

**MIDDLE SCHOOL**

**Green Chemistry**

**In Your Bathroom**

**Teacher Background:** Although the FDA is required to test products for human consumption, it is estimated that only 15% of today’s cosmetics have been truly tested. Also, while other countries have banned a variety of ingredients found in everyday cosmetics because of their potentially harmful side effects, the US has chosen not to ban these same products. Therefore, it is up to the consumer to be aware of the potential harm some products may incur. As part of this lesson plan, a list of commonly found toxins has been provided. It is important to note that while all of these toxins are hazardous, their degree of toxicity does fluctuate from product to product. This exercise is simply to make students aware of the ingredients used in the products they purchase. Hopefully they will be encouraged to research their favorite cosmetics for the effect these ingredients may have on their health.

Information used for this project came from: [**www.ewg.org**](http://www.ewg.org/), **[www.cosmeticdatabase.com](http://www.cosmeticdatabase.com/)** (a great site for finding out specific products and their toxicity levels.)

Carcinogen: something that produces cancer

Toxicity: the degree to which something is poisonous

**Goal:** Students will determine the best method of data display to encourage critical thinking about products used in daily life.

**Objectives:** Students will collect data on ingredients found in products brought from home and investigate the substances used to make these products. They will use this data to practice choosing data display methods and simple probability.

**Time required:** 1 class period

**Materials:**

* Markers
* Graph paper
* Protractors
* Calculators
* Copies of list of toxins and tally sheets for both individual records and group records.

**Standards:**

* **Science In Personal and Social Perspectives Standards:** Personal health
* **Science In Personal and Social Perspectives Standards:** Natural hazards
* **Science In Personal and Social Perspectives Standards:** Risks and benefits
* **Science In Personal and Social Perspectives Standards:** Science and technology in society

**Prep:**

* Ask students to bring shampoo bottles, or collect a sample of these items personally.

**Procedure:**

* Hand out containers or havethe students look at the containers they brought with them.
* Hand out the student sheet and the shampoo ingredient information table.
* Have the students review the information about ingredients.
* Have the students answer questions 1 & 2 on the student sheet.
* After everyone has a tally for their own ingredients and has answered through questions two, have the class submit all of their data and compile a tally sheet on the board of the data from the entire class. Use the categories of:
  + High hazard
  + Medium hazard
  + Low hazard
* Give students the Graph Information sheet. Review expectations.
* Data from each of these lists can be used to practice measures of central tendency and form any of a number of graphic displays: Stem/leaf, bar graph, histogram, and pie chart. Your choice will depend on the kind of data you collect (For instance a stem/leaf does not work well if the data is all single digits. A histogram does not work well unless there are meaningful intervals of data.) Discuss with your students the fact the appropriateness of different forms of display. Let them decide which form (bar graph, circle graph, etc.) would best relate the findings from this data.
* Optional: spend a day in the computer lab, allowing students to research the ingredients that weren’t included in the chart

**Extensions:**

Probability: You can make up probability problems like the following:

* + a. If these were the shampoo choices on the store shelf, and I chose randomly from them, what is the probability that I would have chosen a shampoo that has two or more highly hazardous ingredients?
  + b. What would be the probability that I would choose a shampoo with 2 highly hazardous ingredients and with 1 or more ingredients of medium hazard?
  + c. What is the probability that I would get a product that contains Acetate?
* Again, these questions would be modified according to your data and the interests of your students.

Other interesting things to note:

1. Ask the students how many of their products that have toxins in them also have the word “Healthy”,” “Gentle” “Natural” in the name.
2. Are there any brands that showed up more often for having toxins?
3. Are any students going to change brands or do more research on their brands as a result of these findings?

**In Your Bathroom - Student Sheet**

1. Make a tally of how many high hazard, medium hazard, and low hazard ingredients were in your product.
2. Based on your shampoo ingredients:
   1. What is the percentage of high hazard ingredients? \_\_\_\_\_\_\_\_
   2. What is the percentage of medium hazard ingredients? \_\_\_\_\_\_\_\_
   3. What is the percentage of low hazard ingredients? \_\_\_\_\_\_\_\_
3. Based on classroom data:
   1. What is the percentage of high hazard ingredients? \_\_\_\_\_\_\_\_
   2. What is the percentage of medium hazard ingredients? \_\_\_\_\_\_\_\_
   3. What is the percentage of low hazard ingredients? \_\_\_\_\_\_\_\_
4. Questions for thought:
   1. Do you think the products from your class are a good representation of the products on the market? If not, why not?
   2. Is there any product that you are currently using that you will no longer use or would like to research further?

**In Your Bathroom: Shampoo Ingredient Information Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Ingredient Name** | **Toxicity Rating** | **Health & General Information** | **Purpose** |
| **Acetone (Dimethylketone, 2-propanone,beta-ketopropane)** | **5** | Low dose: nose, throat, lung irritant ,High dose: kidney, liver, nerve damage, birth defects, coma. | Used as a solvent. |
| **Alpha Hydroxy Acid** | **2** | destroys skin cells, skin cancer, ages skin | Used to exfoliate skin |
| **Aluminum**  **(D&C Red 7 Lake or other colors)** | **4** | Central nervous system damage, linked to Alzheimers | Pigment used to color a product |
| **Amino Acids** | **0** | These are the keratin amino acids obtained by the hydrolysis of human hair. | Hair conditioning agent |
| **Ammonium Chloride** | **3** | It is an inorganic salt. | Used as fragrance & thickening agent |
| **Amyl Cinnamal** | **6** | One or more animal studies show brain and nervous system effects at high doses, skin irritant, Known human immune system toxicant, EU Banned and Restricted Fragrances | Used as fragrance agent |
| **Ascorbic Acid** | **1** | Vitamin C | Used as fragrance agent, pH adjustor, & skin conditioner |
| **Barbadensis** | **1** | extract from the aloe vera plant, known for its ability to help heal burns and moisturize | Used as a skin conditioning agent |
| **Benzene (Benzoic, Benzyl, any compound that contains these words)** | **6** | Inhalation affects nervous system, carcinogenic, birth defects | Used as a solvent, fragrance agent, preservative, & thickening agent |
| **BHA – BHT** | **10** | carcinogenic ( banned in other countries) | Antioxidant & fragrance agent |
| **Biotin** | **2** | animal studies show brain and nervous & reproductive system effects at low doses | Used as a hair conditioner |
| **Butylene glycol** | **1** | Irritation (eyes, skin, or lungs) | Used as skin conditioner & solvent |
| **Butyphenyl methylpropional** | **8** | Known human immune system toxicant, evidence of human neurotoxicity | Used as a fragrance & perfuming agent |
| **Cetyl alcohol** | **1** | Derived from whales or dolphins or Vegetable cetyl alcohol, like coconut | Used as an emulsifier and surfactant |
| **Citric Acid** | **2** | Can irritate skin | Used to balance pH |
| **Cocamide MEA** | **2** | Not safe for use in products intended to be aerosolized | Used as emulsifier & thickening agent |
| **Cocamidopropyl betaine** | **5** | Skin Sensitizer - An agent that can induce an allergic reaction in the skin or lungs | Used as anti-static, hair conditioner, & surfactant |
| **DEA, TEA, MEA** | **7** | highly carcinogenic | Used to balance pH |
| **DMDM Hydantoin** | **8** | Can instigate itching, burning, scaling, hives, and blistering of skin; Irritation (eyes, skin, or lungs) | Used as a preservative |
| **FD&C colors (D&C, coal tar)** | **4** | carcinogen | Pigment used for color |
| **Glycol (propylene glycol)** | **4** | causes skin irritation and sensitization as low as 2% concentration, cosmetics can contain up to 50% of the substance. | Used as humectants, skin conditioner, & solvent |
| **Glycerin (GLYCERYL MONOSTEARATE)** | **1** | monoester of glycerin and stearic acid. | Used as surfactant, emulsifier, & skin conditioning agent |
| **Keratin** | **2** | Use is restricted in Canadian cosmetics based on concentrations | Used as hair conditioning agent, humectant |
| **Limonene** | **6** | Known human immune system toxicant, EU Banned and Restricted Fragrances | Used as a perfume |
| **Niacinamide** | **2** | One or more animal studies show liver effects at very low doses, possible carcinogen | Used as hair conditioner & smoothing agent |
| **Panthenol** | **2** | One or more animal studies show broad systemic effects at high doses | Used as an anti-static & skin conditioner |
| **Paraben (Butylparaben,Isobutylparaben, Sodium)** | **6** | carcinogen | Used as preservative |
| **PEG (may be followed by a number)** | **10** | carcinogen | Used as surfactant & emulsifier |
| **Phthalate (also look for Diethyl or Dibutyl)** | **10** | cancer causing, fertility, banned in Europe | Used as a solvent |
| **PolyQuaternium (10, 11, 22, 24, 28,39, 51** | **0** | Safe as used in cosmetics according to industry panel (Cosmetic Ingredient Review, CIR) | Used as anti-static agent & hair fixative |
| **Polysorbate-20** | **1** | One or more animal studies show gastrointestinal effects at high doses | Used as surfactant & emulsifier |
| **Sodium lauryl sulfate ( SLS, SLES, formaldehyde,formalin, MDM, hydantoins, surfactants)** | **4** | skin irritant & alleged carcinogen | Used as a surfactant |
| **Quaternium-15** | **6** | Known human immune system toxicant & skin irritant | Used as anti-static agent & preservative |
| **Quaternium (18, 22, 37)** | **0** |  | Anti-static agent |
| **Tetrasodium EDTA** | **2** | Risk of serious damage to eyes | alters skin structure, allows other chemicals to penetrate deeper into the skin |
| **Tocopherol Acetate** | **4** | Skin toxicant | Skin conditioner |
| **Tocopherols and tocotrienols** | **1** | Vitamin E | Used as anti-oxidant, fragrance agent, & skin conditioner |
| **Toluene** | **10** | bone marrow, liver, kidney damage, birth defects, brain cancer | Used as anti-oxidant and solvent |
| **Triethanolamine** | **6** | carcinogen | Used to adjust pH, as a surfactant and emulsifier |

score key --  0-2: low hazard | 3-6: moderate hazard | 7-10: high hazard

# Information taken from Skin Deep at http://www.cosmeticdatabase.com/

**In Your Bathroom – Graph Information**

Design a data display that you think best illustrates the findings your class has tabulated concerning toxins in shampoo. Follow the steps below to decide what information you want to highlight and what data display would best illustrate your information.

1. What information did you find most interesting or you felt affects you the most?
2. As data can be interpreted differently, what is the message you want your display to convey: toxins are rampant and the buyer has to be careful, or we don’t really need to worry about the number of toxins found in shampoo.
3. Given decisions made above choose from one of the choices below: Your choices are

* Box and whisker
* Histogram
* Pie chart
* Bar graph
* Stem and leaf
* Line graph