Cedar chips or Citronella candles
Oven cleaner	For baked-on spills, use 2 tablespoons soap plus 2 tablespoons borax plus warm water and steel wool
Paint: oil-based, stains, and sprays	Water-base, non-aerosol paints
Rust stain remover (to get stains out of clothing)	Lemon juice and salt plus sunlight
Clear shoe polish	Banana peel
Silver polish	1 quart warm water, 1 tablespoon baking soda, a piece of aluminum foil and 1 tablespoon salt
Spot remover	Club soda, lemon juice and salt
Window cleaner	2 tablespoons vinegar mixed in 1 quart water

Source: Sally McDole, WSU-Cooperative Extension, Jefferson County, Washington

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Identifying Pathways of Exposure to Toxic Chemicals Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are pathways of human exposure to toxic substances? *(circle all that apply)*

Ingestion	Touching	Inhalation
Observation	Absorption	Qualitative Analysis

2. Which of the following are words or symbols that might indicate that a chemical is hazardous? *(circle all that apply)*

Skull & crossbones symbol	Flammable	Explosive
Child & pet friendly	Mr. Yuck symbol	Corrosive
Caution	Warning	Danger
Made from recycled materials		

3. Which of the following are ways to avoid/reduce exposure to hazardous chemicals? *(circle all that apply)*

Eating at your workstation	Washing your hands often
Move from one workstation to another	Drinking often at your workstation
Wearing safety goggles	Working without gloves

4. What is an alternative to using drain cleaner? _____
   _____

5. What is an alternative to using window cleaner? _____
   _____

6. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Identifying Pathways of Exposure to Toxic Chemicals Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the pathways of exposure to toxic chemicals and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel the students learned how to limit their exposure to toxic chemicals?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Hazardous Substance Exposure and Treatment Simulation

Grades

Secondary

Subjects

Science, Drama, Health

Type of Lesson Plan

Project

Suggested Duration

Depends on teacher's schedule

Materials

- Left up to the students

Objectives

TLW…

- Perform research on the exposure pathways, health effects, and treatment of patients exposed to hazardous substances.
- Work with a group to develop a script, action, and props for a simulated treatment of a patient or patients exposed to a hazardous substance.

Set

Show clips from any number of syndicated medical/hospital dramas of a treatment scenario, preferably one dealing with hazardous materials exposure.

Have the students identify the elements that make the scene believable/unbelievable.

Instructional Input

Scenes like these can be believable if people put enough research into the actual facts of the situation they are trying to create. Writers for these hospital dramas do not simply make up scenes without any input. They have access to real medical professionals as advisors. They also research their topics before trying to film them for an audience.

Your task is to develop a scene, a mock response to a hazardous substance exposure event. The event can be a serious medical emergency for an individual or a group of individuals. It could also be a simulation of a simple doctor's visit. As long as the scene focuses on an exposure to a

hazardous substance, the health impacts of the exposure, and the medical treatment following the exposure.

The purpose of this exercise is to educate yourselves and your classmates about exposure pathways, health effects of, and treatment of a hazardous substance exposure.

See "Hazardous Substance Poster" (lesson # 9) and "Develop an Educational Brochure" (lesson # 21) lesson plans for ideas on how to introduce students to hazardous substances, their health effects, and treatment of people who have been exposed to hazardous substances.

Your task is to develop a script and act it out in front of the class, or film it on location and show the tape to the class. The scene will deal with an exposure of a patient or patients to a hazardous substance, the patient's symptoms and health impacts as a result of the exposure, treatment, and prognosis for recovery.

Your cast of characters should include a patient(s), witnesses if appropriate, and medical professionals (doctors, nurses, paramedics, and ER staff). Your set, location, and costumes are up to you. You are required to hand in a complete script along with your performance.

Remember that the goal is to educate your audience about the implications of exposure to the hazardous substance you choose. Your performance could save a life!

Evaluation

Unlike the other lesson plans in this series, a rubric will not be provided for this lesson. It will be up to the individual teacher to develop evaluation for this lesson.

Closure

Discuss what worked and what did not in each scene as well as ways to improve it. Did students gain an appreciation for the health challenges posed by exposure to hazardous substances?

Resources

Provide the students with the following links as research sources:

Excellent links to many hazardous substances identified by the EPA.
http://www.epa.gov/ebtpages/pollutants.html

ATSDR's ToxFAQs – extensive fact sheets on many hazardous substances.
http://www.atsdr.cdc.gov/toxfaq.html

United States National Library of Medicine. Health effects and treatment for exposure to hazardous substances.
http://www.nlm.nih.gov/pubs/factsheets/hsdbfs.html

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Hazardous Substance Exposure and Treatment Simulation Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are routes of human exposure to toxic substances? *(circle all that apply)*

Ingestion	Touching	Inhalation
Observation	Absorption	Qualitative Analysis

2. Which of the following are words or symbols that might indicate that a chemical is hazardous? *(circle all that apply)*

Skull & crossbones symbol	Flammable	Explosive
Child & pet friendly	Mr. Yuck symbol	Corrosive
Caution	Warning	Danger
Made from recycled materials		

3. Give one example of how exposure to a hazardous substance may harm a person?
   _____
   _____
   _____

4. What is an alternative to using drain cleaner? _____
   _____

5. What is an alternative to using window cleaner? _____
   _____

6. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Hazardous Substance Exposure and Treatment Simulation Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand implication of exposure to hazardous substances and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand how people are exposed/treated for hazardous substances?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Health Effects of Sulfur Dioxide

Grades

High School

Subjects

Science (Biology, Chemistry) and Health

Type of Lesson Plan

Lab

Suggested Duration

Day one – 20- 30 minutes
5 – 10 minutes on successive days
Final day – 20 minute wrap up

Materials

- *Plant Observation Sheet*
- *Sulfur Dioxide Fact Sheet*
- *Health Effects of Sulfur Dioxide Worksheet*
- Large clear plastic bag
- Tape
- 2 Green plants in a pot (small)
- Small beaker (50-100 ml)
- Sodium nitrate (2g)
- Sulfuric acid (5%)

Objectives

TLW…

- Observe the effects of sulfur dioxide gas on plant life.
- Be able to understand the potential health effects of sulfur dioxide on humans.
- Be able to obtain information from a government agency fact sheet.

Instructional Input

Sulfur dioxide has adverse health effects on plants and animals. This demonstration will expose a plant to a high concentration of sulfur dioxide gas in a closed container for a brief period of time. This is known as an acute exposure (an exposure to a chemical over a short period of time, generally less than 2 weeks) as opposed to a chronic exposure (an exposure to a chemical over a long period of time, generally a year or more).

It is important to distinguish between acute and chronic exposures. The two types of exposures generally involve different concentrations of chemical exposure as well as differing health effects.

Since the plant will be acutely exposed to a high concentration of sulfur dioxide gas, the effects on the plant will be rapid and severe. This experiment involves toxic sulfur dioxide gas. Teachers should complete this experiment as a demonstration, rather than allowing the students to perform it. Teachers should use a vent hood or conduct the demonstration outside.

PROCEDURE

1. Allow the students to make observations of the plant before placing it in the bag.
2. Place 2 grams of sodium nitrate in the small beaker.
3. Place the beaker and the potted plant inside the plastic bag.
4. Add 2 ml of 5% sulfuric acid to the small beaker and seal the bag shut with the tape.
5. If sulfur dioxide gas leaks from the bag, you will notice a rotten egg smell. Move the students away from the bag until the reaction is complete.
6. Leave the plant in the closed bag for at least 10 minutes.
7. Cut the bag open and allow the gas to disperse.
8. After the plant has aired out, take it back to the classroom.
9. Be sure to wash your hands.
10. Allow the class to make observations of the plant after it has aired out on their *Plant Observation Sheet*. Have them compare it to their initial observations and make note of any changes. Repeat the observation and recording over the next few days. Use the unexposed plant as a comparison.

Evaluation

Make sure the students note the color, leaves, and overall appearance of the plant compared with the health of the unexposed specimen. What do they think might have happened to the plant if it had been exposed to a smaller dose over a longer period of time? Ask the class if they think sulfur dioxide gas might cause adverse health effects in humans.

Guided Practice

Hand out the *Sulfur Dioxide Fact Sheet*. Allow students time to read through it on their own, or read through it as a class. Solicit reactions about the potential health effects and sources of sulfur dioxide. Next, hand out the *Health Effects of Sulfur Dioxide Worksheet*.

Correct the *Health Effects of Sulfur Dioxide Worksheet* as a class, or have the students hand them in. Go over the answers in detail, pointing out the location of the answer within the text of the fact sheet.

Extended Practice

If you want to spend more time on this subject, you could prepare and administer a brief quiz, or have the students react to the lesson in their daily journals.

Closure

Sulfur dioxide is a toxic substance. The main sources of sulfur dioxide are related to combustion. How can sulfur dioxide emissions be reduced? What are some alternatives to creating sulfur dioxide?

Plant Observation Sheet

Name_____

Please fill out the table according to your observations. You may wish to make sketches in the boxes or on the back. Keep track of this observation sheet; you will need it over the next few days.

	color	leaves	stem	overall
Before exposure				
After exposure				
One day after exposure				
Two days after exposure				
Three days after exposure				

Health Effects of Sulfur Dioxide

Name_____ Date_____

Give a physical description of sulfur dioxide.

Sulfur dioxide, when combined with moisture can form _____ _____.

About _____ of all the sulfuric acid in the atmosphere is caused by humans.

List at least 4 sources of sulfur dioxide.

_____ _____

_____ _____

In sentence form and in your own words, describe how people are exposed to sulfur dioxide.

List four health effects caused by a short-term (a few minutes) exposure to sulfur dioxide.

_____ _____

_____ _____

When sulfur dioxide combines with moisture in your lungs, it can form _____ _____.

List four health effects caused by long-term exposure to sulfur dioxide.

_____ _____

_____ _____

List four groups of people who may be more sensitive to sulfur dioxide than others.

_____ _____

_____ _____

Health Effects of Sulfur Dioxide

Name_____**KEY**_____

Give a physical description of sulfur dioxide.

Sulfur dioxide can be found as a liquid or a gas. It is colorless with a strong odor.

Sulfur dioxide, when combined with moisture can form **_sulfuric_ __acid__**.

About **__one third_** of all the sulfur compounds in the atmosphere is caused by humans.

List at least 4 sources of sulfur dioxide.

- **Burning fossil fuels**
- **Fertilizer manufacturers**
- **Wood and paper mills**
- **Metal smelters**
- **Refineries**
- **Power plants**

In sentence form and in your own words, describe how people are exposed to sulfur dioxide.

If people breathe air with sulfur dioxide in it, they may be exposed.

List four health effects caused by a short-term (a few minutes) exposure to sulfur dioxide.

- **Difficulty breathing**
- **Irritation of the nose, throat, lungs**
- **Coughing**
- **Shortness of breath**
- **Fluid in lungs**
- **Forms sulfuric acid in lungs**

When sulfur dioxide combines with moisture in your lungs, it can form **__sulfuric__ __acid_**.

List four health effects caused by long-term exposure to sulfur dioxide.

- **Temporary loss of smell**
- **Headache**
- **Nausea**
- **Dizziness**
- **Irritation of lungs**
- **Phlegm**
- **Coughing**
- **Shortness of breath**
- **Bronchitis**
- **Reduced fertility**

List four groups of people who may be more sensitive to sulfur dioxide than others.

- **Children**
- **Elderly**
- **People with asthma**
- **People with chronic lung disease**
- **People with cardiovascular diseases**

January 2008

IDAHO DEPARTMENT OF HEALTH & WELFARE

Bureau of Community and Environmental Health

Sulfur Dioxide Fact Sheet

What is it?

Sulfur dioxide (SO_2) is considered a pollution problem worldwide. SO_2 is a colorless gas or liquid with a strong odor, which affects the human respiratory system and aggravates cardiovascular disease. When SO_2 combines with moisture in the atmosphere, it can form sulfuric acid. Sulfuric acid is the main component of acid rain. Acid rain can harm humans, animals, vegetation, and can erode buildings, statues, and other structures.

Where does it come from?

Human beings cause the release of about one-third of all sulfur compounds in the atmosphere. SO_2 is released when fossil fuels are burned (coal, oil, gasoline, and diesel fuel). Most SO_2 is caused by stationary sources such as fertilizer manufacturers, power plants, refineries, wood and paper mills, metal smelters, and other industrial processes.

How can a person be exposed?

Exposure to SO_2 happens when people breathe in SO_2 fumes from the air. Living next to industries that generate SO_2 will greatly raise a person's risk of exposure.

What are the effects of SO_2 on human health?

Healthy people exposed to 1.5 parts per million (ppm) of SO_2 for a few minutes may have temporary difficulty breathing normally. Breathing SO_2 can irritate the nose, throat, and lungs causing coughing and shortness of breath. A brief exposure to higher concentrations of SO_2 (400 ppm) can cause severe shortness of breath and a build-up of fluid in the lungs (pulmonary edema, a medical emergency). SO_2 can go deep into the lungs where it combines with moisture to form sulfuric acid, possibly causing permanent lung damage.

Long term exposure to SO_2 at lower concentrations can cause temporary loss of smell, headache, nausea, and dizziness. SO_2 can irritate the lungs causing phlegm, coughing, shortness of breath, development of bronchitis and other respiratory diseases, as well as aggravation of existing cardiovascular disease. Long term exposure to SO_2 may also decrease fertility in males and females.

Who is most sensitive to SO_2?

Because children breathe in more air for their body weight than adults do, children can be more sensitive to the effects of SO_2 than adults. Long term exposure to SO_2 can change a child's ability to breathe deeply. Increased respiratory illness, wheezing fits, and respiratory related emergency room visits are possible effects of long term exposure to SO_2 for children.

Individuals with asthma, the elderly, and those with cardiovascular or chronic lung disease (bronchitis, emphysema) are also sensitive to the effects of SO_2. In fact, these people may be sensitive to lower concentrations of SO_2 than healthy people.

When may levels of SO_2 be unhealthy?

The Idaho Department of Environmental Quality (IDEQ) announces air quality advisories when levels of pollution could possibly harm human health. These advisories are more common in the winter months when weather inversions occur. During inversions, air pollution is trapped close to the ground and can not escape to the upper atmosphere. The longer the inversion lasts, the more concentrated the pollution becomes potentially reaching unhealthy levels.

How can I protect myself from exposure to unhealthy levels of SO_2?

Listen for air quality advisories from the IDEQ. Local TV news stations, radio stations, and newspapers will carry advisories. You can also visit the IDEQ daily report web site at http://www.deq.state.id.us/air/air1.htm.

When levels of SO_2 are high, avoid moderate exercise and stay indoors. This is especially important for sensitive people. The American College of Sports Medicine defines moderate exercise as any activity level which maintains 55-75% of a person's maximum heart rate. To calculate the heart rate you need to stay below to avoid moderate exercise, subtract your age from 220 and multiply by 0.55 ([220 – age] x 0.55).

For more information:

The Bureau of Community and Environmental Health (BCEH), Idaho Division of Health, works to protect human health from dangerous substances in the environment. This fact sheet has been created to assist you in understanding what effects exposure to SO_2 can have on human health. For further information about the Bureau, hazardous waste sites, and dangerous substances, contact:

Bureau of Community and Environmental Health (BCEH)
Environmental Health Education and Assessment
450 W. State St. 6th Floor, Boise, Idaho 83720-0036
Toll Free: 1-866-240-3553
(208) 334-5508
BCEH@dhw.idaho.gov

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Health Effects of Sulfur Dioxide Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are sources of Sulfur Dioxide? *(circle all that apply)*
   Burning fossil fuels Power plants Grocery store waste
   Wood & paper mills fertilizer manufacturers
   Lawn waste (cut grass and tree limbs)

2. Which of the following are short-term (a few minutes) health effects of sulfur dioxide exposure? *(circle all that apply)*
   Irritation of the eyes Coughing Shortness of breath
   Fluid in lungs Diarrhea Vomiting
   Irritation of the nose

3. Which of the following are groups of people who may be more sensitive to sulfur dioxide than other groups of people? *(circle all that apply)*
   People with Asthma Children Teens
   People with chronic lung disease Elderly Middle aged adults

4. When sulfur dioxide combines with fluid in your lungs, it can form _____?

5. Do you think this activity was fun?
   No Neutral Yes Comments: _____
   1 2 3 4 5 _____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Health Effects of Sulfur Dioxide Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the potential health effects of sulfur dioxide and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand the effect of sulfur dioxide on plant life?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned how to obtain more information about sulfur dioxide from fact sheets?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Chemicals in Drinking Water

Grades

High School

Subjects

Science (Chemistry)

Type of Lesson Plan

Lab

Suggested Duration

Two class periods

Materials

- "Drinking water" solution
  - Distilled water
  - NaCl – to represent a contaminant
  - Other non-hazardous soluble elements or inorganic compounds as you choose
- Graduated cylinders
- Burners or hot plates
- Ring stands if using burners
- Matches if using burners
- Oven or dehydrator
- 1,000 ml beakers
- 250 ml beakers
- tongs
- hot pads
- scales
- EPA's MCL list (http://www.epa.gov) or (http://www.epa.gov/safewater/mcl.html) overhead, focus on inorganics
- Copies of lab sheet
- Overhead of Consumer Confidence Report from your Public Water System

Objectives

TLW…

- Separate contaminants from a "drinking water" solution and accurately determine the mass of the contaminant per unit volume of water.
- Compare the concentration of their contaminant to the EPA drinking water standards in order to determine if the contaminant poses a threat to human health.
- Explain the adverse health effects of their contaminant, as well as sources for the contaminant.
- Identify and understand methods of treating or removing the contaminant from drinking water.

Set

One option for an introduction to this lesson is a field trip to a water treatment plant (preferably drinking water, but wastewater is valuable as well). Alternatively, a visit to an analytical laboratory could be substituted. An additional realistic introduction to this lesson would be to invite an analytical chemist as a guest lecturer.

Have the students pick up and preview a lab sheet as they enter the class.

Ask the class to hold up their hands if they think their drinking water is safe for consumption. Ask those that do not raise their hands why they think the drinking water in your town may not be safe. Many will respond that the water contains various types of pollution. Ask them if they know of any specific pollutants that might be in drinking water and if they know the sources of the pollution. Ask if drinking water must be totally absent of contaminants in order to be considered safe.

Show the overhead of the EPA's MCLs for drinking water. Point out the extremely small quantities of contaminants that can be present in water, for it to be considered unsafe to drink. Inform the student that they will be engaged in a lab designed to test the quality of a hypothetical sample of drinking water.

Instructional Input

Go over the lab procedure with the students.

Conduct the lab.

See "Closure."

Guided Practice

See the lab sheet.

Evaluation

See the lab key. You may assign point values as you see fit.

Closure

Obtain a copy of the Consumer Confidence Report from your local Public Water System. Analyze the report with the class (overhead) and compare the results of water sample analysis with the EPA Drinking Water Standards. Discuss any areas of potential concerns or MCL violations. What are some of the potential contaminant sources, health effects of contaminants in your drinking water, and treatment methods for any contaminants in your water? (http://www.cyber-nook.com/water/concerns.html is a good place to start to identify treatment methods)

Resources

1. Fill an appropriate number of 1,000-ml beakers with 1,000 ml of distilled water. The number of beakers should equal the number of lab groups you will have in your class. Label each beaker with a unique code.
2. Measure out a given amount of "contaminant" and dissolve in the beaker of water. Make sure you keep a table of beaker codes, concentration of contaminant (mg/L), and the type of contaminant you are simulating for each beaker.
3. Cover to prevent evaporation if leaving over night.
4. Make sure you have the requisite sets of lab materials (see lab sheet)

Most scales available to schools will not be sensitive enough to measure milligrams of the solutes you add to the water. I suggest using 0.5 g or more of solute (NaCl or sugar works well) if your scales can accurately and precisely measure this amount. **Do not merely use your school's tap water!** Your equipment will not be sensitive enough to measure any contaminants that might be present.

Keep in mind that the students will take the tare mass of their empty beakers, pour in the "drinking water," and boil the water. **Be careful not to boil all the water out.** This could cause the beaker to break. Instead boil the water until there is a very small amount left and place the beaker in the oven or dehydrator overnight. The remaining water will evaporate. The following day, weigh the beaker and contaminant in order to determine the mass of the contaminant before calculating its concentration in the water. Of course the concentration will be many orders of magnitude higher than what would normally be found in safe, and even unsafe, drinking water. This is addressed in the follow up lab questions. The solute/contaminant you use is up to you; you may even want to use different kinds. The important thing to remember is that you are simulating actual drinking water contaminants. It would not be safe to use mercury, lead, or arsenic; consequently it is suggested that teachers substitute safer contaminants. These substitutions will represent the more dangerous contaminants found in drinking water.

"Chemicals in Drinking Water" Lab

Name_____Period_____Date_____

Materials

- "Drinking water" solution in a 1,000 ml beaker
- Empty 250 ml beaker
- Burners or hot plates
- Ring stands if using burners
- Matches if using burners
- Tongs
- Graduated cylinder
- Hot pads
- Scale
- Calculator
- Safety goggles

Procedure

1. Using a graduated cylinder, collect 100-ml beaker of "drinking water" from one of the 1,000-ml beakers. Record the type of contaminant in your water in Table 1.
2. Collect a 250-ml beaker and measure its mass using a scale. Record its mass in Table 1.
3. Carefully pour all of the drinking water into the empty beaker. Be careful not to spill.
4. Place the beaker with the drinking water on the hot plate or ring stand.
5. Turn the hot plate control knob to the setting provided by your teacher. If using a burner and ring stand, light your burner and set the flame to the level your teacher shows you.
6. Allow the water to come to a light boil. DO NOT allow your water to boil vigorously as you will loose some of your contaminant to splattering.
7. Begin working on questions 1,2,7,8 and Extra Credit while monitoring your solution.
8. When very little water is left, turn off your hot plate or burner.
9. Using a hot pad or tongs, carefully move your beaker and place it in the oven or dehydrator overnight.
10. The following day, place the beaker on the scale and record the mass of the beaker and contaminant in Table 1.
11. Calculate the mass of the contaminant and record the amount in Table 1.
12. Calculate the concentration of your contaminant and record the results in mg/L in Table 1.
13. **SHOW YOUR WORK** to the right of Table 1.

Table 1

Contaminant	
Mass of empty 500-ml beaker in **g**	
Mass of beaker and Contaminant in **g**	
Mass of the contaminant **in mg (pay attention to units)**	
Volume of drinking water in **L**	**0.1 L**
Concentration of the Contaminant in **mg/L**	

Questions Name_____ Period_____ Date_____

1. What was your contaminant? _____

2. Check the EPA Drinking Water Standards and record the Maximum Contaminant Level (MCL) for your contaminant.
   _____

3. What was the concentration of your contaminant in your drinking water? _____mg/L

4. Does this concentration exceed EPA Drinking Water Standards? YES or NO

5. If your concentration is above the MCL, by how much is the MCL exceeded?
   _____mg/L

6. Look at the amount of contaminant in your beaker and compare that with the mass. Now consider the MCL for your contaminant. What does this tell you about the EPA Drinking Water Standards?

7. What are the health effects of your contaminant?

8. What are some of the sources of your contaminant? (Where does is come from?)

Extra Credit:

How can drinking water be treated to remove this contaminant? Cite your source.

"Chemicals in Drinking Water" Lab Name__**Example Key**___Period__

Materials

- "Drinking water" solutions in a 1,000 ml beaker
- Empty 250 ml beaker
- Burners or hot plates
- Ring stands if using burners
- Matches if using burners
- Tongs
- Hot pads
- Scale
- Calculator
- Safety goggles

Procedure

1. Using a graduated cylinder, collect 100 ml of "drinking water" from one of the 1,000 ml beakers. Record the type of contaminant in your water in Table 1.
2. Collect a 250-ml beaker and measure its mass using a scale. Record its mass in Table 1.
3. Carefully pour all of the drinking water into the empty beaker. Be careful not to spill.
4. Place the beaker with the drinking water on the hot plate or ring stand.
5. Turn the hot plate control knob to the setting provided by your teacher. If using a burner and ring stand, light your burner and set the flame to the level your teacher shows you.
6. Allow the water to come to a light boil. DO NOT allow your water to boil vigorously as you will loose some of your contaminant to splattering.
7. Begin working on questions 1, 2, 7, 8, and Extra Credit while monitoring your solution.
8. When very little water is left, turn off your hot plate or burner.
9. Using a hot pad or tongs, carefully move your beaker and place it in the oven or dehydrator overnight.
10. The following day, place the beaker on the scale and record the mass of the beaker and contaminant in Table 1.
11. Calculate the mass of the contaminant and record the amount in Table 1.
12. Calculate the concentration of your contaminant and record the results in mg/L in Table 1.
13. **SHOW YOUR WORK** to the right of Table 1.

Table 1

Contaminant	*Chromium (Cr)*
Mass of empty 250-ml beaker in **g**	100 g
Mass of beaker and Contaminant in **g**	100.42 g
Mass of the contaminant **in mg (pay attention to units)**	420 mg
Volume of drinking water in **L**	**0.1 L**
Concentration of the Contaminant in **mg/L**	4200 mg/L

Questions KEY

1. What was your contaminant? ____**Chromium**_____

2. Check the EPA Drinking Water Standards and record the Maximum Contaminant Level (MCL) for your contaminant.

   ____**0.1 mg/L**_____

3. What was the concentration of your contaminant in your drinking water? _**4200**____**mg/L**

4. Does this concentration exceed EPA Drinking Water Standards? **YES** or NO

5. If your concentration is above the MCL, by how much is the MCL exceeded?
   __**4199.9_mg/L**

6. Look at the amount of contaminant in your beaker and compare that with the mass. Now consider the MCL for your contaminant. What does this tell you about the EPA Drinking Water Standards?

   The amount of contaminant left in the beaker appeared to be very small. It looked like a residue or film. Since the contaminant in out water was 420,000 times the MCL, it is obvious that the Drinking Water Standards are very strict. They do not allow for much contamination at all.

7. What are the health effects of your contaminant?

   According to the National Primary Drinking Water Regulation, if the MCL for chromium in my drinking water was exceeded for many years, I could develop allergic dermatitis.

8. What are some of the sources of your contaminant? (Where does is come from?)

   Chromium is found in natural deposits as well as discharge from steel and pulp mills.

Extra Credit

How can drinking water be treated to remove this contaminant? Cite your source.

Activated carbon, ion exchange, and reverse osmosis may be used to treat and remove chromium from drinking water.
http://www.ext.nodak.edu/extpubs/h2oqual/watsys/ae1029w.htm#what

Falls Water Company, Inc. 2006 Drinking Water Report-2005 Sampling Results

Maximum Contaminant Level (MCL): the highest level of a contaminant that is allowed in drinking water.
Action Level (AL): the concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Regulated	MCL	Our Water	Range of Detection	Sample Date	Violation	Typical Source of Contaminant
Total coliform bacteria	**2**	**0-2**	**ND-2**	**Monthly**	**Yes**	**Naturally occurring**
Nitrate as N (ppm)	**10**	**3.4**	**0.94-3.4**	**Dec 2005**	**NO**	**Run off from fertilizer**
Lead (ppb)	**15 AL**	**5**	**ND-5**	**Dec 2005**	**NO**	**Corrosive water & home plumbing**
Copper (ppm)	**1.3 AL**	**0.086**	**0.086**	**Dec 2005**	**NO**	**Corrosive water & home plumbing**
Fluoride (ppm)	**4**	**0.3**	**0.2-0.3**	**Dec 2005**	**NO**	**Naturally occurring**
Barium (ppm)	**2**	**0.2**	**0.2**	**Dec 2005**	**NO**	**Naturally occurring**
Arsenic (ppb)	**50**	**7.2**	**1.7-7.2**	**Dec 2004**	**NO**	**Erosion of natural deposits**

n/a: not applicable; **nd**: not detectable at testing limit; **ppm**: parts per million or milligrams per liter; **ppb**: parts per billion or micrograms per liter

*This is an example only. Each teacher can obtain a drinking water report for their specific city/town from their local water company.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Chemicals in Drinking Water Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following common chemicals in drinking water can cause health effects? *(circle all that apply)*

Nitrates	Copper	Uranium	Sodium
Lead	Pesticides	Mercury	Potassium

2. Which of the following are water treatment methods? *(circle all that apply)*

Coagulation	Sifting	Filtration	Sanitization
Disinfection	Purifying		

3. What are some of the potential health effects for ingestion of contaminated water? *(circle all that apply)*

Bacterial infection Nothing – our bodies adapt
Toxic levels of chemical that may cause death

4. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Chemicals in Drinking Water Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students can identify common chemicals in drinking water which can cause health effects?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students can identify and describe different water treatment methods?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned about potential health effects from ingestion of contaminated water?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

What is a Part Per Million?

Grades

Secondary

Subjects

Science – (chemistry)

Type of Lesson Plan

Lab

Suggested Duration

45 minutes

Materials

- Small paper cups, Styrofoam egg cartons, or small test tubes (7 containers per group)
  Make sure the inside of the containers are white, or in the case of clear containers, place them over white sheets of paper.
- Graduated cylinder
- Test tube rack
- Eye droppers
- Food coloring (blue works best)
- Make an overhead of the *Parts Per Million Comparison Sheet*"
- Consumer Confidence Report from your local Public Water System overhead (one is included if you can not obtain your own)
- Lab sheet copies

Objectives

TLW…

- Observe the difficult to grasp concept of a part per million.
- Understand that very small amounts of pollution (l part per million or less) can cause adverse health effects in humans.
- Appreciate the role chemistry plays in protecting human health.

Set

Bring in a copy of your local public water system's Consumer Confidence Report (mailed out annually and available from your local drinking water supplier) or use the example provided with this activity. Turn the report into an overhead and go through the results with your students. The reports list the chemicals present in your drinking water. These results are generally reported in parts per million or the equivalent milligrams per liter (mg/L). Ask your students to try and visualize a part per million. It is difficult. Show them the *Parts Per Million Comparison Sheet*

overhead. Go through some examples. Now inform the students that they will be going through a lab that will produce 1 part per million of "pollutant" in tap water.

Instructional Input

Place the students in groups of 4, hand out the lab sheet, make the appropriate materials available, and go over the procedure with the class. Allow them to work on the lab. Check their math as you observe their progress. Allow them time to work on the questions before ending the lab. After the lab is over, go over the answers to the lab questions and the follow up questions at the end. Discuss the feasibility of the designed experiments.

Evaluation

Grade the lab sheets individually or as a class as you prefer. A lab key is provided.

Closure

Make sure to discuss the last paragraph on the lab sheet. Many times students question the relevancy of material taught in school. "How does this relate to me?" or "How can I use this in real life?" The ability to grasp the concept of small concentrations is important to understanding the role of environmental contaminants in human health. This lab also shows the importance of chemistry in the protection of human health.

A Part Per Million Lab Sheet

Names_____Period_____Date_____

Obtain the following materials:

- 7 empty containers
- eye dropper
- tap water
- food coloring

Step 1

Place 1 mL of food coloring into one of your empty containers.
Pour some tap water into another of your empty containers.
The food coloring is a 10% solution of dye and water.
How many parts of water are there for every part of dye?

_____ parts of water for every part of food coloring

Step 2

Rinse the eye dropper. Using the eye dropper, place 9 drops of tap water into an empty container, then place one drop of food coloring into this same container. Stir your new solution. Observe the color difference between the 10% food coloring and the solution you just created. You have changed the amount (concentration) of the food coloring. There is 10 times less food coloring per water than there was in the original food coloring solution.

Now there are _____ parts of water for every part of food coloring in your new solution.

Step 3

Rinse the eye dropper. Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is ____ times less food coloring per water in the new solution than there was in the original food coloring solution. There are now _____ parts of water for every part of food coloring in your new solution.

Step 4

Rinse the eye dropper. Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is ____times less food coloring per water in the new solution than there was in the original food coloring solution. There are now _____ parts of water for every part of food coloring in your new solution.

Step 5

Rinse the eye dropper. Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is ____times less food coloring per water in the new solution than there was in the original food coloring solution. There are now _____ parts of water for every part of food coloring in your new solution.

Step 6

Rinse the eye dropper. Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is ____ times less food coloring per water in the new solution than there was in the original food coloring solution. There are now _____ parts of water for every part of food coloring in your new solution.

Answer the questions below in complete sentences.

1. In which step did your solution appear to be clear?

2. Was there still food coloring in the solutions that appeared to be clear? How do you know?

3. Describe an experiment you could use to prove the presence or absence of food coloring in the clear solutions.

The US Environmental Protection Agency has placed a limit of **0.01 parts per million** (or 10 parts per billion) of arsenic in drinking water. That is 1% of the concentration (or 100 times less) of food coloring in your solution in step six! So you see, very small concentrations of pollutants, so small you can't detect them by sight, can cause harm to human health. This is one reason chemical laboratory work is important. Chemistry is used to protect human health.

A Part Per Million Lab Sheet

Names ____KEY_____

Obtain the following materials:

- 7 empty containers
- eye dropper
- tap water
- food coloring

Step 1

Place 1 mL of food coloring into one of your empty containers.
Pour some tap water into another of your empty containers.
The food coloring you added to the water is a 10% solution of dye and water.
How many parts of water are there for every part of dye?

_____**10**_____ parts of water for every part of food coloring

Step 2

Using the eye dropper, place 9 drops of tap water into an empty container, then place one drop of food coloring into this same container. Stir your new solution. Observe the color difference between the %10 food coloring and the solution you just created. You have changed the amount (concentration) of the food coloring. There is 10 times less food coloring per water than there was in the original food coloring solution.

Now there are ___**100**_____ parts of water for every part of food coloring in your new solution.

Step 3

Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is _**100** times less food coloring per water in the new solution than there was in the original food coloring solution. There are now ___**1000**____ parts of water for every part of food coloring in your new solution.

Step 4

Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is **1,000 times** less food coloring in the new solution than there was in the original food coloring

solution. There are now **__10,000__** parts of water for every part of food coloring in your new solution.

Step 5

Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is **10,000 times** less food coloring in the new solution than there was in the original food coloring
solution. There are now **_100,000** parts of water for every part of food coloring in your new solution.

Step 6

Using the eye dropper, place 9 drops of water into another empty container, then place one drop of the solution you created in the previous step into this new container. Stir your new solution. Observe the color difference between your new solution and the one you created in the previous step. You have changed the concentration of the food coloring in the water again.

There is **100,000 times** less food coloring in the new solution than there was in the original food coloring
solution. There are now **_1,000,000** parts of water for every part of food coloring in your new solution.

Answer the questions below in complete sentences.

1. In which step did your solution appear to be clear?

This would certainly occur in step six, possibly earlier depending on observational skills.

2.Was there still food coloring in the solutions that appeared to be clear? How do you know?

There was still food coloring even though it was not visible. The concentration was very low, but it was still there. The food coloring has to be there because no chemical or physical process removed it.

3. Describe an experiment you could use to prove the presence or absence of food coloring in the clear solutions.

The containers could be left out under a heat lamp, causing the water to evaporate. This would leave the food coloring dye behind.

The US Environmental Protection Agency has placed a limit of **0.01 parts per million** of arsenic in drinking water. That is 1% of the concentration (or 100 times less) of food coloring in your solution in step six! So you see, very small concentrations of pollutants, so small you can't detect them by sight, can cause harm to human health. This is one reason chemical laboratory work is important. Chemistry is used to protect human health.

Part Per Million Comparison

One part per million is one minute in two years.

One part per million is one second in 12 days of your life.

One part per million is one penny out of $10,000.

One part per million is one inch out of a journey of 16 miles.

One part per million is approximately one hole in one in 35,000 golf tournaments.

One part per million is approximately one bad apple in 2,000 barrels of apples.

One part per million is one drop of dye in 18 gallons of water.

National Primary Drinking Water Regulations

Inorganic Chemicals	MCL (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Antimony	0.006	Increase in blood cholesterol; decrease in blood glucose	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	0.05	Skin damage; circulatory system problems; increased risk of cancer	Erosion of natural deposits; runoff from glass & electronics production wastes
Beryllium	0.004	Intestinal lesions	Metal refineries and coal-burning factories; discharge from electrical industries
Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; waste batteries and paints
Chromium (total)	0.1	Over many years could experience allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper	1.3	Short term exposure: Gastrointestinal distress. Long term exposure: Liver or kidney damage.	Corrosion of household plumbing systems; erosion of natural deposits

Inorganic Chemicals	MCL (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth.	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Lead	0.015	Infants and children: Delays in physical or mental development. Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and cropland
Nitrate (measured as Nitrogen)	10	"Blue baby syndrome" fatal without immediate medical attention. Infant looks blue and has shortness of breath.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits

Inorganic Chemicals	MCL (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and pharmaceutical companies

Notes

Definitions:

Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are enforceable standards.

Treatment Technique - A required process intended to reduce the level of a contaminant in drinking water.

[2] Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: What is a Part Per Million? Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. If you have a 10% solution of dye and water, how many parts of water are there for every part of dye? _____

2. One part per million is one penny out of $_____ dollars?

3. One part per million is one drop of dye in _____ gallons of water?

4. True or false, 4 parts per million of fluoride has been shown to cause risk to your health like brittle bones. *(circle one)*

5. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: What is a Part Per Million? Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand that very small amounts of pollution can have adverse effects on health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand the role of chemistry in protecting human health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Perceived Versus Actual Risk

Grades

Secondary

Subjects

Science

Type of Lesson Plan

Activity

Suggested Duration

30 – 45 minutes

Materials

- *Understanding Risk* handout
- *Perceived Risk / Actual Risk* handout
- *Actual Risk* overhead

Objectives

TLW…

- Understand the difference between voluntary versus involuntary risk.
- Recognize factors that account for the difference between perceived and actual risk.

Set

Ask students which of the scenarios listed below puts them at greatest risk to their health and safety.

1. Being forced to live in a house located one mile away from a nuclear power plant.
2. Playing with fireworks.

Playing with fireworks is by far more risky than living next to a nuclear power plant. Each year, there are thousands of reported serious injuries in the United States associated with fireworks. To date, only 3 deaths have been attributed to nuclear power plants in North America despite the potential for increased risk of developing cancer. However, many students will choose living next to the power plant as the riskier of the two scenarios. Why? One of the reasons is that playing with fireworks is a voluntary act. Many students will assume that because a choice is involved in the scenario the risk of the action will be reduced. This is not necessarily so as the following exercise will demonstrate.

Instructional Input

Distribute the *Understanding Risk* handout. Allow the class time to read the document and then discuss. Clarify any questions about the risk factors discussed by soliciting examples from the class.

Hand out the *Perceived Risk/Actual Risk* worksheet. Have the students complete the "Perceived Risk" side of the table only and then stop. Once all students have completed the table, determine which actions the class ranked as being the most risky and the least risky (take a hand tally). Next, display the answer key (*Actual Risk*) on the overhead and allow the class to fill in their papers. Allow the class time to compare their perceptions of risk with the actual risk ranking. Ask them to complete the Accept or Reject column and be prepared to share their reasons. Students should pay special attention to the actual risk of an activity before choosing to accept the risk. For instance, many people ride motorcycles. However, would they still choose to do so if they knew the actual risk they were taking? Accepting the risk means continuing the activity with no change in behavior. Rejecting the risk means a person may have to alter their behavior to avoid the risk.

Evaluation

Have students complete the questions on the back of the *Perceived Risk/Actual Risk* sheet.

Closure

Ask students why they would accept or reject certain risks as listed on their sheets. Listen for factors that affect risk perception listed in the *Understanding Risk* handout. Make sure you point those factors out to the class as they come up.

Have students hand in their papers.

Understanding Risk

Probability – The chance of something happening, usually expressed as a fraction or percent. There is never a 0% chance (will never happen) or 100% chance (guaranteed to happen) when we are talking about risks incurred as a result of an action. This is because there is always some amount of uncertainty.

Uncertainty – A lack of knowledge about factors that may affect the outcome of an action.

Risk – The probability that something bad will happen as the result of an action.

Hazard – A measure of the severity of a harmful effect or event.

Exposure – An individual or group's contact with an environmental contaminant. This contact includes ingestion (eating and drinking), inhalation (breathing), and absorption (skin contact).

Dose – The amount of a contaminant that enters the body.

Toxicity – A measure of the ability of a substance to cause adverse health effects.

The risk of suffering an adverse health effect from exposure to an environmental contaminant depends on the exposure, the toxicity of the contaminant, the dose of the contaminant you are exposed to, and personal characteristics. Risk assessors, health assessors, and toxicologists communicate risks in terms of numbers (quantitatively). Below is a probability table displaying how risk can be communicated quantitatively.

Wording	Fraction	Decimal	Percent	Scientific Notation
One in ten chance	1/10	0.1	10%	1×10^{-1}
One in one hundred chance	1/100	0.01	1%	1×10^{-2}
One in one thousand chance	1/1,000	0.001	0.1%	1×10^{-3}
One in ten thousand chance	1/10,000	0.0001	0.01%	1×10^{-4}
One in one hundred thousand chance	1/100,000	0.00001	0.001%	1×10^{-5}
One in a million chance	1/1,000,000	0.000001	0.0001%	1×10^{-6}

In reality, people often do not view risk quantitatively. Often people associate risk with an action depending upon their perceptions. There are many factors which influence how people perceive risk. The following factors often influence the public's perception of risk:

Involuntary versus Voluntary – Most people would not like to be forced to jump off a bridge. However, others pay for the privilege of jumping off bridges when they go "bungee jumping." The first risk would be *involuntary*, while the second is clearly *voluntary*. If there is a choice in the matter, many people perceive an action as having less risk.

Uncontrollable versus Controllable – When people are not in control of an action (chlorination of drinking water), they tend to think the action carries greater risk. However, when they are in control of an action (using a chemical water softening system in their home) they tend to think the action carries less risk.

Natural versus Industrial – Natural risks (hiking on Mt. St. Helens) tend to be viewed as more acceptable than industrial risks (walking next to an oil refinery).

Unfamiliar versus Familiar – People drive cars every day but are extremely fearful of living anywhere near a nuclear reactor even though car accidents kill thousands annually while nuclear reactor accidents have resulted in only 3 deaths in North America.

Uncertain versus Certain – People view a proven health hazard like tobacco as less risky than other less well known chemicals such as dioxin. Tobacco has proven health effects whereas the health effects of dioxin have yet to be fully understood by scientists.

Catastrophic versus Ordinary – Flying in a jet airplane is much less risky than driving in a car. Yet the perception is that flying is more dangerous because when a jet crashes it is a much more catastrophic event in terms of damage and lives lost in a single event.

Fair versus Unfair – People in lower socioeconomic communities who face health risks more than those in more affluent neighborhoods often feel a sense of outrage against the source of the risk, especially if there is no direct benefit to their community from the risk in question. Risk without benefit is seen as unfair.

Untrustworthy versus Trustworthy – A person generally doesn't think twice about drinking water from their tap. However, how would that person feel about drinking a cup of water taken from an open, common well in the middle of a town in a third world country?

NAME_____Period_____Date_____

Fill in the "Perceived Risk" portion of the table below. Assign a risk value to each action, and then decide whether the action was voluntary or involuntary. Do not fill in the "Actual Risk" and "Accept or Reject" portions of the table until your teacher presents the actual risks.

Perceived Risk			**Actual Risk**			
Action	**Risk rank 1 = most risk 15 = least risk**	**Voluntary Or Involuntary**	**Action**	**Risk rank 1 = most risk 15 = least risk**	**Voluntary Or Involuntary**	**Accept or Reject WHY?**
Being struck by a meteorite			Being struck by a meteorite			
Coal mining			Coal mining			
Chlorinated drinking water			Chlorinated drinking water			
Farming			Farming			
Firefighting			Firefighting			
Struck by lightning			Struck by lightning			
Hunting			Hunting			
Living with a cigarette smoker			Living with a cigarette smoker			
Motorcycling			Motorcycling			
Motor vehicle accidents			Motor vehicle accidents			
Playing high school football			Playing high school football			
Sky diving			Sky diving			
Smoking – all health effects			Smoking – all health effects			
Smoking – cancer only			Smoking – cancer only			
Swimming			Swimming			

Questions Name_____Date_____
Each student should share the action they perceived as having the most and the least risk.

Which activity did the majority of the students perceive as the most risky? Why?

How does the perceived risk of this activity compare with the actual risk?

Which activity did the majority of the students perceive as the least risky? Why?

How does the perceived risk of this activity compare with the actual risk?

Look at the results from the Actual risk portion of the table. In general, which risks are larger, those that are voluntary, or those that are involuntary?

Please discuss what is wrong with the argument in the following scenario from a risk assessment perspective: A concerned parent hops in the car with their child. There is an active thunderstorm outside with many flashes of lightning. As they are driving to school an argument ensues over the child's desire to play football. The parent states, "I do not want you to play football because it is too dangerous. There is too much risk involved and you could get hurt. My primary concern is for your safety. Football is not safe, so I don't want you playing. Besides, wouldn't your games interfere with our hunting trips and our country rides on the motorcycle?" The child replies, "Yeah, I guess it would. OK, if you don't think it's safe, I won't play." The child exits the car, unfurling an umbrella. "Put that away," exclaims the parent. "I don't want you to get hit by lightning!"

KEY

Actual Risk			
Action	**Lifetime risk (# of harmful events per million participants)**	**Voluntary Or Involuntary**	**Rank Order 1 = most risk 15 = least risk**
Motorcycling	**20,000**	**Voluntary**	**1**
Smoking – all health effects	**3,000**	**Voluntary**	**2**
Sky diving	**2,000**	**Voluntary**	**3**
Smoking – cancer only	**1,200**	**Voluntary**	**4**
Firefighting	**800**	**Voluntary**	**5**
Coal mining	**630**	**Voluntary**	**6**
Farming	**360**	**Voluntary**	**7**
Motor vehicle accidents	**240**	**Involuntary**	**8**
Swimming	**32**	**Voluntary**	**9**
Hunting	**30**	**Voluntary**	**10**
Living with a cigarette smoker	**10**	**Involuntary**	**11**
Playing high school football	**10**	**Voluntary**	**12**
Drinking chlorinated drinking water	**8**	**Involuntary**	**13**
Struck by lightning	**0.5**	**Involuntary**	**14**
Being struck by a meteorite	**0.00006**	**Involuntary**	**15**

Questions Name **KEY** Date

Which activity did the majority of the students perceive as the most risky? Why?

Answers will vary.

How does the perceived risk of this activity compare with the actual risk?

Answers will vary.

Which activity did the majority of the students perceive as the least risky? Why?

Answers will vary.

How does the perceived risk of this activity compare with the actual risk?

Answers will vary.

Look at the results from the Actual risk portion of the table. In general, which risks are larger, those that are voluntary, or those that are involuntary?

Voluntary risks are by far more risky

Please discuss what is wrong with the argument in the following scenario from a risk assessment perspective: A concerned parent hops in the car with their child. There is an active thunderstorm outside with many flashes of lightning. As they are driving to school an argument ensues over the child's desire to play football. The parent states, "I do not want you to play football because it is too dangerous. There is too much risk involved and you could get hurt. My primary concern is for your safety. Football is not safe, so I don't want you playing. Besides, wouldn't your games interfere with our hunting trips and our country rides on the motorcycle?" The child replies, "Yeah, I guess it would. OK, if you don't think it's safe, I won't play." The child exits the car, unfurling an umbrella. "Put that away," exclaims the parent. "I don't want you to get hit by lightning!"

Driving is more risky than playing football
Hunting is more risky than playing football
Motorcycle riding is more risky than playing football
The child's chance of being struck by lightning is minuscule compared to the risks incurred by riding in a motor vehicle, riding on a motorcycle, or hunting.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Perceived Versus Actual Risk Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which one of the two scenarios puts you at greatest risk to your health?
   Being forced to live in a house located one mile away from a nuclear power plant
   Playing with fireworks

2. Which of the following situations are voluntary? *(circle all that apply)*

Bungee jumping	Being pushed off a bridge	Struck by lightning
Firefighting	Sky Diving	Swimming
Being pushed from a plane		

3. Which of the following situation are involuntary? *(circle all that apply)*

Bungee jumping	Being pushed off a bridge	Struck by lightning
Firefighting	Sky Diving	Swimming
Being pushed from a plane		

4. In general, which risks are larger, those that are voluntary or those that are involuntary?
   _____

5. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Perceived Versus Actual Risk Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of perceived risk versus actual risk?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand how to express risk as a percent/fraction?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Mercury Exposure Investigation

Grades

High School

Subject

Science (Chemistry and /or Biology)

Type of Lesson Plan

Project

Suggested Duration

1-2 class periods

Materials

- Copies of *Mercury Fact Sheet*
- Copies of *Site Map*
- Copies of *Patient Profile*
- Copies of *Investigation Record* worksheet / or transparency for the overhead projector

Objectives

TLW…

- Identify sources of mercury exposure given a map of the exposure area and various patient profiles.
- Appreciate the variety of ways humans can come in to contact with mercury.
- Recognize the symptoms of mercury poisoning.

Set

Hand out the ATSDR *Mercury Fact Sheet.* Discuss what a fact sheet is and how it is useful. Read the fact sheet with the class. Identify main points and important facts relating to mercury.

Instructional Input

Form teams of "medical investigators." Teams should be made up of three to four students.
Hand out or place the site map on the overhead projector.
Hand out the case history and patient profiles and have the teams read through them.
Instruct students to think about likely cases of mercury poisoning and possible sources of exposure. Encourage them to use the site map, case history information, and the patient profile in their decisions.

Hand out the *Investigation Record* worksheet and instruct the students to thoughtfully fill it out. Stress the fact that they need to justify their responses based on knowledge gained from the fact sheet and information from the site map, case history, and patient profile.

Closure

Have each group present and defend their results. Come to a class consensus.

Extended Practice

Have the students respond in essay format to the following questions.

- What should be done about the mercury contamination at this site?
- Assuming there is no money available to clean the site up, how could humans be protected from exposure to mercury?
- Attempting to remove the mercury contaminated sediments around the mine, in the river, and in the reservoir can potentially reintroduce mercury, which was previously buried. How would you justify removing, or not removing this sediment?

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

MERCURY
CAS # 7439-97-6

This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List sites identified by the Environmental Protection Agency.

What is mercury?

(Pronounced mŭr′kyə-rē)

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

- Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.
- Methylmercury may be formed in water and soil by small organisms called bacteria.
- Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

- Eating fish or shellfish contaminated with methylmercury.
- Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fuels.
- Release of mercury from dental work and medical treatments.
- Breathing contaminated workplace air or skin contact during use in the workplace (dental, health services, chemical, and other industries that use mercury).
- Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea,

vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also can pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may be passed from the mother to the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to show whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Case History

Blue River Mine operated as a gold and silver mine for 90 years before closing down operations 20 years ago. The southern portion of the mine site backs up against the Blue River and contains large piles of mining wastes called tailings. The tailings piles have leaked chemicals into the Blue River as well as the groundwater beneath the mine. Mercury is one of the chemicals that is found in the soils around the mine, in the Blue River, and in the groundwater south of the mine.

Ten years ago, Water Town built a dam on the Blue River east of town. Water Town and Dry Town now enjoy inexpensive hydroelectric power as well as recreation on Skinny Reservoir. Over the past ten years, local ecologists have noted an increased number of bear, eagle, owl, hawk, elk, and deer carcasses in the area surrounding the mine, Blue River, and Bird Lake. Biologists and chemists traced the deaths to elevated levels of mercury in the tissues of these animals. Since fish are a main source of food for local predators, the fish populations were tested for the presence of mercury in their tissues. Trout in all the local bodies of water tested positive for unusually high levels of mercury. Bass in Skinny Reservoir contained slightly elevated levels of mercury, while bass in Bird Lake were free of mercury.

Water and sediment samples were collected from Bird Lake, Skinny Reservoir, Blue River, Bird River, and water supply wells. Soil samples were also collected from around the mine. These samples were analyzed by chemists for the presence of mercury. The results are summarized in Table A. Geologists studied the results and determined that the development of the reservoir stirred up sediments in Blue River releasing mercury which had accumulated for 110 years and until recently was buried by sediment. As water from upstream enters the reservoir, it slows down and the mercury falls to the bottom and is covered with sediment and decaying organic matter.

TABLE A

Contaminant	Bird Lake	Bird River	Mine	Blue River	Skinny Reservoir	Well Water
Inorganic Mercury	None	None	High Levels	Moderate Levels	Moderate Levels	Moderate in contaminated wells – see site map.
Methylmercury	None	None	Moderate Levels	High Levels	Low Levels	None

The local wheat field is irrigated with mercury contaminated water. This field supplies the flourmill and bakery in Water Town. This bakery supplies many residents of Water Town with various baked goods. The bakery ships flour and baked goods to communities within a 100 mile radius of water town.

Local health officials have been alerted to the fact that humans could be exposed to mercury through various pathways. Patients admitted to the local hospital are being interviewed to determine if they have been exposed to mercury. Attached is a patient profile sheet for various patients admitted to the hospital in a 24 hour period.

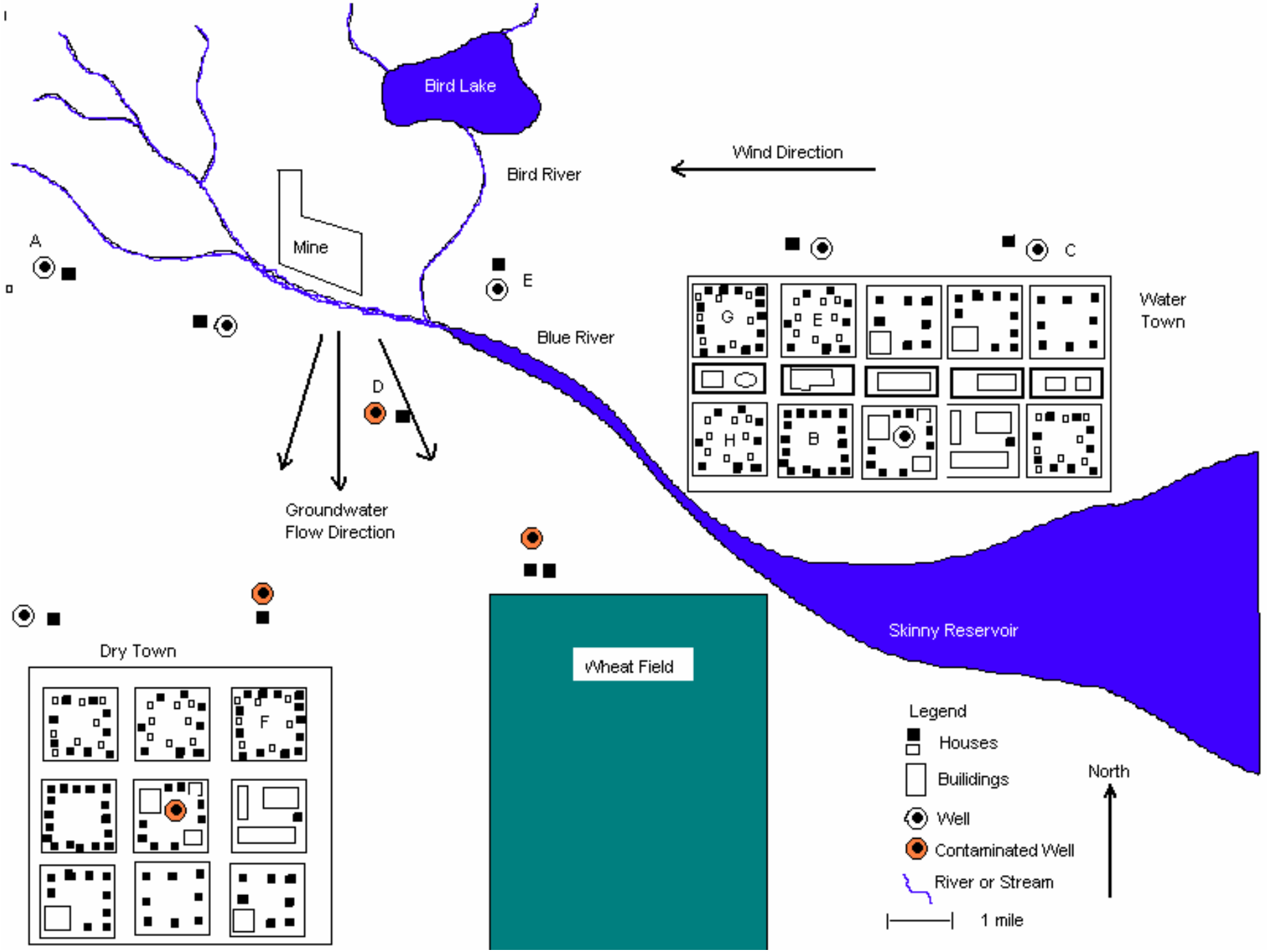
Your task is to identify which patients may have been exposed to harmful levels of mercury, how they may have been exposed, and if other people who share common traits with these patients should be screened for possible mercury poisoning.

Patient Profile – Place of residence is listed on the map according to patient letter.

Patient	Symptoms	Age	Sex	Others in Residence	Occupation	Recreation Activities	Diet	Water Supply
A	Seizures	3 months	M	Mother, Father, two brothers	Infant	None	Breast fed	Domestic well water
B	Chronic fatigue	15	M	Mother, brother, and sister	Student	Baseball, track	Mostly "Junk" food. Few vegetables or fruits	Municipal well water from Water Town
C	Kidney damage, change in vision	50	F	Husband, the last of three children moved out 10 years ago.	Flour Mill worker – 30 years.	Biking, walking the dog, and aerobics	Healthy. Fruits, vegetables, meats (Occasional local fish), lots of baked goods from work	Domestic well water
D	Urination problems	65	M	Wife	Retired teacher	Avid camper, hiker, and hunter – North of Blue River, west of Bird River	Meat and potatoes some fruit and grains. Deer and Elk. No fish.	Domestic well water
E	Coughing and shortness of breath	35	M	Wife and 2 daughters	Auto mechanic	Fishing (bass only) and boating in Bird Lake	Meats, starches, Fruits and vegetables, fish (bass only)	Domestic well water
F	Mood swings, loss of hearing	41	F	Mother, husband, and son	Accountant	Fly fishing (trout) in the blue river and riding jet skis in the reservoir	Healthy. Meats, organic fruits, vegetables, and grains, local trout	Municipal well water from Dry Town well.
G	Acting out in school, memory problems	11	M	Mother, sister	Student	Soccer, skateboarding, building a bmx track near the mine	Meats and starches. Refuses to eat most vegetables. Loves candy	Municipal well water from Water Tow
H	Shaking, socially withdrawn recently	10	M	Mother, Father	Student	Water skiing, bmx, building the track with Patient G	Very healthy. Mother is a nutritionist	Municipal well water from Water Town

Investigation Record NAMES_____Period_____Date_____

Patient	Based on their **symptoms**, do you think this patient was exposed to mercury? Why or why not?	Based on occupation, recreation, diet, water supply, do you think this patient was exposed to mercury? If so, explain **all possible** sources of exposure to mercury for this patient.	Should others in this household be screened for mercury exposure? Why or why not. Keep in mind the possible sources of exposure.
A			
B			
C			
D			
E			
F			
G			
H			


Bird Lake
Bird River
Wind Direction
Mine
A
E
C
Blue River
Water
Town
G
E
H
B
D
Groundwater
Flow Direction
Skinny Reservoir
Dry Town
F
Wheat Field
Legend
Houses
Builidings
Well
Contaminated Well
River or Stream
1 mile
North

Investigation Record NAMES **KEY – other answers on the back**

Patient	Based on their **symptoms**, do you think this patient was exposed to mercury? Why or why not?	Based on occupation, recreation, diet, water supply, do you think this patient was exposed to mercury? If so, explain **all possible** sources of exposure to mercury for this patient.	Should others in this household be screened for mercury exposure? Why or why not. Keep in mind the possible sources of exposure.
A	Yes. Seizures are a symptom of mercury exposure.	Yes. This child was breastfed. If the mother is exposed, she could have passed mercury to her child through breast feeding and in vitro prior to birth.	The whole family should be screened. They live down wind of the site and could be exposed to dust particles containing mercury
B	No. Symptoms don't match mercury exposure.	No. No identifiable exposure from this information.	No. No identifiable exposure from this information.
C	Yes. Kidney damage is a symptom of mercury exposure.	Yes. This patient works at the flourmill and bakery which uses wheat irrigated by mercury contaminated groundwater. Breathing in the flour and eating the baked goods could expose her.	Her husband and children could have been exposed through the baked goods.
D	Yes. Indicates possible kidney dysfunction.	Yes. Ingestion of mercury through consumption of deer and elk flesh. Also, this patient's drinking water well is contaminated with mercury.	The wife should be screened if she consumes elk and deer flesh. Also, this patient's drinking water well is contaminated with mercury.
E	No. Symptoms are not indicative.	No. The patient's well is clean and his activities occur on a clean lake. He consumes fish that is not contaminated with mercury.	No. Same as patient.
F	Yes. Symptoms match those of mercury exposure.	Yes. Dual exposure from trout and water contaminated with mercury.	The entire family should be screened due to dual exposure from trout and water contaminated with mercury.
G	Yes. Symptoms match those of mercury exposure.	Yes. Possible exposure to mine tailings and mercury contaminated soil.	No. No identifiable exposure from this information.
H	Yes. Symptoms match those of mercury exposure.	Yes. Possible exposure to mine tailings and mercury contaminated soil.	No. No identifiable exposure from this information.

Describe any other people in this case that should be screened for mercury exposure. Include the possible sources of exposure involved.

Those to screen next

Flourmill and bakery employees – exposure to contaminated wheat and flour
Consumers of baked goods from the flourmill – exposure to contaminated wheat and flour
Residents of Dry Town who are connected to the contaminated water supply
All residents with contaminated domestic water wells
Residents living west of the mine – exposure to contaminated dust particles blown by the wind
Hunters and fishers and their friends/families that may eat the flesh of fish and game which contains mercury (bass in Bird Lake excluded).
Those recreating around the mine and Blue River – exposure to contaminated soils.
Those consuming exports from the wheat field.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Mercury Exposure Investigation Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are ways one can be exposed to mercury? *(circle all that apply)*
   Breathing contaminated air — Breathing car exhaust
   Ingesting contaminated food or water — Breathing paint thinner
   Having dental and medical treatments

2. Which of the following are forms of mercury? *(circle all that apply)*
   Liquid Gas Solid

3. Which of the following are symptoms of mercury exposure? *(circle all that apply)*
   Seizures — Kidney Damage
   Urination problems — Shaking and socially withdrawn
   Coughing and shortness of breath — Chronic Fatigue
   Memory problems — Loss of hearing

4. Which of the following forms of mercury is the most harmful?
   Gas in the air Mercury in the soil Metallic mercury vapors

5. Do you think this activity was fun?
   No Neutral Yes Comments: _____
   1 2 3 4 5 _____

6. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Mercury Exposure Investigation Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand how mercury gets into our bodies?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel the students learned the symptoms associated with high levels of mercury exposure?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Protesting Pollution Sources

Grades

Secondary

Subjects

Science and English

Type of Lesson Plan

Project

Suggested Duration

Long term assignment + presentation = open time table

Objectives

TLW…

- Conduct independent research to gather information for a group project.
- Identify a local/regional pollution problem and the impact to human health.
- Describe the chemical and biological behavior of the pollution.
- Describe how to protect humans from exposure and how to treat exposed humans.
- Propose solutions/alternatives to the pollution problem in question.

Set

See *Identifying Sources of Pollution* lesson plan # 1 for a good opener.

Instructional Input

Students should be placed into cooperative groups of no more than five students and preferably no less than three.

Students represent a local concerned citizen's group. The citizen's group is concerned with a local/regional pollution problem that is affecting their community.

Students must answer the following:

1. Identify the type of pollution they are concerned with (see the *Identifying Sources of Pollution* lesson plan and modify it for your classroom)
2. Identify the activity (industry, manufacture process, agriculture) that is producing the pollution. Identify all sources in your area that contribute to this problem.
3. Identify who is producing the pollution, where the pollution is produced, how it is produced, and why it is produced.

4. Be able to explain the chemical process, which produces the pollution. Write out and explain the chemical reaction in balanced equations.
5. How is it released to the environment?
6. What form (solid, liquid, gas) is the pollution found in the environment? Provide the chemical formula or symbol.
7. How much is released to the environment from each source over time? (if available)
8. How does it behave in the environment? Identify and explain any secondary reactions this pollution may cause when it enters the environment. INCLUDE
   - Behavior in air, water, soil (if appropriate)
   - Behavior in plants and animals (if appropriate)
   - Behavior in humans (biochemical reactions)
9. What is the extent of the contamination now and in the future? How far has it spread? What is its concentration in the environment? How has it impacted the environment?
10. How are humans exposed to this pollution? How do they come into contact with it? How does it enter their system?
11. How does this pollution impact human health? Who is at risk?
12. How can humans be protected from exposure to this pollution? How can they be treated if they are exposed, or are there no effective treatments at all?
13. What are the approximate costs of treating exposed humans (per case or total)? What are the clean up costs (how much does it cost to remove the pollution from the environment – remediation)? Check hospitals, EPA, and/or insurance companies for information.
14. How can this pollution be reduced or eliminated? Are there any alternatives that would avoid producing this pollution at all? What are the costs? How would this effect business and society?

Students should compile this information into a report and a presentation. Presentations should be made in front of the class. The class will then be responsible for generating questions for the presenters. Presenters must be prepared to defend their positions with facts and references.

Research

Use the library, Internet, and professionals as resources. Attached to this lesson plan are some links to help the students get started. Local health and environmental officials, plant engineers and risk managers, chemists, and toxicologists are also excellent resources.

Evaluation

Evaluation should take many forms for this long-term assignment.

Students should have the chance to assess the work of their teammates. Also, rubrics should be developed for the papers and the presentations. Class participation should also be assessed (quality of questions, showing courtesy and respect to presenters).

Closure

Take a hand poll from students regarding which pollution sources they regard as being the most critical.
Ask students to write a 5 minute essay about which source they think is most important and why. Invite students to share their reactions.

Links

Excellent links to many hazardous substances identified by the EPA.
http://www.epa.gov/ebtpages/pollutants.html

ATSDR's ToxFAQs – extensive fact sheets on many hazardous substances.
http://www.atsdr.cdc.gov/toxfaq.html

Top 20 Hazardous Substances.
http://www.atsdr.cdc.gov/cxcx3.html

United States National Library of Medicine. Health effects and treatment for exposure to hazardous substances.
http://www.nlm.nih.gov/pubs/factsheets/hsdbfs.html

EPA Web site ("About the EPA")
http://www.epa.gov/epahome/aboutepa.htm

ATSDR Web site (link to "ATSDR FAQs" and About "ATSDR")
http://www.atsdr.cdc.gov/

CDC Web Site
http://www.cdc.gov

Idaho Department of Health and Welfare, Division of Health, Bureau of Community and Environmental Health, Environmental Health Education and Assessment Program
http://www.healthandwelfare.idaho.gov/site/3393/default.aspx

DEQ Web site
http://www.deq.state.id.us/

These are by no means the only sources available!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Protesting Pollution Sources Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. Which of the following are credible internet sites to gather information about pollution? *(circle all that apply)*

   www.epa.gov
   www.atsdr.cdc.gov
   www.hazardoussubstances.com
   www.pollutionsources.com
   www.deq.state.id.us

2. Give a brief summary of the pollutant you chose, how it impacts human health, and how can it be reduced or eliminated?

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

3. Please circle any of the following pollutants that are a problem in Idaho/your area? *(circle all that apply)*

Selenium	Radon	Carbon
Arsenic	Mercury	Fluoride

4. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Protesting Pollution Sources Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of pollution and how it affects their health?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand how to protect humans from exposure?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned how to conduct individual research?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Health and Environmental Agency Overview

Grades

High School

Subject

Science

Type of Lesson Plan

Activity

Suggested Duration

2 class periods

Materials

- Access to the Internet or copies of the agency home pages and mission statements
- Copies of the quiz (developed by the student groups)
- Quiz grading key

Objective

TLW…

- Identify the primary human health and environmental health roles of the United States Environmental Protection Agency (EPA), Centers for Disease Control and Prevention (CDC), Agency for Toxic Substances and Disease Registry (ATSDR), Idaho Department of Health and Welfare, Division of Health, Bureau of Community and Environmental Health (BCEH), your local health district, and the Idaho Department of Environmental Quality (IDEQ).

Set

Copy the acronyms and proper names of the agencies listed on the board (or overhead). Ask the students "do you know what any of these agencies do?" Which ones are Federal agencies? Which ones are State agencies? Which ones are local agencies?

Instructional Input

Students will work in cooperative groups to research the purpose, goals, and objectives of the above agencies. They will determine the most important facts concerning each agency and formulate a 5 minute presentation about that agency to the class. A graphic organizer should be utilized (drawn on the board, a poster, a handout, or a PowerPoint presentation) in the presentation. The students in the audience should be encouraged to take notes since a quiz will follow the presentations.

After the presentation, the group will answer any questions the class might have about their assigned agency. Also, the group should ask 3-5 questions of the class which deal with information contained in the presentation. Finally, each group will develop 5 questions (short answer, true / false, fill in, and / or multiple choice) to be used on a class quiz over these agencies. The answers to the questions should be provided by the group.

Extended Practice

Invite the students to list the primary activities/responsibilities of these agencies. Create a table on the board listing the similarities and differences of the agencies. Have the students provide categories for comparison, and then list the agency comparisons on the table.

Evaluation

Students should evaluate their fellow group members on their level of cooperation and quality of participation in the group's research, presentation, and preparation of quiz questions using a Likert scale (1=poor, 5=excellent). The average of these scores should be entered as the participation portion of the student grade for this project.

The class will be evaluated using the questions prepared by each presenting group. Preview the questions to make sure that they are not too obvious or too ambiguous. Omit any outliers. Prepare the key from the answers provided by the groups.

Closure

Correct the quizzes as a class.

Resources

EPA Web site ("About the EPA")
http://www.epa.gov/epahome/aboutepa.htm

ATSDR Web site (link to "ATSDR FAQs" and About "ATSDR")
http://www.atsdr.cdc.gov/

CDC Web Site ("About CDC)
http://www.cdc.gov/aboutcdc.htm

Idaho Department of Health and Welfare, Division of Health, Bureau of Community and Environmental Health, Environmental Health Education and Assessment Program
http://www.healthandwelfare.idaho.gov/site/3393/default.aspx

IDEQ Web site
http://www.deq.state.id.us/

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Health & Environmental Agency Overview Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. What is the purpose of the Centers for Disease Control and Prevention (CDC)?
   _____
   _____
   _____
   _____

2. What are the primary goals of the Idaho Department of Environmental Quality (IDEQ)?
   _____
   _____
   _____
   _____

3. What is the primary human health and environmental health roles of the Environmental Protection Agency (EPA)?
   _____
   _____
   _____
   _____
   _____

4. Do you think this activity was fun?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Health & Environmental Agency Overview Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the purpose of the CDC, IDEQ, and EPA?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand the primary goal of Environmental Health agencies?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Superfund in Idaho

Grades

High School

Subject

Science

Type of Lesson Plan

Activity

Suggested Duration

One class period ~ 45 minutes

Materials

- Access to the computer lab
- Access to the Internet
- Computer and LCD projector
- Class copy of EPA Web site http://www.epa.gov/superfund/about.htm if access to computers and the Internet is limited.
- Copies of guided worksheet

Objective

TLW…

- Understand what Superfund is and how it relates to hazardous waste sites in Idaho.

Set

Take a hand poll to see how many students have heard the term Superfund. Ask those who raise their hand if they can briefly explain what it is. Expect to see many misconceptions about Superfund. Inform students that they will be educating themselves about Superfund today in class, using the Internet.

Instructional Input

This will be a self-guided lesson on Superfund using the computer and the Internet. Students may need to double up on computers depending on your school's capacity.

Pass the guided worksheet out to students, make sure everyone is logged on and at the correct site, and turn them loose on the assignment.

Evaluation

Use the guided worksheet as the evaluation tool for this lesson. You may also wish to further evaluate student understanding with a quiz over the main points.

Closure

You may wish to have the students correct the worksheets as a class. Have the students write an essay explaining in their own words what Superfund is and how it protects human health.

Name_____Period_____Date_____

Superfund in Idaho, A Guided Worksheet

When was the Superfund Program created?

Who established the Superfund Program?

Who administers the Superfund Program?

Why was the Superfund Program created?

Superfund _____, _____, and _____
hazardous waste sites in the United States.

Where does the money in the Superfund Trust Fund come from?

Who can discover and report hazardous waste sites?

What is the difference between Early Actions and Long-term Actions?

List three types of Early Actions.

How long can Early Actions last?

What is Superfund's number one priority during a chemical emergency?

List three types of chemical emergencies.

How does the EPA decide what actions are necessary at non-emergency hazardous waste sites?

List three types of tests EPA performs during site investigations.

What is a CIP? Why is a CIP important for local residents?

The Technical Assistance Grant (TAG) Program is an important part of Superfund. How can TAG assist communities with Superfund sites?

List at least six types of people involved in Superfund cleanups.

What does NPL stand for? How can the NPL be useful?

How long can Long-term Actions last?

List the four phases of a Long-term Action and give a brief description of each.

What can the EPA do if a responsible party refuses to pay for a Superfund cleanup?

How many people have been protected by Superfund cleanup actions nationwide?

What is the ULTIMATE goal of Superfund?

Access http://www.epa.gov/superfund/ for the following questions. Make sure to click on links for information and then go back to this page.

How many Superfund sites are there nationwide?

How many Superfund and NPL sites are there in Idaho?

List eight ways people may be exposed to hazardous substances.

Provide the name, location, and a description of the Superfund site nearest to your community.

Describe the difference between hazardous and non hazardous waste? Click on the "What Makes a Waste Hazardous?" link.

Name_____**KEY** _____Period_____Date_____

Superfund in Idaho, A Guided Worksheet

When was the Superfund Program created? **1980**

Who established the Superfund Program?
Congress

Who administers the Superfund Program?
EPA

Why was the Superfund Program created?
Superfund was created in response to growing concern over health and environmental risks posed by hazardous waste sites.

Superfund **_locates__**, **__investigates_____**, and **___cleans up____** hazardous waste sites in the United States.

Where does the money in the Superfund Trust Fund come from?
The Trust Fund is supported by taxes on the chemical and petroleum industries.

Who can discover and report hazardous waste sites?
Ordinary citizens as well as local and state agencies, businesses, EPA, the Coast Guard, and the military.

What is the difference between Early Actions and Long-term Actions?
Early actions deal with immediate risks to human health or the environment. Long term actions are for sites that require extensive clean up.

List three types of Early Actions.

- **Prevent human contact with contaminants from the site**
- **Remove hazardous materials from the site**
- **Prevent contaminants from spreading**
- **Provide safe drinking water to local residents**
- **Evacuate residents**

How long can Early Actions last?
They may last a few days up to five years.

What is Superfund's number one priority during a chemical emergency?
The number one priority of Superfund is to protect human health and their environment.

List three types of chemical emergencies.

- **Train derailments**
- **Truck accidents**
- **Chemical plant accidents**

How does the EPA decide what actions are necessary at non-emergency hazardous waste sites?
EPA reviews site data, inspects the site, and conducts interviews to determine what actions to take.

List three types of tests EPA performs during site investigations.
Soil, water, and air tests.

What is a CIP? Why is a CIP important for local residents?
Community Involvement Plan. CIPs allow residents to participate in the decision making process at Superfund sites. Since local residents are impacted the most, their input is important.

The Technical Assistance Grant (TAG) Program is an important part of Superfund. How can TAG assist communities with Superfund sites?
TAG can provide up to $50,000 per site to allow communities to hire experts to help interpret data and educate the community about site hazards and cleanup options.

List at least six types of people involved in Superfund cleanups.
- **Scientists**
- **Engineers**
- **Public health officials**
- **Managers**
- **Lawyers, Judges**
- **Community members**

What does NPL stand for? How can the NPL be useful?
National Priorities List. This list provides the locations and information about sites that require Long-Term Actions.

How long can Long-term Actions last?
Several years to decades are required to clean up Long-term Action sites.

List the four phases of a Long-term Action and give a brief description of each.
- **Study – identify cause and extent of contamination, threats to the environment and human health, and cleanup options.**
- **Proposed Plan – The plan for clean up of the site. Citizens and state and local officials have 30 days to comment on the plan.**
- **Record of Decision – A description of the site cleanup plans.**
- **Remedial Design – Actual cleanup operations are conducted in this phase.**

What can the EPA do if a responsible party refuses to pay for a Superfund cleanup?

EPA can pay for the cleanup costs out of the Superfund Trust Fund, then sue the responsible party to recover the costs.

How many people have been protected by Superfund cleanup actions nationwide?
Millions

What is the ULTIMATE goal of Superfund?
The goal is to protect your health and your environment.

Access http://www.epa.gov/superfund/ for the following questions. Make sure to click on links for information and then go back to this page.

How many Superfund sites are there nationwide?

Depends on when you access the site. This is a dynamic process with new sites listed as old ones are deleted.

How many Superfund and NPL sites are there in Idaho?

Depends on when you access the site. This is a dynamic process with new sites listed as old ones are deleted.

List eight ways people may be exposed to hazardous substances.

- **Contaminated air**
- **Direct contact with waste**
- **Contaminated drinking water**
- **Fire or explosion**
- **The food chain**
- **Contaminated ground water**
- **Contaminated soil**
- **Contaminated surface water**

Provide the name, location, and a description of the Superfund site nearest to your community.

See the website. Click the "locate Superfund sites" under "Tools" in the right column on http://www.epa.gov/superfund/.

Describe the difference between hazardous and non hazardous waste? Click on the "What Makes a Waste Hazardous?" link.

See the "What is the difference between hazardous and other waste?" paragraphs. Summarize as you see fit.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Superfund in Idaho Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. When was the Superfund Program created?
   1950 1960 1970 1980

2. Superfund _____, _____, and _____ hazardous waste sites in the United States?

3. What is the ULTIMATE goal of Superfund?
   _____
   _____
   _____

4. Which of the following are ways people may be exposed to hazardous substances? *(circle all that apply)*

Contaminated air	Direct contact with waste	Contaminated drinking water
Fire or explosion	The food chain	Contaminated ground water
Contaminated soil	Contaminated surface water	

5. What is the name, location and description of the Superfund site nearest to your community?
   _____
   _____
   _____

6. Do you think this activity was fun?
   No Neutral Yes Comments: _____
   1 2 3 4 5 _____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Superfund in Idaho Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand the definition of a Superfund site?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel students understand the ultimate goal of a Superfund site?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the students learned where Superfund sites are in Idaho?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

7. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

8. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.

Develop an Educational Brochure

Grades

High School

Subjects

Science, Biology, English, Art

Type of Lesson Plan

Project

Suggested Duration

Open ended project.

Materials

- Access to computers, the computer lab, the library, and the Internet
- Examples of Brochures
- Various art supplies (markers, colored pencils, construction paper, glue, tape, scissors)
- Copies of rubric

Objectives

TLW…

- Design an educational brochure intended to educate the public about the harmful health effects of any environmental health topic.
- Conduct research to support the information included in their brochure.

Set

List as many environmental health topics as you can. Pick one and write what you know about it. How does it affect human health? How did you learn about the health effects?

Instructional Input

Invite students to share answers. Discuss the ways students have learned about the health effects of environmental factors. Show an example of a brochure. Have students seen one of these before (most likely they have in the form of anti-smoking or drug pamphlets)? Inform students that the purpose of an educational brochure is to inform the public about health issues.

The student's task is to choose an environmental health topic and develop an educational brochure for it. Brochures should contain the following:

- Title
- An explanation of what the environmental health factor is.
- An explanation of what happens in the environment.
- Description of how humans can be exposed.
- Description of the health effects.
- How to avoid exposure.
- What to do if you are exposed.
- Summary
- A section of references people can access for more information.

Students should be required to hand in a set of references to document the sources of their information. Require three or more and STRONGLY discourage plagiarism.

Formatting

Traditionally, brochures are no longer than one page, filled front and back. Brochures can have simple or elaborate formats, as long as they effectively convey their message. The rationale behind a one-page document is that many people will not take the time to read a multi-page document. Also, it is much easier to distribute a single page brochure to the public than multi-page documents.

Provide examples of brochures for the students. Include a variety of formats (simple, columns, two and three fold pamphlets).

Evaluation

Students will be required to peer review each other's brochure prior to handing them in, using the rubric.

Rubrics should be used to evaluate the brochure. You may develop your own, develop one in conjunction with the class, or use the rubric provided.

Encourage students to use the rubrics to assess their own work as they develop the brochure. You may want to practice using the rubric by allowing students to score sample brochures, matching their scores against yours.

Students may be allowed class time to research and construct their brochure, or you may require that they work on their own, or both. Provide the students with the following links as research sources:

NIH Environmental Health Topics for Kids
http://www.niehs.nih.gov/kids/hottopics.htm

Environmental health Perspectives Topic List
http://www.ehponline.org/topic/

Excellent links to many pollutants and toxins identified by the EPA.
http://www.epa.gov/ebtpages/pollutants.html

Top 20 Hazardous Substances.
http://www.atsdr.cdc.gov/cxcx3.html

United States National Library of Medicine
http://www.nlm.nih.gov/pubs/factsheets/hsdbfs.html

Closure

You may wish to have the students share their brochures, or even require them to present them in class. After evaluating the brochures, hang them in the hall, the library, the office, the nurse's office, or any place where they might be appropriate. You may even wish to submit them to your local health district for evaluation.

Brochure Rubric

Category	Excellent __ points	Good __ points	Room for improvement__points	Comments
Content	All required elements of the brochure are included and properly addressed. The reader is educated about all pertinent aspects of the substance's effects on human health.	Most elements of the brochure are included and properly addressed. The reader is educated about most pertinent aspects of the substance's effects on human health.	Half of the required elements of the brochure are missing or are poorly addressed. The reader is confused about the subject or not educated about key issues regarding the substance's effects on human health.	
Formatting	Formatting catches the reader's attention and assists them in locating important information. Formatting enhances the flow of the brochure. Creative.	Formatting is logical and easy to follow. Formatting allows reader to find all necessary information.	Formatting does not have good flow. The reader may be confused by the order of information. The reader may not be able to easily find important information.	
Appearance	Typed neatly with no correction marks. Text lines up and looks like a professionally published document. Graphics are neat and address the topic.	Typed or written neatly with no more than five (5) correction marks. Text lines up and is easily read. Graphics are neat and address the topic.	Not typed or not written neatly. More than 5 correction marks. Text does not line up consistently. Difficult to read. Graphics are not neat and / or do not address the topic.	
Spelling and grammar	No more than one spelling or grammar mistake.	Few ($\leq$5) spelling or grammar mistakes.	Many (>5) spelling or grammar mistakes.	
Sources	More than three sources are correctly cited on a separate sheet of paper. **Wording of the sheet reflects the student's own words. No plagiarism.**	Three sources are correctly cited on a separate sheet of paper, or more than three sources, but not cited correctly. **Some of the wording does not reflect the words of the student. Minor plagiarism.**	Fewer than three sources cited, and / or sources are not correctly cited on separate sheet of paper. **Wording is not that of the student. Plagiarism suspected.**	

The Brochure should include

- Title
- An explanation of what the environmental health issue is and what happens in the environment.
- Description of how humans can be exposed and the health effects.
- How to avoid exposure and what to do if exposed.
- Summary
- A section of references people can access for more information.

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Student Lesson Plan Review and Comment Form

Title of Lesson: Develop an Educational Brochure Date:_____

After completing lesson, please circle the appropriate answer/number for each question. Feel free to include your comments.

1. What is the environmental factor you chose and how does it affect human health?

   _____
   _____
   _____
   _____
   _____

2. How did you learn about this environmental factor?

   _____
   _____
   _____
   _____
   _____

3. What is the purpose of an education brochure?

   _____
   _____
   _____

4. Do you think this activity was fun?

   No Neutral Yes Comments: _____
   1 2 3 4 5 _____

5. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Bureau of Community and Environmental Health
Idaho Division of Health
Environmental Health Education and Assessment Program

Teacher Lesson Plan Review and Comment Form

Title of Lesson: Develop an Educational Brochure Date:_____

After completing lesson plan, please circle the appropriate number for each question. Feel free to include your comments.

1. How long did it take to perform the lesson plan? _____

2. Do you feel students understand how to conduct research in order to develop an educational brochure?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

3. Do you feel the students learned how to develop an educational brochure?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

4. Do you feel the majority of the students were engaged and interested in the lesson plan activities?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

5. Was the lesson plan clear?

No		Neutral		Yes	Comments: _____
1	2	3	4	5	_____

6. What is your overall impression of the lesson plan?

Poor		Neutral		Good	Comments: _____
1	2	3	4	5	_____

7. Other comments or suggestions:

_____
_____
_____

Thank you for your help!

Please enclose this evaluation along with student evaluations into the addressed, postage-paid envelope and deposit in the mail.