

Questions to Engage Students in 3D Science

Core Ideas	Crosscutting Concepts	Science & Engineering Practices
<ul style="list-style-type: none"> ● What science concepts do I know that might be useful in this scenario? ● How can I use [science concept] to explain what is happening in this phenomenon? ● How can I use [science concept] to design a solution to this problem? 	<p>Patterns (What's happening?)</p> <ul style="list-style-type: none"> ● What patterns do I notice in this phenomenon? ● What evidence do I have to support these patterns? ● How can I use these patterns to explain what is happening in the phenomenon? <p>Cause & Effect (What's causing the pattern?)</p> <ul style="list-style-type: none"> ● What is happening at the unobservable scale to cause the observable patterns in the phenomenon? ● How do I know whether a relationship is causal or correlational? ● How does the cause lead to the effect? What is the mechanism? <p>Scale, Proportion, & Quantity (How does scale affect the pattern?)</p> <ul style="list-style-type: none"> ● What scales are important in explaining this phenomenon? ● How are processes at one scale related to processes at other scales? ● How can I use quantities and proportions describe the phenomenon? <p>Systems & System Models (In what system is the pattern occurring?)</p> <ul style="list-style-type: none"> ● What are the boundaries, inputs, and outputs of the system in which this phenomenon occurs? ● What are the system's components, and how do they interact? ● How will the system be affected by a change in conditions? <p>Energy & Matter (How are energy and matter behaving within that system?)</p> <ul style="list-style-type: none"> ● How does energy and matter flow into, out of, or within the system in which the phenomenon occurs? ● How does the flow of energy drive the cycling of matter within or through the system? <p>Structure & Function (How does the structure of the system relate to its function?)</p> <ul style="list-style-type: none"> ● How does the structure of the system, and its components, relate to its function? <p>Stability & Change (When is the system stable or unstable?)</p> <ul style="list-style-type: none"> ● Under what conditions is this phenomenon (or system) stable? Under what conditions does it change? ● How does the rate of change within the system help us understand what is happening in the system? 	<p>Asking Questions & Defining Problems (What do we need to know?)</p> <ul style="list-style-type: none"> ● What phenomenon do I want to explain, or what real-world problem do I want to solve? ● What scientific questions will help explain this phenomenon or design a solution to this problem? <p>Developing & Using Models (How can we represent the system?)</p> <ul style="list-style-type: none"> ● How well does this model match the evidence I have? ● How well does this model help me explain and predict what is happening in the system? ● What are the limitations of this model, and how could it be improved? <p>Planning & Carrying Out Investigations (How can we collect evidence?)</p> <ul style="list-style-type: none"> ● How can I collect accurate, reliable data that will provide evidence to support an explanation of a phenomenon or test a solution to a problem? ● What is the design for my investigation, in terms of: independent and dependent variables, controls, hypothesis, tools for measuring and recording data, replication, and safety, and ethical considerations? <p>Analyzing & Interpreting Data (How can we make sense of our evidence?)</p> <ul style="list-style-type: none"> ● What tool (e.g., table, graph, visualization, or statistical analysis) will be most helpful for finding patterns in this data? ● What are the sources of error in this data, and how certain can I be of its accuracy? ● How does my data analysis support or refute possible explanations or design solutions? <p>Using Mathematics & Computational Thinking (Are there mathematical patterns?)</p> <ul style="list-style-type: none"> ● How can I use mathematics to make sense of this phenomenon or design a solution to this problem? ● How can I use mathematics to understand the relationships between variables, support an argument, or create a simulation of this phenomenon? ● How can I use a computer program or model to make sense of this phenomenon or test my design solution? <p>Constructing Explanations & Designing Solutions (Why and how is this pattern happening?)</p> <ul style="list-style-type: none"> ● What is causing this phenomenon? Why is it happening? What is the relationship between these variable? ● What is the mechanism for this phenomenon? How is it happening? How are the variables connected? ● What scientific evidence, concepts, and principles support my explanation? ● How does my design solve a real-world problem within the given constraints? <p>Engaging in Argument from Evidence (How do we know?)</p> <ul style="list-style-type: none"> ● What claim can I make based on the evidence available? ● How does the evidence support that claim? ● How can I refute alternative claims? ● What are the strengths and weaknesses of this argument or design? <p>Obtaining, Evaluating, & Communicating Information (What have we learned?)</p> <ul style="list-style-type: none"> ● Where can I find reliable scientific information related to this phenomenon or problem? ● How can I determine the validity, reliability, and usefulness of information I find? ● How can I communicate my ideas clearly and persuasively?

Adapted from: <http://nstahosted.org/pdfs/ngss/MatrixOfCrosscuttingConcepts.pdf>, https://pbs.twimg.com/media/Cj_W4gSVEAA7RfO.jpg