

## LESSON:

# A Yen for Maximum Residue Limits in Food

**Summary:** Students read a short article on new rules for farm chemicals in Japan and answer questions about the maximum residue limit (MRL) for the pesticide 2,4-D in apples for five different countries.

**Lesson Type:** Short Lesson—This lesson will take 20 to 30 minutes to implement.

**EHP Article:** "A Yen for Better Farm Chemical Rules"  
*EHP Student Edition*, January 2007, p. A577  
<http://www.ehponline.org/docs/2006/114-10/forum.html#beat>

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

1. read information from a table;
2. compare MRLs for a common pesticide used on apples in five different countries; and
3. provide potential factors considered when setting an MRL.

**Class Time:** 20–30 minutes

**Grade Level:** 9–12

**Subjects Addressed:** General Science, Environmental Science, Health, Chemistry

### ► Prepping the Lesson (15 minutes)

#### INSTRUCTIONS:

1. Download the entire January 2007 *EHP Student Edition* at <http://www.ehponline.org/science-ed/>, or download just the article "A Yen for Better Farm Chemical Rules" at <http://www.ehponline.org/docs/2006/114-10/forum.html#beat>.
2. Review the Instructions and Student Instructions.
3. Make copies of the Student Instructions.

#### MATERIALS (per student):

- 1 copy of *EHP Student Edition*, January 2007, or 1 copy of "A Yen for Better Farm Chemical Rules," preferably in color
- 1 copy of the Student Instructions

#### VOCABULARY:

- maximum residue limit (MRL)
- parts per million (ppm)
- pesticide drift

#### BACKGROUND INFORMATION:

The article and lesson provide sufficient background information.

#### RESOURCES:

*Environmental Health Perspectives*, Environews by Topic page, <http://ehp.niehs.nih.gov>. Choose Laws/Regulations/Policy, Pesticides/Pest Management  
 Environmental Protection Agency, Setting Tolerances for Pesticide Residues in Food, <http://www.epa.gov/pesticides/factsheets/stprf.htm>

USDA Foreign Agricultural Service, International Maximum Residue Limit Database (can be used to compare MRLs for different chemicals, crops, and countries), <http://www.mrldatabase.com/>

U.S. Food and Drug Administration, Compliance Policy Guide, Pesticide Residues in Food and Feed, [http://www.fda.gov/ora/compliance\\_ref/cpg/cpgfod/cpg575-100.html](http://www.fda.gov/ora/compliance_ref/cpg/cpgfod/cpg575-100.html)



## ► Implementing the Lesson

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### INSTRUCTIONS:

1. Hand out the article and the Student Instructions.
2. Have students complete the exercise.
3. Discuss the questions/student answers as needed.

### NOTES & HELPFUL HINTS:

1. This lesson can be extended by having students conduct an investigation into how MRLs are negotiated and set. This would be an interesting project for social studies classes.
2. Students could go to the website <http://www.mrldatabase.com/> and investigate MRLs for other chemicals, foods, or countries.

## ► Aligning with Standards

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### SKILLS USED OR DEVELOPED:

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

### SPECIFIC CONTENT ADDRESSED:

- Chemical concentrations
- Maximum residue limits
- 2,4-D
- Setting enforceable environmental standards

### NATIONAL SCIENCE EDUCATION STANDARDS MET:

#### Science Content Standards

##### Unifying Concepts and Processes Standard

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

##### Science as Inquiry Standard

- Abilities necessary to do scientific inquiry

##### Science in Personal and Social Perspectives Standard

- Personal and community health
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenge

## ► Assessing the Lesson

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a. The MRL is in the unit parts per million (ppm). Using the U.S. MRL for 2,4-D as an example, define or briefly explain what ppm means.

There are 5 parts of the pesticide 2,4-D per million parts of apple.

b. How many times greater are the U.S. and European Union MRLs for 2,4-D compared to the Japanese MRL? Show your calculations.



The European Union MRL is 5 times greater than the Japanese MRL for 2,4-D:

$$0.05/0.01 = 5$$

The U.S. MRL is 500 times greater than the Japanese MRL for 2,4-D:

$$5.0/0.01 = 500$$

c. The MRLs listed in the table are those that have been established on a permanent basis under U.S. legislation (*i.e.* it is an established law). What do you think the dashes in the table may mean? Discuss how your explanation, if true, may impact potential exposure to the pesticide 2,4-D for people living in Guatemala, India, or New Zealand.

Students answers may vary and could range from simple to complex depending on their background knowledge and analytical skills. A simple answer may be that the dash could indicate that there are no MRLs set for 2,4-D in apples imported into those countries. If that were the case the people living in those countries could potentially be exposed to higher concentrations of 2,4-D from apples (either grown locally or apples imported depending on the country of origin – *i.e.* a country with poor internal regulations for use of pesticides when growing may consistently have higher residues on its produce compared to a country with stricter internal controls).

Other explanations for the dashed lines could include that those countries have not yet negotiated or agreed upon a limit with the U.S. or there are temporary MRLs in place that are not included in the table. Potential for exposure to 2,4-D from apples will depend on any temporary MRLs set by that country. The higher the MRL limit (e.g. 5 ppm compared to 0.01 ppm) the greater the potential exposure to 2,4-D from apples.

d. As you can see in the answers to “b” and “c” above, there are large ranges of allowable residues. Numerous factors are incorporated into deciding an MRL. List two factors you think are considered in setting an MRL and provide a short, logical reason for each factor.

Student answers will vary. Because their background knowledge on this topic is probably limited, their answers may or may not be “correct.” It is more important that students consider the issue from multiple perspectives and provide a clear, logical response. Below are some sample answers:

- Health—The MRL may be set to protect public health, which would presumably be based upon health/toxicology data.
- Average residue amounts—The MRL may be set based upon average residue amounts so that large amounts of produce or food are not seized or thrown out by the importing country and/or to maximize the allowable imports of that product.
- Measurement considerations—The MRL may be set based upon the ability to measure the quantity of a substance (*i.e.*, limitations of measurement technology) or how challenging it may be to obtain appropriate samples.
- Enforcement—The MRL may be set based upon the ability to enforce the MRL. If the majority of a high-demand product is imported from a country that has poor environmental standards, there may be no realistic way to enforce the standard. Another scenario might be if the product is in very high demand and there are many places from which the product comes, it would potentially be difficult to enforce violations.
- Trade agreements—An MRL may be based upon political trade agreements. For example, if a country if a country is being rewarded economically for political actions (like agreeing to nuclear inspections) standards may be lowered to encourage trade.
- Farmers’ requests—Farmers and distributors may request a certain MRL they know they can easily meet but that would still allow them to spray enough pesticides to keep their crops safe from disease, insects, and other invaders.

## ► Authors and Reviewers

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**Give us your feedback!** Send comments about this lesson to [ehpscienced@niehs.nih.gov](mailto:ehpscienced@niehs.nih.gov).



# A Yen for Maximum Residue Limits in Food

**Step 1:** Read the article "A Yen for Better Farm Chemical Rules."

**Step 2:** The table below compares the new Japanese regulations for the maximum residue limit (MRL) of the pesticide 2,4-D in apples with the regulations in four other countries. Look at the information in the table and answer the following questions.

	<b>United States</b>	<b>European Union</b>	<b>Guatemala</b>	<b>India</b>	<b>Japan</b>	<b>New Zealand</b>
<b>2,4-D MRL</b>	5.0 ppm	0.05 ppm	—	—	0.01 ppm	—

a. The MRL is in the unit parts per million (ppm). Using the U.S. MRL for 2,4-D as an example define or briefly explain what ppm means.

b. How many times greater are the U.S. and European Union MRLs for 2,4-D compared to the Japanese MRL? Show your calculations.

c. What do you think the dashes in the table mean? Discuss how that relates to potential chemical exposure to 2,4-D when people in that country eat apples.

d. As you can see in the answers to "b" and "c" above, there are large ranges of allowable residues. Numerous factors are incorporated into deciding an MRL. List two factors you think are considered in setting an MRL and provide a short, logical reason for each factor.

