Crosscutting Concepts
for Middle School Students
(grades 6-8)

A project of the
CA NGSS K-8 Early Implementation Initiative

A Collaboration of the K-12 Alliance @ WestEd,
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The following resource was developed by the CA NGSS K-8 Early Implementation Initiative as a way for middle school students to gain independence in using Crosscutting Concepts once they have had guidance from a teacher.

Please acknowledge the CA NGSS Early Implementation Initiative, K-12 Alliance @WestEd when using or adapting.
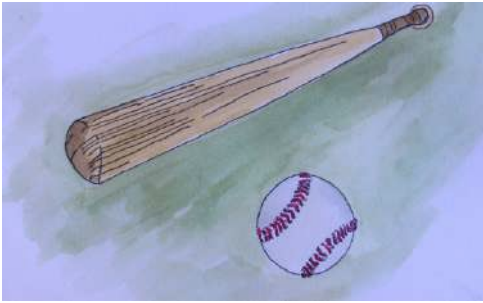
Cause and Effect

Crosscutting Concepts

Identifying the cause of an event (whether there is one cause or many) helps us decide if there is a relationship that can be explained, and, in some cases, it might inform a solution to a problem.

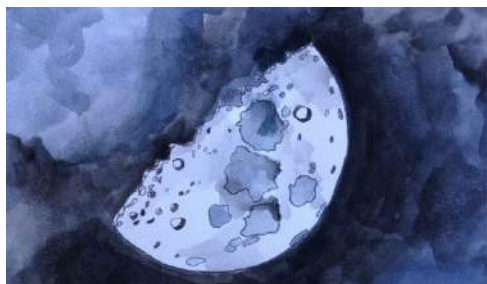| Entry Level	Increasing Sophistication	On-Target
I can use evidence to identify and analyze causes of events and design tests that gather more evidence.	**I can identify cause and effect relationships to help explain change and the reasons for the change.**	**I can use evidence of cause(s) and effect(s) to decide the type of relationship between them and to predict future change.**
• What is the cause of this event? How do you know? • How does this cause help you identify a pattern? • How can you design a test to gather evidence (or refute ideas) about a possible cause?	• What cause and effect relationship(s) can you identify? How did this change happen? Why did this change happen? • What conditions were needed for an event to happen? • What did you learn when you tested a cause and effect relationship? Do the results of this test help you explain change? If so, how? • If your observations/data show that two things happen together regularly - does it mean that one caused the other? How do you explain this? • What evidence do you have that one event caused (or didn't cause) another when the two things happen together regularly?	• Is the relationship you are seeing describing a cause that directly leads to an effect? Or, is the relationship describing two (or more) events that occur together, where one may not cause the other? • What predictions can you make about phenomena, with confidence, based on this cause and effect relationship? What is your evidence for this? • How confident/sure are you? What else do you need to be more confident/sure? • What other causes might help you explain these phenomena? • How can a pattern in the effect, predicted by the cause, help describe phenomena? • How likely is it that this effect is going to happen? Why is this more or less likely?

Energy and Matter

Crosscutting Concepts

In any system, there are amounts of energy and matter that can change, but are conserved. Tracking how these flow/cycle into, within, and out of a system help us understand how a system works.

Entry Level	Increasing Sophistication	On-Target
I can identify and describe the change in objects.	**I can identify and describe matter moving into, within, and out of a system and the parts it's made of. I can describe energy moving from one object to another.**	**I can identify and describe how matter and energy are conserved, how they can change, and the relationship between the two.**

Entry Level
- How can the object be broken down into smaller parts?
- How can smaller parts make a larger structure?
- How can the object change shape?
- How can the objects be broken down and put back together?

Increasing Sophistication
- How can you show/describe what this matter is made of?
- What evidence do you have that matter moved - into, within, or out of - a system?
- Where did the energy come from? Where is the energy going?
- How does the energy change? Can it change in another way?
- How can you show/describe what is happening to energy?

On-Target
- What evidence do you have for changes in matter during this physical process?
- What evidence do you have for changes in matter during this chemical process?
- What happened to the amount(s) of matter as a result of these changes?
- How is matter changed, yet still conserved?
- What evidence do you have of atom rearrangement in a chemical process?
- What are the different forms of energy you can identify? Do they change? Do they move? What is your evidence?
- How can you describe/show the different forms of energy?
- How can you describe/show the path of energy flowing through a system?

Patterns

Crosscutting Concepts

Patterns are used to help organize and classify observed phenomena, and ask questions about relationships and their underlying causes.

Entry Level	Increasing Sophistication	On-Target
I can make observations, find patterns, and describe them.	**I can see similarities and differences in patterns and use them to predict and explain.**	**I can identify and infer patterns in things not easily seen.**
• What patterns can be you identify based on your observations? • How can the patterns you identified be used to describe phenomena? • How can the patterns you identified be used as a way to provide evidence about phenomena?	• When you compare patterns, what about them is similar? What about them is different? • How can you use similarities and differences to sort, classify, and help communicate understanding? • What is a rate of change between patterns you have observed? • What do you predict will happen in the future? How does a pattern showing change help you predict what will happen in the future? • What patterns provide evidence for your explanation?	• What are macroscopic patterns you are observing? • What patterns can you identify from structure(s) that are microscopic? • How can you describe a large pattern based on all the components of smaller patterns? • How do your observations of large patterns help you understand smaller patterns and patterns in things not directly observable? • What information do patterns in rates of change provide? • What patterns in the organized data (graph, chart, figure, or image) can you identify? • What cause and effect relationship(s) can you identify from the pattern?

Scale, Proportion and Quantity

Crosscutting Concepts

Recognizing that systems and processes can be different in size, time, and in the amount of energy flowing through them helps us understand that the way things work will change with scale (like things too small or fast to observe, or those that are too large or slow making them hard to understand) and that there will be differences in rates of changes between things because of scale, and changes in scale can also change the relationship between things.

Entry Level	Increasing Sophistication	On-Target
I can describe and compare the differences in scale in objects, space, and time, and I can measure length.	**I can estimate scale as I make sense of data. I can measure, compare, and organize quantities of weight, time, temperature, and other variables.**	**I can use models showing different scales to help me understand phenomena, including time, space, and energy. I have a sense of how relationships change with changes in scale. I can recognize, use, and interpret mathematical representations.**
- How can you describe differences between two objects or events? (Which is bigger/smaller? Which is hotter/cooler? Which is faster/slower?) - How can you measure the length of an object (using m, cm, or mm)?	- How can you describe and estimate the size of something very small? Very large? Very short? Very long? - Does your description sound reasonable? - How can you measure the weight of an object (using g, kg)? - How can you measure the time involved (using seconds, minutes, hours, years, etc.)? - How can you measure the temperature (using C)? - How can you measure the volume (using mL, L)? - What is another way you can measure this? - How can you use the measurements of something to compare and organize objects?	- How is this model used to represent very long/ short periods of time (or things that are very large/small)? What does it help you understand? - How can you develop a model to represent very long/short periods of time (or things that are very large/small)? What are important considerations for this model for the scale to be understandable? - How can the model be adjusted to improve understanding of the scale of the phenomena to you or another person? - If the scale of this changes, how will the function change? - Is there a proportional relationship in the types of quantities? Can you use this to describe a property or process at larger and smaller scales? - How does this equation represent a relationship between aspects of the phenomenon? - What equation could you write to show the relationship between parts of this phenomenon? - If you change the scale, would you still be able to observe this? How would the relationships change?

Stability and Change

Crosscutting Concepts

To help make sense of our world, we try to understand how change occurs how some parts of the system can change but the overall system stays stable.

Entry Level	Increasing Sophistication	On-Target
I can describe and explain things that don't appear to change (remain stable) and things that change.	**I can describe and measure change, and differences in change.**	**I can explain Aspects of change including understanding of sub-structures, interactions between parts, and the need for feedback to maintain stability.**
• What things are staying the same? How do you know? • What things are changing? How do you know? • How quickly or slowly is change happening? • What is affecting the speed of change?	• How do you know a change happened? How do you measure it? • How do you know something is stable? How do you measure it? • How do you determine if the change is consistent or if it fluctuates? • When did the change occur? • When did things become stable? • How can you suggest a better way to measure change and stability? • Would you describe the change as great or small? Why? • What happens to the change over short periods of time? • What happens to the change over long periods of time?	● What evidence do you have for when and why the change occurred? ● What evidence do you have for when and why things became stable? ● How can you explain the changes over time? What is your evidence? ● How can you explain the disruption in stability? What is your evidence? ● How do forces at different scales influence change? ● How does change in one part of the system lead to change in another part? ● How could a sudden event affect stability? ● How do gradual changes over long periods of time influence overall stability? ● What leads to stability? ● How does information about subsystems inform the overall system? ● How does one part of the system respond to changes in other parts of the system? ● How can parts of the system respond to changes in another part to create an overall stable system?

Structure and Function

Crosscutting Concepts

Understanding how an object is shaped and how it is structured helps us understand its properties and function.

Entry Level	Increasing Sophistication	On-Target
I can identify the relationship between shape, stability, and the function of an object. • How does the shape of the structure affect its function? • How does the shape of the structure affect its stability? • What is the relationship between stability and function of the structure?	**I can relate the structure of sub-systems and the shapes of their parts to their function.** • What evidence do you have for the type of material a substructure is made of? • How do the shapes and parts of substructures impact their function?	**I can visualize and model the structure and function of objects, sub-systems, and processes** • What variables influence the properties of this structure? (Variables include shape, composition, relationship among its parts, etc.) • How can this system or structure (whether complex or microscopic) and the influence of its variables be visualized, modeled, and/or used to describe how variables impact its function? • What function does this object, sub-system or process need to do? What variables need to be taken into account when designing a structure for this particular function?

Systems and System Models

Crosscutting Concepts

Sometimes things we want to understand are so big and complicated they can be hard to make sense of. Applying systems thinking, we can consider a small part, with pretend boundaries, to build smaller understanding first. All of the small parts we consider add up to the whole part and can give us bigger understanding.

Entry Level	Increasing Sophistication	On-Target
I can describe (through words and drawings) everything in the world as made up of smaller parts that work together.	**I can describe a system based on its smaller parts and the jobs they do. The small parts have a relationship with each other and also work together to help the whole system function.**	**I can describe a system and the smaller sub-systems that create the larger system. I can use models to represent the system, its sub-systems and how these sub-systems interact together and I can identify the limitations of those models.**
- What are the parts that make up this object/organism? - How can you show/describe the parts of the system? - How do the parts of this object/organism work together as a system? - How can you show how the parts of this object/organism work together as a system? - What changes can you make to your plan or model of parts and how they work together so someone else can understand it?	- What are the parts within this system? - What are the functions of these parts of this system or this system as a whole? - How can this system be described? - How does your model show things you can't see, but have indirect evidence for? - What do the parts do together that no single part can do alone?	- How does one system interact with another system? - Is your system really a sub-system of a larger, more complex system? How do you know? - What model could you use to represent the whole system? The sub-systems? - What part of the system does the model represent? How is that shown? - What interactions between parts are represented in the model? How are they shown? - How does energy flow into, within, and out of the system? - How does matter cycle into, within, and out of the system? - How does information flow into, within, and out of the system? - What is the model unable to show? - What do you have to assume is true for this model to work? - How confident are you that this model fairly represents the system? Why? Are there any changes you can make to increase confidence?