About the Lesson

Using the properties of a mystery element and using the Periodic App, students identify the element that has the following properties:

1. It is a transition metal.
2. Its outermost (valence) electrons are in the fourth energy level.
3. It has an atomic radius larger than Ru and smaller than Cd.
4. It has a first ionization energy greater than Ru and less than Cd.
5. It has an electronegativity greater than Cd and less than Rh.
6. It has the highest density of the remaining possible choices.

Vocabulary

- valence
- atomic number
- electronegativity

Teacher Preparation and Notes

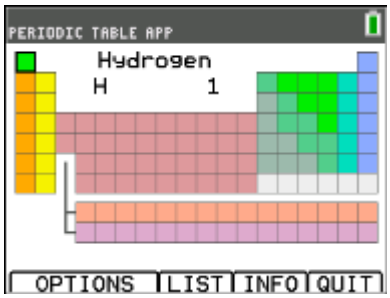
- In this activity, students will use the exponential regression model that is provided on the TI-84 family of calculators: y = a*b^x to estimate a cooling curve.

Activity Materials

- Compatible TI Technologies:

  TI-84 Plus*
  TI-84 Plus Silver Edition*
  TI-84 Plus C Silver Edition
  TI-84 Plus CE

** with the latest operating system (2.55MP) featuring MathPrint™ functionality.*



Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

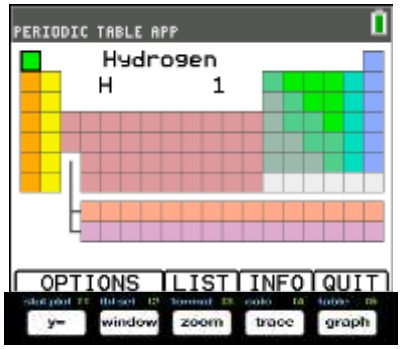
Lesson Files:

- It's a Mystery_Student.pdf
- It's a Mystery_Student.doc

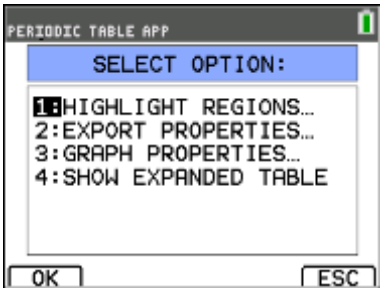
The Investigation—The Periodic App

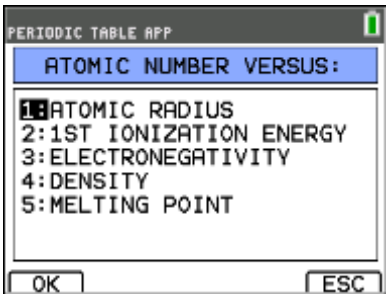
1. Turn the calculator on and press [APPS]. Find the PERIODIC app, highlight it, and press [ENTER]. .

Note: In the Periodic App the tabs at the bottom of the screen indicate menus that can be accessed by pressing the key directly below it.

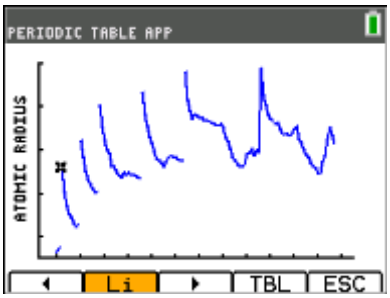


2. When you press [y=], you go to the OPTIONS menu (See the menu below.). Use the arrow keys to highlight GRAPH PROPERTIES. Press [ENTER]. ATOMIC RADIUS should be highlighted. Press [y=] to select OK.



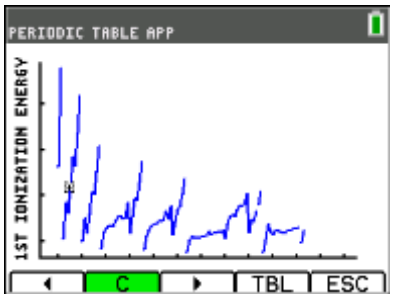


3. Use the arrow keys to move the cursor along the points in the graph. The element corresponding to each point is displayed between at arrow tabs ◄ Li ► at the bottom of the screen. Use the arrow keys to move the cursor through the elements. When students have identified the elements with atomic radii larger than Ru and smaller than Cd, they record the symbols of these elements in the data table.

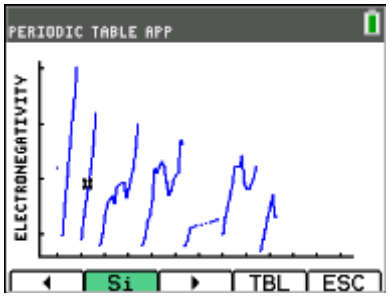


Note: The tab [TBL] takes you back to the main periodic table. The tab [ESC] takes you back one menu, in this case back to the GRAPH PROPERTIES menu.

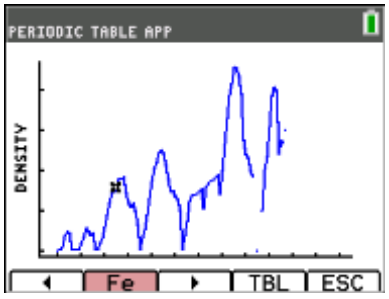
4. In the 1ST IONIZATION ENERGY graph, students find the elements have first ionization energies larger than Ru and smaller than Cd and record the symbols of these elements in the data table. To get back to the GRAPH PROPERTIES menu, press GRAPH to select [ESC].



5. In the ELECTRONEGATIVITY graph, students identify elements that have electronegativities higher than Cd and smaller than Rh and record the symbols of these elements in the data table. They then cross off the element that does not appear in all of the rows of the data table.



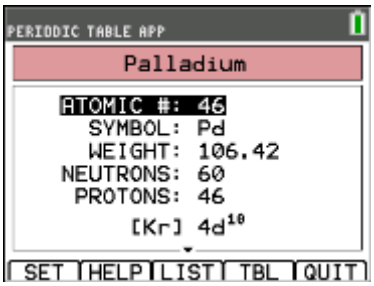
6. In the DENSITY graph, students find the trend line that includes the two elements that remain in the data table and identify the remaining element has the higher density. This is the symbol of the mystery element.



Data Table

Graph	Element	Element	Element
Atomic radius between those of Ru and Cd	~~Rh~~	Pd	Ag
First ionization energy between those of Ru and Cd	~~Rh~~	Pd	Ag
Electronegativity between those of Rh and Cd		**Pd** Higher density	Ag

Identify the symbol of the mystery element. **Pd**



Data Analysis

1. Name the mystery element.

   Answer: Palladium

2. Determine the electron configuration.
   Answer: ($1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10}$)

3. Determine the atomic number (number of protons) for the mystery element.
   Answer: Atomic Number = 46)

Going Further

Use the procedures above to identify a different element #2 with the following properties:

1. It is a metalloid (semi-metal).
2. Its valence electrons are in the third energy level.
3. It has an atomic radius larger than Ar and smaller than Al. ***(Cl, S, P, Si)***
4. It has a first ionization energy greater than Al and less than Ar. ***(Cl, P, S, Si)***
5. It has an electronegativity greater than Al and less than Cl. ***(S, P, Si)***
6. It has the highest density of the remaining possible choices. **(Si)**

Mystery element #2- ***Answers:***

Element Symbol: ***Si***

Element Name: ***Silicon***

Electron configuration:***[Ne]$3s^2 3p^2$***

Atomic number: ***14***