

Plotting Trends

A Periodic Table Activity



Introduction

Does ionization energy increase going up or down a column in the periodic table? Do atoms get smaller or larger from right to left across a row? Most students have a hard time answering these questions. In this cooperative activity, students use microscale reaction plates and straws of different lengths to construct three-dimensional bar-type charts of element properties. Let students discover for themselves the existence and direction of periodic trends.

Concepts

- Periodic table
- Periodic trends

Materials*

Calculator, at least 1 per student group

Index cards, 4 × 6 inches, 7

Reaction plates, 96-well (8 × 12 layout), 7

Periodic table, 28†

Straws, 300

Scissors, at least 1 per student group

Metric rulers, marked in millimeters, 28

Plumber's putty or clay (optional)

*For a class of 28 students working in groups of four.

†The Flinn Scientific Periodic Table of the Elements (Catalog No. AP9020) lists all of the required properties of the elements.

Safety Precautions

Although the materials in this activity are considered nonhazardous, please follow all laboratory safety guidelines.

Procedure

1. Form a working group with three other students. Obtain a periodic table, a reaction plate, a metric ruler, scissors, and 40 plastic straws.
2. Each group chooses or is assigned one element property: atomic mass, atomic radius, ionization energy, electronegativity, electron affinity, density, or melting point.
3. Find your assigned physical property on the periodic table.
4. Find the maximum value of the assigned physical property for the elements 1–20, 31–38, and 49–54 (these are the representative or main group elements in periods #1–5). *Example:* The maximum value of the density for these elements is 7.31 g/cm³ (for tin).
5. Let the length of the straw minus one cm represent this maximum value. This length will be the scale for all of the other values of the density of the elements. *Example:* For a straw that is 19.5 cm long, a straw length of 18.5 cm will represent a density of 7.31 g/cm³. The scale is thus 18.5 cm = 7.31 g/cm³. Round off straw lengths to 0.1 cm (1 mm).
6. Using this “straw” scale as a ratio, calculate the straw length that is needed to represent the assigned property for each element in the list. *Example:* The density of beryllium is 1.85 g/cm³. Solving Equation 1 for the straw length (*sl*) shows that a straw length of 4.7 cm is needed to represent the density of beryllium. Round off all straw lengths to 0.1 cm.

$$\frac{18.5 \text{ cm}}{7.31 \text{ g/cm}^3} = \frac{sl}{1.85 \text{ g/cm}^3} \quad \text{Equation 1}$$

$$sl = (18.5 \times 1.85)/7.31 = 4.7 \text{ cm}$$

7. Add 1.0 cm to the calculated straw length for each element and cut a straw to that length. *Example:* Cut a straw 5.7 cm (4.7 cm + 1.0 cm) long to represent beryllium.
8. Place the straw in the reaction plate according to the position of the element in the periodic table. Remember, the transition elements are not included in the list of representative elements. *Example:* Beryllium (period 2, Group IIA or 2) is

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placed in row 2, column 2.

- (Optional) Place a pea-sized amount of plumber's putty or clay in the bottom of each straw before placing it in the reaction plate. This will make the resulting "straw chart" more stable.
- Repeat steps 5–9 for each element in the list.
- Determine the nature of any periodic trend that may exist for the assigned property of the elements and propose an explanation for the observed trend.
- Create a descriptive card to be displayed with the three-dimensional chart. Include the following information on the card: (1) names of group members; (2) the assigned physical property of the element; (3) description of the observed trend; (4) proposed explanation for the trend.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School

MS-PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Disciplinary Core Ideas: High School

HS-PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Science and Engineering Practices

Asking questions and defining problems

Developing and using models

Using mathematics and computational thinking

Crosscutting Concepts

Patterns

Systems and system

models

Tips

- This activity examines the properties of 34 representative (main group) elements, corresponding to the Group IA through Group VIIIA (Groups 1–2, 13–18) elements in periods 1–5. The atomic numbers for these elements are 1–20, 31–38, and 49–54. The transition metals are not included.
- Seven physical properties of the elements are recommended in step 2. This is ideal for a class of 28 students working in groups of four. Each group selects or is assigned a unique property of the elements. For smaller or larger class sizes, adjust the size of the working groups and discard or double-up on the assigned physical properties, as appropriate.
- The straws are cut 1 cm longer than the calculated straw lengths in step 6 because that is the depth of each well in the reaction plate.
- If the periodic tables you have available for student use do not list all of the suggested physical properties, compile a list of the elements and their properties. An appropriate reference source is the *CRC Handbook of Chemistry and Physics*. See also the Website www.webelements.com (accessed September, 2016).
- This is a cooperative class activity. Monitor or assess student groups to ensure that students share responsibilities and discuss choices to arrive at consensus.

Reference

This activity is from *Flinn ChemTopic™ Labs*, Volume 4, The Periodic table; Cesa, I., Ed.; Flinn Scientific: Batavia, IL, 2002.

***Plotting Trends—A Periodic Table Activity* is available as a Student Laboratory Kit from Flinn Scientific, Inc.**

Catalog No.	Description
AP6290	Plotting Trends—A Periodic Table Activity
AP6254	Flinn ChemTopic™ Labs, Volume 4, The Periodic Table
AP9020	Flinn Periodic Table, Notebook Size, Pkg. of 50
AP6025	Straws, plastic, 500/pkg
AP1448	Reaction plates, 96-well

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.