Science Assessment System
Through Course Task

A New Element

Grade Level:
9, 10, 11, 12

Phenomena:
The Periodicity of Elements

Science & Engineering Practices:
Developing and Using Models
Engaging in Argument from Evidence

Crosscutting Concepts:
Patterns

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.

Preparing to implement Through Course Tasks in the Classroom

What is a TCT?

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

How do I facilitate a Through Course Task (TCT)?

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations. Success criteria include:
    - What is this task designed to get evidence of?
    - What is the task asking the students to do?
    - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential "trouble spots" and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student's competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:**
    - The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

A New Element Task Annotation

After **using various models** that depict *trends/patterns for the properties of elements in the periodic table*, **develop an argument** for *the location on the periodic table for a new element created that has defined properties* based on the patterns in the models as **evidence for your argument.**

Overall intent

This task gets evidence of a student's ability to use models that depict the trends of various properties embedded within the structure of the periodic table and use that information to identify the location of a newly created element. The task also gets evidence of their ability to develop a scientific claim, but they make the claim based on their ability to interpret the models appropriately.

Phenomenon within the task

The phenomenon is the periodicity of the elements, the predictability of elemental properties. The periodic table organizes elements according to similar properties so you can tell the characteristics of an element just by looking at its position on the table.

Ideas for setting up the task with students

Share ideas for ensuring that all students have an entry point to the task, and for setting up a positive learning climate in order to get best evidence of what the task is designed to measure.

- Use during or at the end of a unit where periodic trends have been taught.
- Student/teacher model analyzing patterns and comparing models.
- Students practice the creation and writing of accurate claims that are linked to correctly chosen evidence supported by sound reasoning on multiple topics.

Intent of the Task for Assessment

Students will identify and use patterns found in various models of the trends reflected in the arrangement of the periodic table to make an accurate claim giving the location of the element with defined properties. Students will then identify the evidence that supports that claim from each of the models provided, and justify the reasoning that links the evidence to the claim.

If students requiring special needs planning are being assessed, choose scaffolds that will accomplish the task with the same intent as above.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Using Models (Appendix F)

- Use multiple types of models to predict phenomena.

Engaging in Argument from Evidence

- Construct a written argument based upon appropriate and sufficient evidence.
- Make and defend a claim based upon evidence that reflects scientific knowledge.

Patterns (Appendix G)

- Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Graphs and charts can be used to identify patterns in data.
  (From grade band 6-8)

Success Criteria

- Students will make an accurate claim based upon the patterns found in the models to indicate where a "new" element would be located.
- Students will justify their claim by explaining how the trend(s) presented in EACH provided model supports an appropriate identification of the location based on any of the relevant properties provided about the "new element."

Possible Student Responses (these are not complete

- The new element would be found in group 1 and a new period, period 8.
- The new element would be found in the same family as Fr but below Fr.
- Since the new element has:
  1. A mass of 304
  2. Very low ionization energy
  3. Smallest electronegativity

4. Predicatively largest atomic radius
5. Great metallic character

- Based upon the graphs and models given, mass increases, ionization energy decreases, electronegativity decreases, atomic radius increases and metallic character increases. Going down, the group and mass increases, ionization energy increases, electronegativity increases, atomic radius decreases and metallic character decreases are you go across the period.

(Based upon the above requirements students must match the correct reasoning to the evidence pieces chosen)

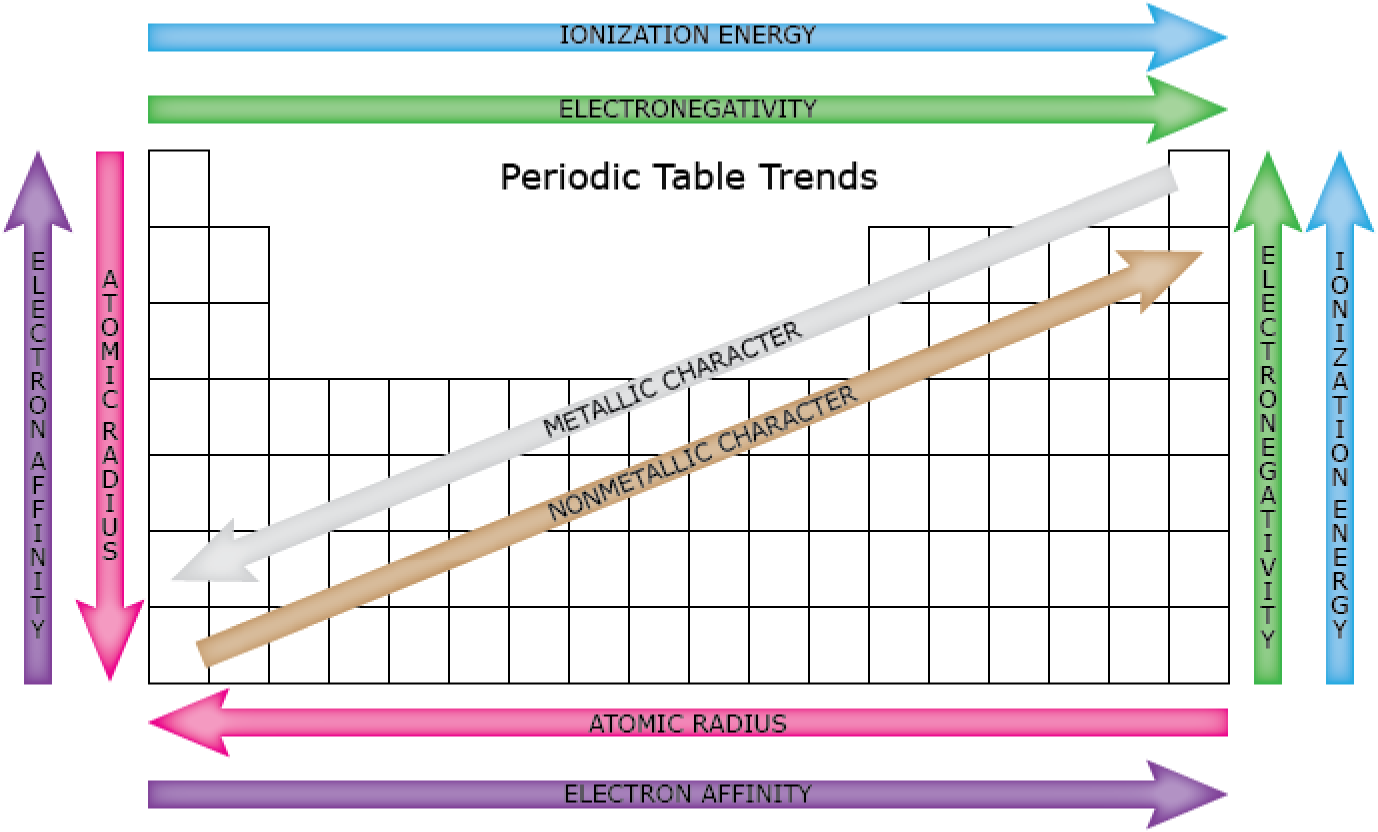
Other information teacher teams might find useful when preparing to use this task in the TCT process

Kentucky students should be using the Science and Engineering Practices regularly in science class. A great way to support the use of SEPs is to employ the Claim, Evidence, and Reasoning strategy with your students on a regular basis and to expose them to models and analyzing and interpreting data in your instruction.

Extensions and/or other uses after the task is implemented

- Students seemed to respond well to the prompt and may even find it easy. However, students seemed to only focus on a single piece of information given and not the all relevant pieces given. They also never mention the outlier properties.
- Students could study the task and resources to determine the fewest number of models needed to accurately identify the location of the "new element."
- More DCI work could be added here to extend the teachers view of student's standard understanding and to further test periodic trend knowledge going into bonding units.
    - valence number of the element
    - electron Configuration of the element
    - the ion charge of the element
    - the dot structure of the element

Answer key for the trend information (Patterns)



A New Element Has Been Created – Chemistry TCT

A new element has been created in the Large Hadron Collider in Cern, Switzerland and you are on the task force to determine where this new element should be placed on the periodic table using its known properties. The International Union of Pure and Applied Chemistry (IUPAC) will be deciding the name of the new element after validating the evidence for its existence.

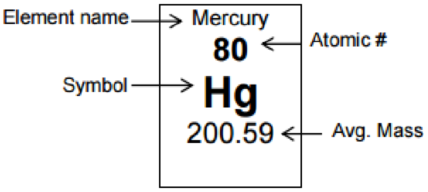
Using the provided models of periodic table or models of periodic table trends, consider the properties given for the "new element" and

- *Make a claim that locates the "new element" on the periodic table.*
- *Justify your claim with evidence and reasoning for each of the models provided.*
- *Describe the pattern or trend in each model and how the associated property for the new element relates to that trend, thus providing evidence for the location of the "new element."*

Properties of newly discovered element:

- *Mass number 304 amu*
- *Very low ionization energy*
- *Bonds easily with other elements*
- *Melting point 50.1 °C*
- *The smallest electronegativity*
- *Predicatively the largest atomic radius*
- *Great metallic character*
- *Silver in color*

The Periodic Table of the Elements

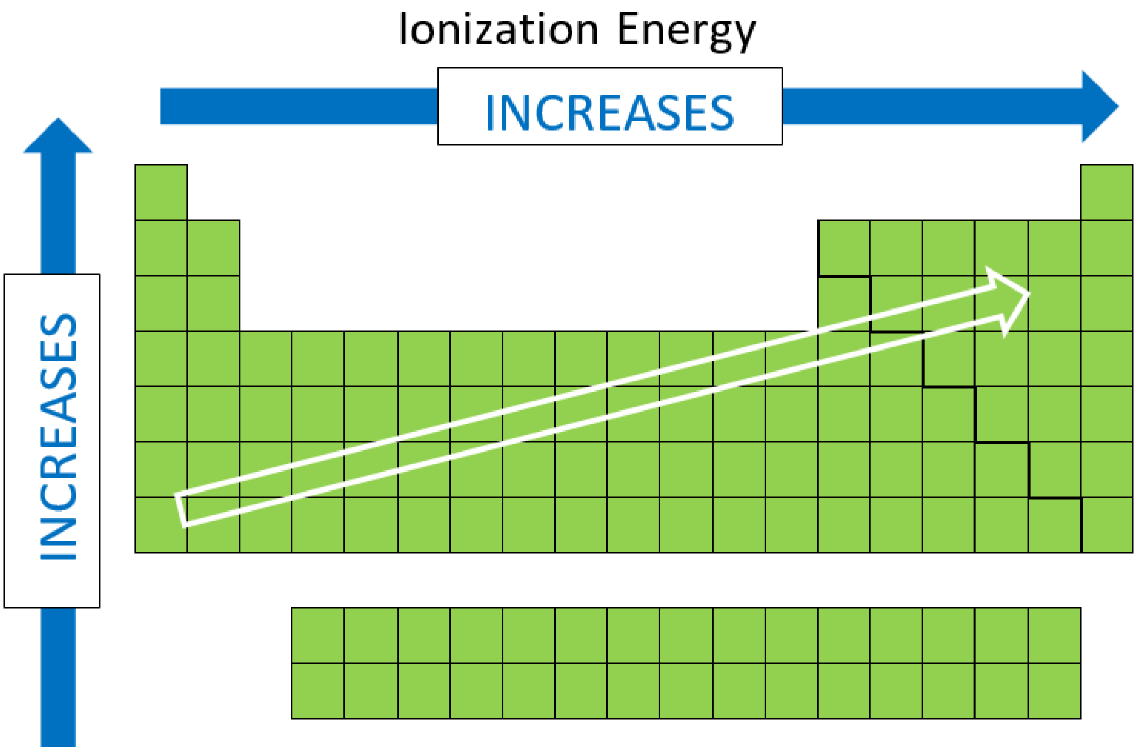


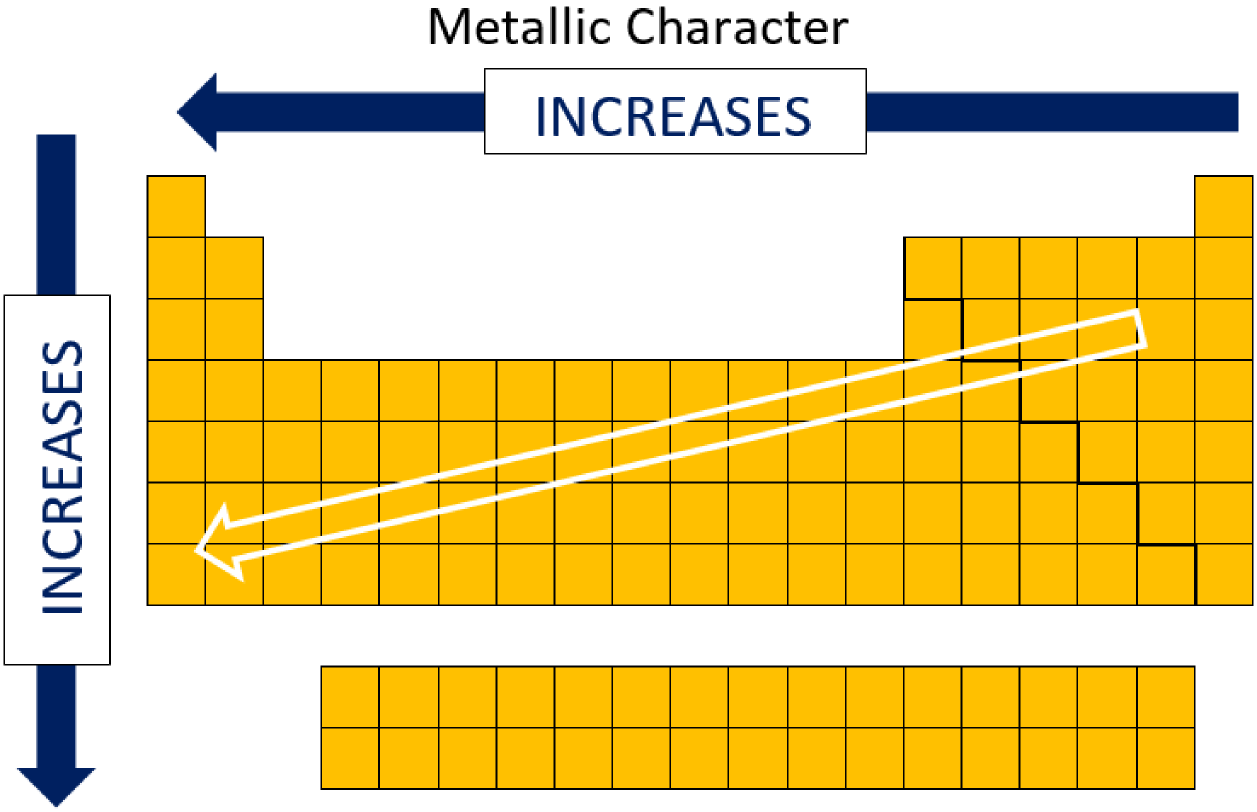
1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Hydrogen 1 **H** 1.01																		Helium 2 **He** 4.00
Lithium 3 **Li** 6.94	Beryllium 4 **Be** 9.01												Boron 5 **B** 10.81	Carbon 6 **C** 12.01	Nitrogen 7 **N** 14.01	Oxygen 8 **O** 16.00	Fluorine 9 **F** 19.00	Neon 10 **Ne** 20.18
Sodium 11 **Na** 22.99	Magnesium 12 **Mg** 24.31												Aluminum 13 **Al** 26.98	Silicon 14 **Si** 28.09	Phosphorus 15 **P** 30.97	Sulfur 16 **S** 32.07	Chlorine 17 **Cl** 35.45	Argon 18 **Ar** 39.95
Potassium 19 **K** 39.10	Calcium 20 **Ca** 40.08		Scandium 21 **Sc** 44.96	Titanium 22 **Ti** 47.88	Vanadium 23 **V** 50.94	Chromium 24 **Cr** 52.00	Manganese 25 **Mn** 54.94	Iron 26 **Fe** 55.85	Cobalt 27 **Co** 58.93	Nickel 28 **Ni** 58.69	Copper 29 **Cu** 63.55	Zinc 30 **Zn** 65.39	Gallium 31 **Ga** 69.72	Germanium 32 **Ge** 72.61	Arsenic 33 **As** 74.92	Selenium 34 **Se** 78.96	Bromine 35 **Br** 79.90	Krypton 36 **Kr** 83.80
Rubidium 37 **Rb** 85.47	Strontium 38 **Sr** 87.62		Yttrium 39 **Y** 88.91	Zirconium 40 **Zr** 91.22	Niobium 41 **Nb** 92.91	Molybdenum 42 **Mo** 95.94	Technetium 43 **Tc** (98)	Ruthenium 44 **Ru** 101.07	Rhodium 45 **Rh** 102.91	Palladium 46 **Pd** 106.42	Silver 47 **Ag** 107.87	Cadmium 48 **Cd** 112.41	Indium 49 **In** 114.82	Tin 50 **Sn** 118.71	Antimony 51 **Sb** 121.76	Tellurium 52 **Te** 127.60	Iodine 53 **I** 126.90	Xenon 54 **Xe** 131.29
Cesium 55 **Cs** 132.91	Barium 56 **Ba** 137.33	**57-70** *****	Lutetium 71 **Lu** 174.97	Hafnium 72 **Hf** 178.49	Tantalum 73 **Ta** 180.95	Tungsten 74 **W** 183.84	Rhenium 75 **Re** 186.21	Osmium 76 **Os** 190.23	Iridium 77 **Ir** 192.22	Platinum 78 **Pt** 195.08	Gold 79 **Au** 196.97	Mercury 80 **Hg** 200.59	Thallium 81 **Tl** 204.38	Lead 82 **Pb** 207.20	Bismuth 83 **Bi** 208.98	Polonium 84 **Po** (209)	Astatine 85 **At** (210)	Radon 86 **Rn** (222)
Francium 87 **Fr** (223)	Radium 88 **Ra** (226)	**89-102** ******	Lawrencium 103 **Lr** (262)	Rutherfordium 104 **Rf** (267)	Dubnium 105 **Db** (268)	Seaborgium 106 **Sg** (271)	Bohrium 107 **Bh** (272)	Hassium 108 **Hs** (270)	Meitnerium 109 **Mt** (276)	Darmstadtium 110 **Ds** (281)	Roentgenium 111 **Rg** (280)	Copernicium 112 **Cn** (285)	Ununtrium 113 **Uut** (284)	Ununquadium 114 **Uuq** (289)	Ununpentium 115 **Uup** (288)	Ununhexium 116 **Uuh** (293)	Ununseptium 117 **Uus** (294?)	Ununoctium 118 **Uuo** (294)

*lanthanides	Lanthanum 57 **La** 138.91	Cerium 58 **Ce** 140.12	Praseodymium 59 **Pr** 140.91	Neodymium 60 **Nd** 144.24	Promethium 61 **Pm** (145)	Samarium 62 **Sm** 150.36	Europium 63 **Eu** 151.97	Gadolinium 64 **Gd** 157.25	Terbium 65 **Tb** 158.93	Dysprosium 66 **Dy** 162.50	Holmium 67 **Ho** 164.93	Erbium 68 **Er** 167.26	Thulium 69 **Tm** 168.93	Ytterbium 70 **Yb** 173.04
**actinides	Actinium 89 **Ac** (227)	Thorium 90 **Th** 232.04	Protactinium 91 **Pa** 231.04	Uranium 92 **U** 238.03	Neptunium 93 **Np** (237)	Plutonium 94 **Pu** (244)	Americium 95 **Am** (243)	Curium 96 **Cm** (247)	Berkelium 97 **Bk** (247)	Californium 98 **Cf** (251)	Einsteinium 99 **Es** (252)	Fermium 100 **Fm** (257)	Mendelevium 101 **Md** (258)	Nobelium 102 **No** (259)

Table of Electronegativity

H 2.20																	**He** n.a.
Li 0.98	**Be** 1.57											**B** 2.04	**C** 2.55	**N** 3.04	**O** 3.44	**F** 3.98	**Ne** n.a.
Na 0.93	**Mg** 1.31											**Al** 1.61	**Si** 1.90	**P** 2.19	**S** 2.58	**Cl** 3.16	**Ar** n.a.
K 0.82	**Ca** 1.00	**Sc** 1.36	**Ti** 1.54	**V** 1.63	**Cr** 1.66	**Mn** 1.55	**Fe** 1.83	**Co** 1.88	**Ni** 1.91	**Cu** 1.90	**Zn** 1.65	**Ga** 1.81	**Ge** 2.01	**As** 2.18	**Se** 2.55	**Br** 2.96	**Kr** 3.00
Rb 0.82	**Sr** 0.95	**Y** 1.22	**Zr** 1.33	**Nb** 1.60	**Mo** 2.16	**Tc** 1.90	**Ru** 2.20	**Rh** 2.28	**Pd** 2.20	**Ag** 1.93	**Cd** 1.69	**In** 1.78	**Sn** 1.96	**Sb** 2.05	**Te** 2.10	**I** 2.66	**Xe** 2.60
Cs 0.79	**Ba** 0.89	**La** 1.10	**Hf** 1.30	**Ta** 1.50	**W** 2.36	**Re** 1.90	**Os** 2.20	**Ir** 2.20	**Pt** 2.28	**Au** 2.54	**Hg** 2.00	**Tl** 1.62	**Pb** 2.33	**Bi** 2.02	**Po** 2.00	**At** 2.20	**Rn** n.a.
Fr 0.70	**Ra** 0.89	**Ac** 1.10	**Rf** n.a.	**Db** n.a.	**Sg** n.a.	**Bh** n.a.	**Hs** n.a.	**Mt** n.a.	**Ds** n.a.	**Rg** n.a.	**Uub** n.a.	—	**Uuq** n.a.	—	—	—	—


Ionization Energy
INCREASES
INCREASES


Metallic Character
INCREASES
INCREASES

Atomic Radius