## Lesson Plan - Transportation Math

### Learning elements

- Math, area, extracting data from tables, data accuracy, problem solving, hazardous materials (spillage)

### Contributes to these Educational Standards

- Math, Reading, Relationships, Safety

### Supports these CRLs

- Communication, Employment Foundations, Personal Management

### Learning Environment requirements:

- Central focus space to set the stage. Projection device for PowerPoint presentation. Individual access to electronic device to access web site(s), Twitter, and/or podcasts. Related URLs:
  - [http://environmentalchemistry.com/yogi/hazmat/erg/ProtectiveTableNotes.html](http://environmentalchemistry.com/yogi/hazmat/erg/ProtectiveTableNotes.html) Spillage
  - [www.truckflix.com](http://www.truckflix.com) (view trucking industry video vault and podcasts)
  - [www.truckline.com](http://www.truckline.com) (American Trucking Association); [www.truckdriver.com](http://www.truckdriver.com) –tips on getting started in trucking
  - [www.womenintrucking.org](http://www.womenintrucking.org) (opportunities for women in the trucking industry)

### Introduction

Trucks carry many different products to many different places. Almost everything we buy has been delivered by truck to a store or to our homes. Truck drivers use math in many different contexts. Today, we will apply the math we have learned in some trucking contexts. And we will learn a new formula that truck drivers use when they respond to a liquid spill. People who drive the trucks travel all over the United States. Sometimes drivers encounter accidents, and frequently during an accident, liquids will spill from the wreckage. We will discuss what drivers are expected to do, what they need to know, and apply some calculations that they would do in response to spillage.
<table>
<thead>
<tr>
<th>Objective</th>
<th>Time (minutes)</th>
<th>Teaching Points</th>
<th>Supplies</th>
<th>Vocabulary Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Explore websites that provide information for truck drivers so that they can effectively respond to spills on the road.</td>
<td>15 min</td>
<td>Introduce resources to help guide people to solve the problem of protecting others from spillage. Sometimes drivers encounter accidents, and frequently during an accident, liquids will spill from the wreckage. Point out the mathematical calculations truck drivers perform when helping to set up a protective zone. Is this opportunity limited to truck drivers? If not, who else could use these formulas?</td>
<td>Computers or other electronic devices with access to the Internet.</td>
<td>Protective Action Zone Initial Isolation Zone</td>
</tr>
</tbody>
</table>
| #2 Apply spillage formula to calculate a protective action zone in hypothetical situations where there is risk of harmful chemical exposure. | 30 min | Using the *Initial Isolation and Protective Zone* PowerPoint (and the table from the *Protective Action Zone* exercises):  
- Introduce the Protective Action Zone intent  
- Introduce the Protective Action Zone formula  
- Demonstrate how to use the formula  
- Provide each student the Protective Action Zone exercises, along with the supplemental handout. | Initial Isolation and Protective Zone PowerPoint (the table in the PowerPoint is available in the Protective Action Zone Exercises) | Protective Action Zone exercises Protective Action Zone handout |
| Total: | 45 min | | | |

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Protective Action Zone Exercises

NOTE: Information can be found in the 2004 Emergency Response Guidebook, or online at http://environmentalchemistry.com/yogi/hazmat/erg/ProtectiveTableNotes.html

1. One bright sunny day, truck driver Amanda came upon an accident scene, and noticed liquid spilling across the road. She noted the direction the leaves on the trees were waving, and stopped her truck upwind of the accident. She could tell by the placard on the wrecked tanker truck that it was carrying Diesel Fuel (Identification number 1993, marked Highly Flammable). How much area should she initially isolate? What is the downward distance she will need to protect also?

2. Late one night, a road washed out under Chin’s truck, and his truck overturned. Chin was unhurt, and he can walk across the washout area. Chin was delivering insecticide. Draw a sketch of the zone Chin should set up to protect others from the spill. Record the distances across the area that should be protected.

3. Truck driver Jamie was carrying paint when the truck overturned, and dozens of gallons spilled. Jamie is unhurt, but must attend to setting up a protective action zone. Please describe the next steps that need to be taken, and the sketch the affected zone (write the distance lengths on the sketch please).

Refer to these formulas for deciding your next steps.
Informational tables are located on the back side of this sheet.
# TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

<table>
<thead>
<tr>
<th>ID no.</th>
<th>Name of material</th>
<th>Small Spills</th>
<th>Large Spills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>First ISOLATE</td>
<td>Then PROTECT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in all directions</td>
<td>Persons downwind during-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meters (Feet)</td>
<td>NIGHT Kilo Meters (Miles)</td>
</tr>
<tr>
<td>none</td>
<td>&quot;Dangerous&quot;</td>
<td>120m (400 ft)</td>
<td>1.0km (0.7 mi)</td>
</tr>
<tr>
<td>1017</td>
<td>Chlorine</td>
<td>30m (100 ft)</td>
<td>0.2km (0.1 mi)</td>
</tr>
<tr>
<td>1072</td>
<td>Oxygen, compressed</td>
<td>120m (400 ft)</td>
<td>1.0km (0.7 mi)</td>
</tr>
<tr>
<td>1079</td>
<td>Sulfur Dioxide</td>
<td>30m (100 ft)</td>
<td>0.3km (0.2 mi)</td>
</tr>
<tr>
<td>1202</td>
<td>Fuel Oil</td>
<td>50m (175 ft)</td>
<td>50m (175 ft)</td>
</tr>
<tr>
<td>1263</td>
<td>Paint</td>
<td>300m (1000 ft)</td>
<td>300m (1000 ft)</td>
</tr>
<tr>
<td>1660</td>
<td>Nitric Oxide</td>
<td>30m (100 ft)</td>
<td>0.2km (0.1 mi)</td>
</tr>
<tr>
<td>1967</td>
<td>Insecticide Gas</td>
<td>120m (400 ft)</td>
<td>1.0km (0.7 mi)</td>
</tr>
<tr>
<td>1993</td>
<td>Diesel Fuel</td>
<td>50m (175 ft)</td>
<td>50m (175 ft)</td>
</tr>
</tbody>
</table>

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How to use the table of initial isolation and protective action distances

NOTE: These instructions can be found in the 2004 Emergency Response Guidebook, or online at http://environmentalchemistry.com/yogi/hazmat/erg/ProtectiveTableNotes.html

4. The responder should already have:
   - Identified the material by its ID Number and Name; (if an ID Number cannot be found, use the material index)
   - Found the three-digit guide for that material in order to consult the recommended emergency actions
   - Noted the wind directions.

5. Look in this Table for the ID Number and Name of the Material involved in the incident. Some ID Numbers have more than one shipping name listed - look for the specific name of the material. (If the shipping name is not known and the Table lists more than one name for the same ID Number, use the entry with the largest protective action distances.)

6. Determine if the incident involves a SMALL or LARGE spill and if DAY or NIGHT. Generally, a SMALL SPILL is one which involves a single, small package (e.g., a drum containing up to approximately 200 liters), a small cylinder, or a small leak from a large package. A LARGE SPILL is one which involves a spill from a large package, or multiple spills from many small packages. DAY is any time after sunrise and before sunset. NIGHT is any time between sunset and sunrise.

7. Look up the initial ISOLATION distance. Direct all persons to move, in a crosswind direction, away from the spill to the distance specified - in meters and feet.

8. Look up the initial PROTECTIVE ACTION DISTANCE in the Table. The Table gives the downwind distance - in kilometers and miles - for which protective actions should be considered. For practical purposes, the Protective Action Zone (i.e., the area in which people are at risk of harmful exposure) is a square, whose length and width are the same as the downwind distance shown in the Table.

9. Initial Protective Actions to the extent possible, beginning with those closest to the spill site and working away from the site in the downwind direction. When a water-reactive TIH producing material is spilled into a river or stream, the source of the toxic gas may move with the current or stretch from the spill point downstream.

   The shape of the area in which protective actions should be taken is shown in this figure. The spill is located in the center of the small circle. The large circle represents the INITIAL ISOLATION zone around the spill.

NOTE: See "Introduction To The Table Of Initial Isolation And Protective Action Distances" for factors which may increase or decrease Protective Action Distances.

Call the emergency response telephone number listed on the shipping paper, or the appropriate response agency as soon as possible for additional information on the material, safety precautions, and mitigation procedures.

Adapted from http://environmentalchemistry.com/yogi/hazmat/erg/ProtectiveTableNotes.html

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