# Design of CCD Curriculum

The general design principles of the Chemistry CCD curriculum is to select a coherent set of models and develop the concepts in a sequential coherent manner that addresses student misconceptions and naïve understanding. In the design process, we have created learning trajectories that follow from foundational concepts through laboratory-based activities that end in the student construction of a scientific model.

Let us take a simple example of a learning trajectory in the construction of Archimedes’ Principle. This is not a model, but an application of the force model.

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| Learning Trajectory | Design a floating craft using 100 cm2 of aluminum foil that will hold the greatest load of pennies. |
|  | Archimedes’ Principle |
| Definition of buoyant force as being the difference of the fluid forces between the top and bottom of the object; this is equal to the force (weight) of the displaced fluid. |
| Force differences within depth of solid object. |
| Pressure as a function of height of fluid column (this assumes a prerequisite of forces, area, and pressure) |
| Defining buoyancy in terms of density. |
| Laboratory experience of placing different density solids (more advanced would be nonmiscible liquids) in fluids. |
| Determining the relationship: density is slope of mass vs. volume graph, and D = m/V |
| Graphical analysis and meaning of slope |
| Laboratory experience of graphing mass vs. volume for a particular material |
| Definition, calculation, and measurement of volume (both calculation and by displacement). Note that multiplication as a prerequisite is assumed. |
| Definition and measurement of length |
| Definition and measurement of mass |

### Figure 1. Learning Trajectory of Archimedes’ Principle

This learning trajectory would then be written by unpacking the concept as a sub-unit of the force model. The construct centered design begins by making claims about student understanding, defining the evidence for verification of the claim, devising the educational task to produce the evidence, and the development of instructional strategies to execute the lessons. Threshold questions, such as understanding density, are important for the final deployment.

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| Literacy | | | | | |
| Model | | | Big Idea | | |
| Standard | | | Cross Cutting Concept | | |
| Fundamental Concepts | Claims | Evidence | | Task | Instruction |
|  |  |  | |  |  |
| Unpacking | | | | | |

**Figure 2. Template for construct centered design.**

***Literacy*** A statement of the broad knowledge or skill in a discipline characterized by learner’s lucidity and ease of discussion.

***Model*** A construct composed of narrative, diagrammatic, pictorial, graphical, and mathematical representations that can be used to test and predict a phenomenon. It must have coherence and self consistency. [For non-STEM disciplines, the graphical and mathematical representations may be omitted.]

***Big Idea*** A broad category that encompasses essential understandings.

***Standard*** The benchmark that the curriculum and lesson addresses.

***Cross Cutting Concept.*** Connections and intellectual tools that are related across the differing areas of disciplinary content and can enrich student application of practices and their understanding of core ideas.

***Fundamental Concepts*** Information derived from the course outline.

***Claims***  A series of specified learner behaviors and corresponding limitations. The behavior is often stated with a verb through which measurement can be made.

***Evidence*** Everything that is used to determine or demonstrate that the learner has satisfied the claim. This is often a combination of actions (verbs) and products (nouns). This involves some value judgment and assessment.

***Task*** The set of activities for the learner to produce evidence needed to verify the claim.

***Instruction*** The plan of activities to support the tasks and outcomes to fulfill the claims. These may include, but are not limited, questioning strategies, threshold questions, media, investigations, and researched misconceptions.

***Unpacking*** The prerequisite skills and knowledge necessary for attaining the claim, model, or literacy.