

Relationship Between Structure and Function

Recurring themes and concepts provide structure to connect scientific ideas across disciplines. Use the following questions to plan intentional conversations, making deep connections between content and recurring themes and concepts. Please note, these questions are not grade specific. Select appropriate questions using your knowledge of your students and grade-level rigor. Complete the questions by selecting the appropriate terms based on the phenomenon.

Within a system or organism:

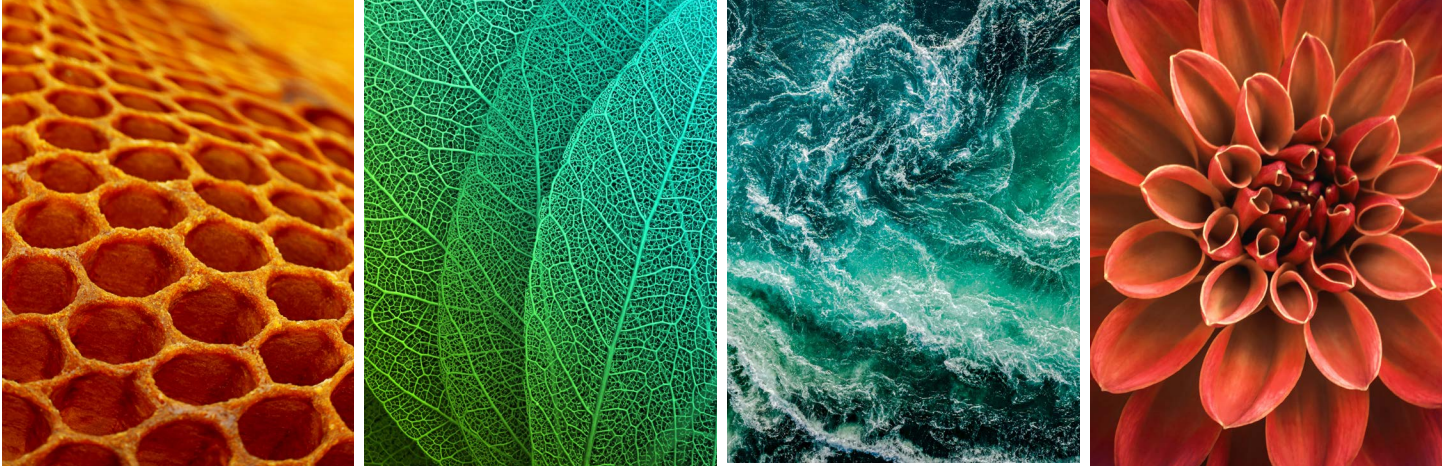
- How does the [structure] allow [organism or system] to [function]?
- How does the [function] drive the [structure]?
- What might this [structure] allow the [organism or system] to do? Why?
- How might the ability to [function] change if the [structure] was a different shape/size/texture?
- What could improve the [structure/design] ability to [function]?

Between two or more systems or organisms:

- How does the [structure] of the [organism or system] affect or interact with the [structure] of the [second organism or system]?
- How does the [function] of the [organism or system] affect or interact with the [function] of the [second organism or system]?
- How are the structures of [organisms or systems] related?
- How are the functions of [organisms or systems] related?

Among systems or organisms and environment :

- How does the [organism or system] use [structure] to interact with its environment?
- What environmental factors could change how the [structure] performs [function]?



Patterns

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Within objects, organisms, or a system:

- What common characteristics do [objects/organisms] have within this phenomenon?
- How could you classify the [objects/organisms]?
- How are the [objects/organisms] similar or different?
- How does the [object /organism/system] mimic the [second object/organism/system]?
- Based on the pattern, what predictions can you make about [object/organism/system]?

Within processes:

- What repeating actions do you observe in this [process/cycle]?
- Based on the [process/cycle] can you predict what will happen after [event/action]?
- How does [process/cycle] correspond with [second process/cycle]?

Within data:

- What patterns do you notice within the [table/chart/graph/data source]?
- What patterns do you notice in [mathematical analysis] of the data?
- What do the patterns in the [table/chart/graph/data source] show?
- Based on the patterns in the data, what [decision/prediction] can you make about the [design/phenomenon/process]?



Cause and Effect

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With force or energy:

- What effect did [force/energy] have on the object?
- What effect might a change in the [force/energy] have on the object?
- What [force/energy] might have caused [change/effect]?
- What evidence supports the claim that [force/energy] caused [effect]?

With actions or behaviors:

- What [action/behavior] led to [effect]?
- What effects might [action/behavior] have on [action/behavior/object]?
- How might a change in [action/behavior] lead to a change in its effect?
- How might an [organism/object] respond to [behavior/action]?

With organisms, systems, or conditions:

- What effect does changing an element of [organisms/design] have on an element of [second organism/design]?
- What effect does a change in [organisms/prototype] have on the system?
- What effect does a change in the system have on the [organisms/prototype]?
- What effect does a change in [conditions] have on the [organism/object/or system]?



Flow of Energy and Cycling of Matter

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Among objects or organisms:

- What supplies energy to the [object/organism]?
- How is matter cycled between [objects/organisms]?
- How is matter conserved during this [physical/chemical] change?
- How is energy [transferred/transformed] between or within [objects/organisms/cycles]?

Among systems:

- How is matter cycled in [system]?
- How did matter [enter/exit] [system]?
- How is energy [transferred/transformed] in [system]?
- How did energy [enter/exit] [system]?
- How are energy and matter connected within [system]?

Among cycles:

- How does energy drive processes within [cycle]?
- How is matter conserved within [cycle]?
- How are energy and matter connected within [cycle]?



Scale, Proportion, and Quantity

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Quantity:

- What is the length of [object/organism/prototype]?
- What is the volume of [object/organism/prototype]?
- What is the mass of [object/organism/prototype]?
- How many [objects/organisms/components] are present?
- How might an [increase/decrease] in [objects/organisms/components] alter the system?
- How does a change in quantity impact the [system]?

Scale:

- How much [shorter/longer] is [one object/organism] than [another object/organism]?
- How much [smaller/larger] is [one object/organism] than [another object/organism]?
- How much [lighter/heavier] is [one object/organism] than [another object/organism]?
- How might changes in scale affect a system's [structure/performance]?
- How is the length of time for [process/cycle] different from the length of time for [process/cycle]?

Proportion:

- What is the ratio of [one object/substance] to [another object/substance]?
- What proportion of the sample has [physical property/characteristic]?



Model Interdependence and Parts of a System

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Parts of a system:

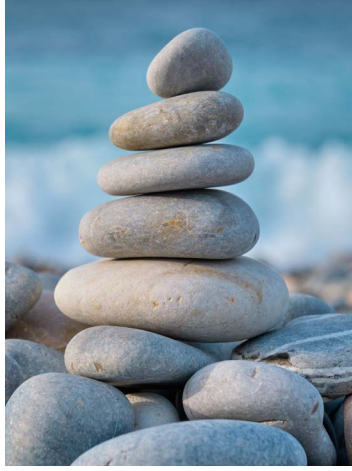
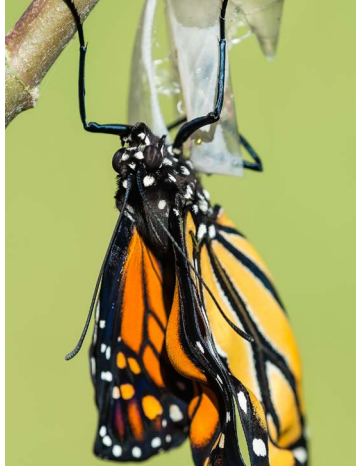
- What are the parts that form the [object/organism/design]?
- How do the parts of the [object/organism/design] work together?
- How would the [object/organism/design] be affected if [one part] were changed?
- Which components are necessary to the overall function of the [object/organism/design]?

Interactions of a system:

- How do the parts/components of [system] depend on the other parts?
- How might a change to [system] affect [one part/component]?
- How does [one system] interact with or affect [another system]?
- How does the [system] depend on a [part/component]?

Models of a system:

- What [assumptions/approximations] does the model make/require?
- What does this model [show/not show] about the system?
- What boundaries define [system]?
- What behaviors of [system] can be described/demonstrated with this model?



Stability and Change

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Balanced or unbalanced:

- What components cause the system to be [stable/unstable]?
- What short term/rapid changes will [affect/cause] [stability/instability] in the system?
- What long term/slow changes will [affect/cause] [stability/instability] in the system?
- What factors or conditions can be changed to make the system [stable/unstable]?
- How is stability [created/maintained] for [system]?

Scale (ex., micro, macro, local, global, time):

- How does [scale] impact our perception of the stability/instability of [phenomenon]?
- How does the [stability/instability] of the system change on different time scales?
- How does the [stability/instability] of the system change at different magnifications?

Factor or condition:

- Which [factors/conditions] would cause [stability/instability] if changed?
- What constant factors or conditions are present in [system of cyclical change]?
- What [inputs/outputs] are needed for system stability?