

Prompts for Assessing Using the Crosscutting Concepts (CCCs)

Recognizing Patterns

After presenting students with data

- What patterns do you observe in the data?
- Are there ways you can use mathematics to summarize the data that might help you see patterns in the data more clearly, to determine whether _____ affects _____?
- What does the pattern of data allow you to conclude from the experiment?
- Are there any other data that are needed to test whether _____ affects _____?
- What observations could you make next to help explain the pattern in the data?
- What do you predict will happen to [variable] in the future? Use the pattern you see to justify your answer.
- On the basis of the patterns you see, what appears to be the cause of failure in the system?

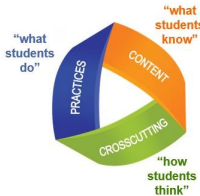
When asking students to classify as part of the scenario

- What are some similarities and differences among the _____?
- What is one way you could classify or group these _____ to create groups that are similar to each other? Describe the characteristics you are using to classify.
- To which of your groups would an [object, organism] with _____, and _____ characteristics belong?

Explaining Cause and Effect Relationships

When drawing conclusions from an investigation

- How do the patterns in data allow you to decide whether _____ caused _____?
- What caused the patterns you observed in the data? How do you know?
- How can you test whether _____ caused _____ to happen?
- What do you predict would happen if [extrapolate to new, related situation]?
- Draw a diagram that shows how changes to one component of the system affects another system.
- What feedback loops are causing this system to be in equilibrium?
- How can such a small change to _____ have a big effect on _____?
- What is the probability that _____ caused _____? How do you know?
- What evidence presented in the scenario supports the claim that _____ causes _____?



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Changes in Scale, Proportion, or Quantity

When eliciting understanding of scale, proportion or quantity in data

- How could you measure [property or characteristic]?
- What would make a good measure of [property or characteristic] to investigate the phenomenon presented in the scenario? Why is this a good measure?
- What is the ratio of _____ and _____ in the data presented?
- On the basis of the data you have, what do you predict would be the effect of a change in _____ on _____?
- What scale of a model would allow you to gain insight into _____?
- What scale of a model would allow you to test the design of _____ in the classroom?

When eliciting student's ability to change scales to investigate phenomena

- How could we test whether _____ is changing, even though it looks like it is not?
- Which of the patterns presented in the scenario do you think could be observed at a [faster/slower, smaller/larger] scale? Why?

Defining the System Under Study

When eliciting information about the components and interactions of systems

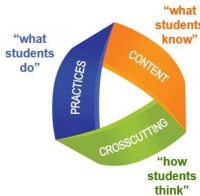
- What are the key parts of the [natural object, designed object, organism] described in the scenario?
- Draw the parts of the system described in the scenario.
- How do the parts of the [natural object, designed object, organism] work together? What do the parts do together that the individual parts cannot do alone?
- What would happen in this system if you increased/decreased [component of the system]?

When eliciting information about the boundaries of the system

- What is the boundary of the system described in the scenario?
- Draw a boundary to indicate what is inside/outside the system.
- Can this system be physically isolated in order to study it?

When there are feedback loops presented in the scenario

- What feedback loops make this system stable/unstable?
- How do positive/negative feedback loops in this system affect how it functions?



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The Movement of Energy and Matter

When eliciting understanding of changes to or of the cycling of matter

- Where is the matter coming from that enters this system? What happens to the matter within the system? Where does the matter go that leaves the system?
- Draw a picture illustrating the flows of matter in and out of the system.
- How are the atoms in molecules being rearranged into different molecules?
- What evidence is there that matter is conserved in these changes/in this cycle?

When eliciting understanding of energy change

- How is energy coming into/going out of this system?
- What forms of energy are involved in this system?
- What energy transformations take place during the chemical change?
- How much energy is needed to [make something happen]?
- Draw a picture that shows the cycle of energy in this system.
- What evidence is there that energy is conserved in this system?

Structure and Function

When presenting students with observational data

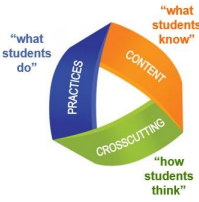
- What structures are present in _____ / What function does each structure have in [scenario]?
- What is the relationship between structure and its function?
- Why does the shape of _____ matter for its function? What other properties of the structure might allow it to have certain behaviors?
- What function do you think [structure] serves in this system? How could we find out?
- This system performs [describe function]. How do you think the structures support those functions?

When asking a student to design a solution

- Describe the structures in your solution. Describe the function of your solution. What is important about the relationship between the structure and function in your solution that make it a successful design.

When asking a student about structure and function in ecosystems

- Identify the properties of the environment that constrain behavior of organisms. What about the structure of the organism allow them to survive within the environment? What is the behavior of the organism and the function of the structures it has?
- You find a new animal in an environment. It has [structure] it uses to [perform function]. Given what you know about the ecosystem, explain how [structure] supports its survival in this ecosystem.



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Conditions of Stability and Change

When the scenario presents a system that periodically experiences equilibrium

- Is the system described in the scenario stable or unstable? Present evidence to support your claim.
- How was this system affected by [sudden event described in scenario]?
- How might this system be affected by [sudden event not in scenario]?
- What are the factors causing this system to be stable/unstable at [point in time]?
- What patterns do you observe in the way that the system changes over time?
- What explains why the pattern is happening in this system?
- How can you design a system that would be more stable?

When a scenario presents a system with feedback loops

- How does _____ affect _____?
- What explains why when _____ happens, _____ changes and then affects _____.

When the scenario looks stable at one scale and unstable at a different scale

- How was this system affected in the long term by [changes described in scenario].
- How might this system be affected in the long term by [gradual changes not described in scenario].
- How is the effect of _____ offset by the effect of _____ in this system?



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