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The Story of Periodicity: An Exploration of Sam Kean's The Disappearing Spoon for Chemistry and English

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UNDERSTANDING BY DESIGN
Unit Cover Page

Unit Title: The Story of Periodicity: An Exploration of Sam Kean's *The Disappearing Spoon* for Chemistry and English

Grade Level: 10th Grade

Subject/Topic Area(s): English II Pre-AP and Chemistry Pre-AP

Designed By: Elizabeth Muire and Kay Newsome

Time Frame: 10 days

School District: North East ISD

School: STEM Academy @ Lee High School

School Address and Phone: 1400 Jackson Keller Rd, San Antonio, TX 78213

Brief Summary of Unit (Including curricular context and unit goals): This unit incorporates knowledge of chemistry and English. Students will read and analyze, write persuasively, and explore the possibilities of storytelling to convey scientific ideas. They explore how the form and function of the periodic table is organized by the form and function of the elements on it, and extrapolate how the table could be continued. Students will design the potential next row of the table, once they have a clear understanding of how the current rows were discovered.

Unit: The Story of Periodicity: An Exploration of Sam Kean's *The Disappearing Spoon* for Chemistry and English

Grade: 10

Stage 1: Desired Results

Understandings

Students will understand that...

Scientific Research and Design

Historical development of the periodic table

The elements in each column of the periodic table have similar properties

Chemistry is relevant in everyday life

How one conveys information is as important as what information one conveys

Essential Questions

Knowledge & Skill

How was the Periodic Table developed?

How are the elements arranged on the Periodic Table?

How are elements synthesized in a laboratory?

Is there a limit to the number of elements that can be added to the Periodic Table of Elements?

(NEISD scope & sequence; TEKS; Core; etc.)

110.32.B.6--Reading/Comprehension of Literary Text/Literary Nonfiction

112.35.CH.2.C - The student uses scientific practices to solve investigative questions.

112.35.CH.2.D - The student is expected to distinguish between scientific hypotheses and scientific theories.

112.35.CH.6.A - The student is expected to describe the experimental design and conclusions used in the development of atomic theory

112.35.CH.5.A-- The student understands the historical development of the Periodic Table and can apply its predictive power.

Next Generation Science Standards

NGSS: www.nextgenscience.org

HS-PS1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Stage 2: Assessment Evidence

Performance Task:

Each student will create their own element that will predict the next row(s) of the periodic table
Description (should follow the conventions of writing; needs clarity and coherence; should use metaphor to assist understanding, like Kean does in the book)

electron configuration

estimate electronegativity

mass proton/electron number

properties

state

symbol and name per current IUPAC rules

melting/boiling point

propose a method for making your element based on current scientific research

Extra credit: write a fictional discovery story a la Sam Kean

Other evidence:

(quizzes, tests, academic prompts, self-assessments, etc.

note – these are usually included where appropriate in Stage 3 as well)

In English:

- 2-3 Reading quizzes over the book
- Persuasive essay about which element is best (“Write an essay stating your position on which element from the periodic table is the best.”)
- Article analysis over article about period/element

Stage 3: Learning Activities

(Steps taken to get students to answer Stage 1 questions and complete performance task)

Intro Activity: (English)

What’s on my head:

Students have a card on their forehead with an element on it. They cannot see their own card.

Students are given four minutes to mingle, with the directions that they want to talk to the “popular” elements-- those in groups with higher numbers.

After the mingling time is up, students find the table with the group number they think they belong at. Students at the table can only confirm or reject their belonging at the table (“You don’t belong in this group”) without telling them what element they are or what group they do belong in. Students who don’t belong try again until everyone is organized by group.

Once in their correct group, they should ask yes or no questions to determine which element they are.

Once they know what element they are, they should answer in complete sentences the question “Based on your prior knowledge of chemistry, was the use of group number to reflect an element’s popularity an accurate representation of reality?”

(ST, stenopsium, #137. NS, newsonium, #119)

Intro Activity: (Chemistry)

Looking for prior knowledge. Have the students write down on a sheet of paper everything they know or think they know about the periodic table. Have the students share out what they have written down and record common ideas/themes on large chart paper. The chart paper will be placed somewhere in the room and will stay up during the entire unit. Each idea will be addressed as the student progresses through the unit.

Additional Activities:

Sam Kean Element Videos

As the periodic table unit proceeds, begin class by watching one of the element videos listed below:

<https://teachchemistry.org/classroom-resources/collections/sam-kean-s-disappearing-spoon>

Watch the element's video pertaining to the group/period being covered. Answer the accompanying questions.

The videos and questions are from AACT/ACS

Element Ball

Students will also create an Element Ball. This activity focuses on chemical/physical properties of the element as a function of their placement on the periodic table and their discovery.

Each student will select an element by random, research and create a 20 sided ball, each side containing specific information regarding their element. The students will present their elements to the class. See attached file for details of this activity. See the write up for this activity below.

If possible, try to get a speaker from a local college or university to discuss how a Particle Accelerator works. A great source in Texas is Texas A&M Cyclotron Institute. <https://cyclotron.tamu.edu/>

Create your own element!

The students will investigate how natural elements were/are discovered versus how scientists create man-made elements today. The Disappearing Spoon discusses how natural elements were isolated and identified. The students will read articles and research how elements are synthesized in the laboratory. A few suggested articles include:

[How To Make an Element](#)

[Making New Elements](#)

[What it takes to make a new element](#)

This next set of articles explores just how large the periodic table could become. Is there a limit?

[A new period in superheavy-element hunting](#)

https://en.wikipedia.org/wiki/Extended_periodic_table

Create your own element project.

Over the past five years, scientist have added four new elements to the periodic table filling out the seventh period on the Periodic Table. These include 113 Nihonium, 115 Moscovium, 117 Tennessine, and 118 Oganesson. These elements were all synthesized in different laboratories located throughout the world.

Many scientist believe that there is a limit to number of elements that can be synthesized; some predict that the table will stop at the element 137, some predict up to 148 and others up to 172. How far can the table be extended? If they can be made, where would they lie on the Periodic Table? There are many unanswered questions but most scientist agree that the next elements synthesized will extend the period table creating the eighth and ninth periods on the Table.

https://en.wikipedia.org/wiki/Extended_periodic_table

You have read the *Disappearing Spoon* where Sam Kean discusses how many of the natural elements were discovered or isolated. In addition, you have read articles on how scientists today create new elements in the laboratory. Your next assignment is going to be to create your own synthetic element.

You will select an available tile (element spot) from either the eighth or the ninth row on the extended periodic table then research the possible synthesis routes to creating your element.

Write a one-page proposal (recipe) for time at the Flerov Laboratory of Nuclear Reactions Laboratory, a part of Joint Institute for Nuclear Research in Dubna, Russia where super heavy elements are made, to make your element.

We are going to assume that you will be successful so you will create the tile on the periodic table for your new element. On the tile, you will include the following

- the name and symbol of your element following the IUPAC guidelines,
 - Here are some websites that explain the process:
 - <https://www.bbc.com/news/magazine-35225788>
 - <https://www.thoughtco.com/how-are-elements-named-606639>
 - <https://www.chemistryworld.com/news/explainer-how-a-new-element-gets-its-name/1017676.article>
 - <http://thescienceexplorer.com/universe/here-are-proposed-names-four-new-elements-periodic-table>
- the atomic number (number of protons),
- atomic mass (number of proton + neutrons),
- number of electrons
- predict chemical/physical properties of your element
- actually build the tile using the 8 ½ x 14 sheet of paper provided by your teacher
- On the back of your tile, attach your one-page proposal
- Citations in APA style

Instructions for the tile.

- Obtain an 8.5" x 14" sheet of paper from teacher
- Draw a red border
- Atomic number in the upper left-hand corner in black ink
- Symbol in the center and color according to group/family
 - Alkali Meta – Yellow
 - Alkaline Earth Metal – Purple
 - Noble Gas – Orange
 - Transition Metals – Lt. Blue
 - Nonmetals – Green
 - Other Metals – Brown
 - Rare Earth Metals - Gray
- Atomic mass at the bottom and centered in black ink
- Number of protons, neutrons and electrons in the upper right-hand corner in black ink

Name: _____ Score: _____ / 18

Disappearing Spoon Element Project Rubric

	3 (Mastered)	2 (Developing)	1 (Suggestions)
Overall Assignment	Completed tile of an element including atomic number, name, symbol, description of the characteristics of the element and one page history of discovery	4 of the 5 items included	Less than 3 of the items included
One page	One page included pertinent and interesting information about your element	Half a page	Less than half a page
Atomic Mass	Atomic mass is consistent within range of the pattern of elements in group or family	Some thought given when determining the atomic mass. Close to range	Atomic mass is a pure guess
Number of Neutrons	Number of neutrons is consistent within range of the pattern of elements in group or family	Some thought given when determining the number of neutrons. Close to range	Number of neutrons is a guess. No thought given.
Citations	Citations present and in APA style	Citations present but not in APA style	No citations given
Tile	Tile is neat, legible and in the order outlined in the instructions	Half of the items included on the tile.	Tile appears to be thrown together at last minute. Less than half of the required items included.

Element Ball Project

Due: _____

This is an *individual project* - each student will build their own element ball. You will create a 20 sided ball describing the physical and chemical properties of an element.



Required Information:

1. Your name and project construction date
2. Element name
3. Chemical symbol
4. Atomic number
5. Atomic mass
6. Atomic radius
7. Number of protons, neutrons, and electrons
8. When discovered and by whom
9. Group and Period number
10. Family (Group) name (*halogen, alkali metal, transition metal, etc.*)
11. Common Oxidation Numbers
12. Boiling or Melting point
13. Density, in g/cm³
14. Is the element a metal, nonmetal, or metalloid?
15. Physical state at room temperature
16. Condensed (noble gas) electron configuration
17. Commercial use
18. Scientific use
19. Health or Safety issues
20. Picture

Suggested websites for Element Ball:

1. <http://www.webelements.com/>
2. www.chemicalelements.com
3. <http://periodic.lanl.gov/index.shtml>
4. www.lenntech.com/Periodic-chart.htm
5. <http://education.jlab.org/itselemental/index.html>
6. <http://www.chemcool.com/>
7. <http://www.ptable.com>
8. <http://www.rsc.org/periodic-table>

My Element is

You will hold a press conference to announce your discovery of a "new" element. In your press conference you will describe your element and facts regarding your element.

Construction:

1. Get 20 circles from Ms. Newsome.
2. Fold the circles into triangles, as shown on pattern. (All triangles must be exactly alike!) The folds will end up INSIDE the icosahedron.
3. Add one of the required items to each of 19 separate faces. Color and decorate as you please. Pictures or clip art may be suitable for some items. (All information must be placed inside the triangle-shaped space!)
4. Select 5 (five) triangles and glue, tape or staple them together in a pie shape pentagon to make the top of the element ball.

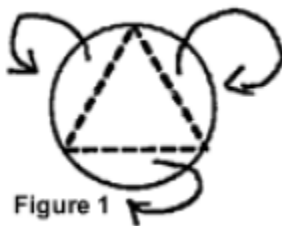


Figure 1

5. The folded parts of the circle should go inside the element ball.



Figure 2

6. Repeat with another 5 (five) triangles to make the bottom of the element ball.
7. Take the remaining 10 triangles and glue, tape or staple them together in a strip.

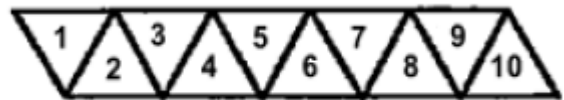
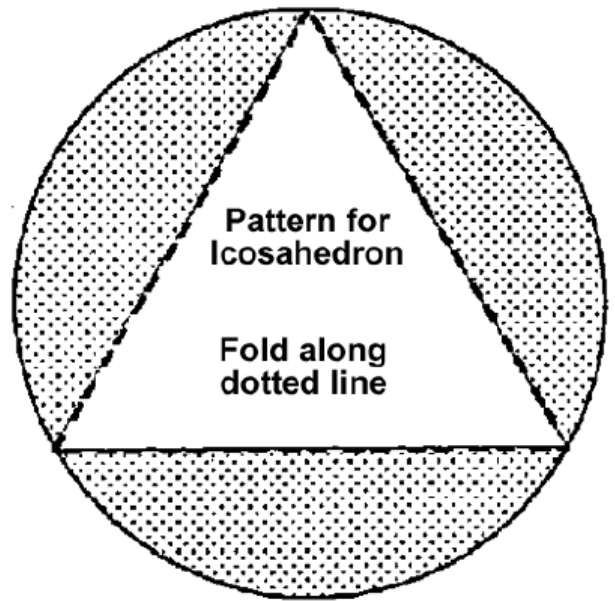
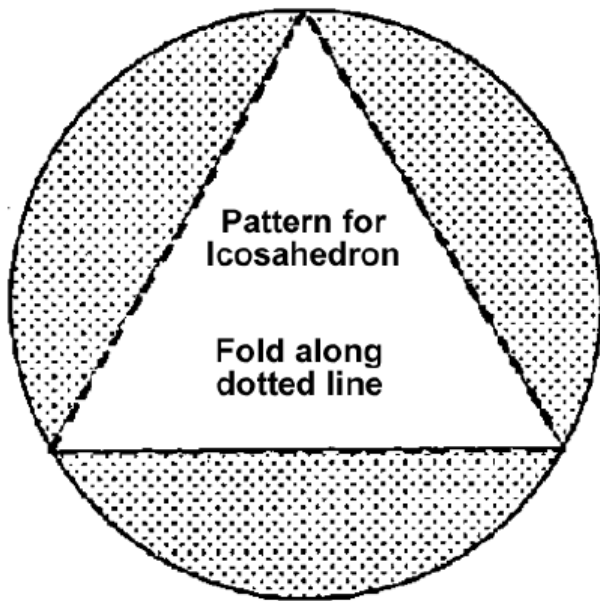
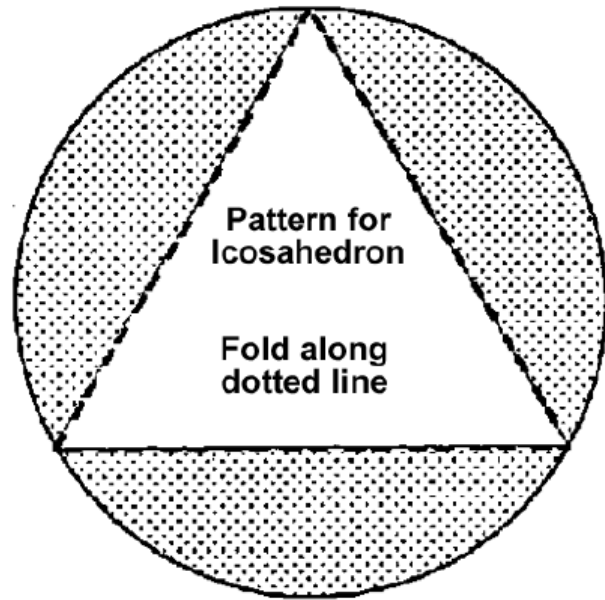
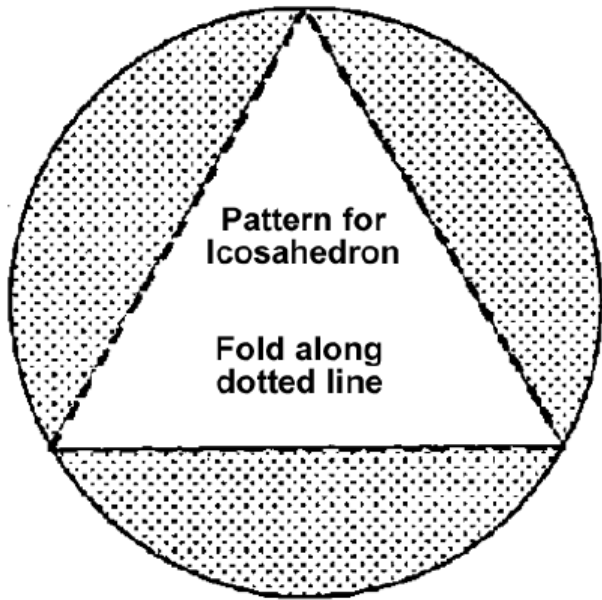


Figure 3

8. Glue, tape or staple the ends of the strip together to form a ring. This will form the equator of the element ball.
9. Secure one of the pentagons to the top of the ring. Turnover and secure the other pentagon to form the complete element ball. (This step requires AT LEAST three hands, so ask someone to help.)



Date: _____

Name: _____

Element Ball Project Fact Sheet – Turn in with your element ball.

1. Your name _____
2. Element name _____
3. Element symbol _____
4. Atomic number _____
5. Number of protons, neutrons, & electrons _____
6. Atomic mass number of the most common isotope _____
7. When discovered & by whom _____
8. Group and Period number _____
9. Boiling or melting point _____
10. Density _____
11. Isotopes _____
12. State of matter at room temperature _____
13. Source(s) in nature for obtaining the element _____
14. Noble-gas electron configuration _____
15. Commercial or scientific uses _____
16. Commercial or scientific use (No this is not a mistake, find 2 uses)

17. Environmental considerations in either producing the element or disposing of it

18. Atomic radius _____
19. Category (halogen, metalloid, etc.) _____
20. Health or safety issues _____

Sources, In APA style:

- 1.
- 2.
- 3.
- 4.
- 5.

Element Ball Rubric

Name _____ Element _____

	Exceeds	Meets	Approaching	Does not meet
Information	All 20 facts included and accurate plus up to 5 additional accurate, unique facts. 35 points	All 20 facts included and accurate 30 points	10 – 15 facts included and accurate 10-15 points	10 or less facts included and accurate 0-10 points
Construction	Unique, alternative materials chosen and meets expectations. 25 points	All sides neatly fitting together forming an icosahedron; is structurally sound and will not easily fall apart and can be hung up 20 points	Most of the sides are neatly fitting together. Contains a few loose pieces, can be hung up 15 points	Not all the sides are together, does not form an icosahedron; incomplete. Not structurally sound, cannot be hung up 5 points
Neatness & Creativity	Icosahedron has a theme that is complementary to your element and meets expectations. 25 points	All the information is clearly readable, pictures included. The layout is in logical order 20 points	Most of the information is legible and is in a somewhat logical order 10 points	Information not legible and randomly put on the icosahedron. 5 points
Presentation	The facts are presented in a logical and interesting format that the audience can follow. The presenter engages the audience 15 points	The facts are presented in a logical and interesting format that the audience can follow 10 points	Some of the facts are presented, others are read off of the project. The sequence is difficult to follow 5 points	Read the information off the ball; mumbles, difficult to understand 2 points
Sources	Four sources correctly cited APA style 12 points	Three sources correctly cited APA style 10 points	One source cited 5 points	No sources cited 0 points
Fact Sheet	Completed and turned in early with your project 12 points	Completed and turned in with icosahedron on time 10 points	70% completed or turned in completed late 5 points	Incomplete or not included 0 points
Total/100 points				

