**Crosscutting Concepts (CCCs) Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**1.** [**Patterns (P)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=1)[**https://youtu.be/pSb3tSKhCr0**](https://youtu.be/pSb3tSKhCr0)

**2.** [**Cause and Effect: Mechanism and Explanation (C/E)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=2)[**https://youtu.be/Ke1qGciyT7U**](https://youtu.be/Ke1qGciyT7U)

**3.** [**Scale, Proportion, and Quantity (SPQ)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=3)[**https://youtu.be/Dw1sphCEmq8**](https://youtu.be/Dw1sphCEmq8)

**4.** [**Systems and System Models** **(SM)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=4)[**https://youtu.be/8kj\_\_V8ehDU**](https://youtu.be/8kj__V8ehDU)

**5.** [**Energy and Matter: Flows, Cycles, and Conservation (E/M)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=4)[**https://youtu.be/U22h55dHIi0**](https://youtu.be/U22h55dHIi0)

**6.** [**Structure and Function (S/F)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=6)[**https://youtu.be/hAyHev2cwd0**](https://youtu.be/hAyHev2cwd0)

**7.** [**Stability and Change (S/C)**](https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=7)[**https://youtu.be/EMiHXXUlh6c**](https://youtu.be/EMiHXXUlh6c)

For each of the 7 CCCs, Use the Bozeman Science Video links above to explore more what is meant by each crosscutting concept.

Then answer the following questions. (3 for each CCC)

1. Provide 2 types of activities that scientists or engineers might be doing that are related to their use of patterns.

**Classification, graphing, comparing, product testing, ranking, sketching…**

2. Give an example of the use of or identification of, patterns outside of the domain of science to demonstrate that it is a cross cutting concept.

**e.g. Traffic patterns, weaving patterns in textiles, patterns in music, patterns in poetry, patterns/statistics in baseball performance**

3. What does this sequence of numbers mean and what pattern did you use to solve this puzzle?

**18-5-3-15-7-14-9-20-9-15-14 = RECOGNITION**

**Each number corresponds to a letter using its position in the alphabet.**

4. What is the difference between “cause and effect” and correlation? Stork populations in Sweden and Swedish birth rates both peak in the spring. Is this a case of cause and effect?

**Two things linked by cause and effect, first the cause happens, then through some mechanism an effect happens. For a correlation, two variables have a relationship but there is no mechanism of action. This example is a correlation, NOT a causation.**

5. How can you demonstrate that an effect is due to a specific cause?

**Needs a chain of interaction or mechanism of action, argue from evidence and theory to support a proposed mechanism.**

6. What is a big fundamental assumption we make that allows us to commonly infer causation?

**That cause and effect are universal.**

7. Define what is meant by Scale? Proportion? Quantity?

**Scale = of a size related to some reference….e.g. human scale, microscopic scale, astronomic scale, atomic scale**

**Proportion = a ratio, or fraction. Proportions are often the same even at different scales.**

**Quantity = how much you have of something, how many items or how much of some characteristic**

8. What two scales are most commonly used in chemistry?

**Human scale and atomic scale**

9. Which of these scientific activities are examples of the use of scale, proportion and quantity?

**a. measuring the mass of a sample**

**b. graphing mass vs. volume**

c. classifying compounds by type

d. identifying the type of intermolecular force present

**e. ranking ionization energies**

10. What is a system?

**A part of the universe that we study with a defined boundary.**

11. Give 4 examples of systems.

**An organism like an elephant, a celestial body like a star or a galaxy, an atom or subatomic particle, the contents of a reaction flask, a machine like a car, part of a larger system that performs some function like the circulatory system of the heart and blood vessels….**

12. What’s the difference between a mental model and a system model?

**Mental models are your own ideas of how a system works and are personal, incomplete, internal, unstable, and idiosyncratic. A system model is a clear, shared and external demonstration of how a system works.**

13. Define flow, cycle and conservation of matter or energy for a system.

**Flow is matter and energy entering and exiting a system. Input, Output.**

**A cycle is matter and energy moving around within a system.**

**Conservation is that matter and energy of a system must remain constant.**

14. Are mass and weight the same thing? Explain.

**No. Mass is the amount of matter. Weight is the pull of gravity on matter.**

15. When can matter turn into energy and vice versa?

**Only in nuclear reactions.**

16. What is a structure and what is a function?

**A structure is all of the parts of a system, a description of the matter identity and organization. Function is what a system does, its purpose.**

17. Infer the function of a movable jaw on a wrench? Infer the function of the length of the wrench?

**Movable jaw allows wrench to fit around many different sizes of nuts. The length increases the ability to turn the nut.**

18. Sketch a functional bicycle including two wheels, a seat, handlebars, a frame, pedals and chain.

**Stable box to back wheel and single rod to front wheel, pedals in the middle, chain connecting the pedals and rear wheel.**

19. What is stability? Give an example of a stable system.

**A system that doesn’t change over time. Eg: A table; books sitting on a table; a bridge…**

20. What is change? Give an example of a system that is experiencing change.

**A system that does change over time. Eg: Bacterial growth; predator population…**

21. What is stable change (or equilibrium)? Give an example of system that has shows a stable change.

**A system that changes over time, but does with no net change overall or in a repeating pattern. Eg: The phases of the moon…**