Next Generation Science Assessment

Designing Aligned Tasks for Assessing Three Dimensional Science Learning

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The terrain we will cover…

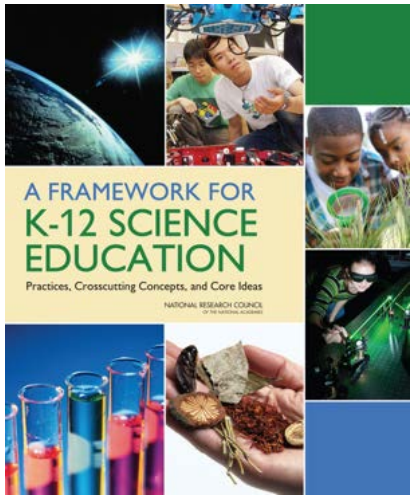
- Challenges in designing tasks that align with NGSS Performance Expectations
- Goals of the NGSA Project
- Components and Logic of our Evidence-Centered Design Approach
- Designing for Alignment - Role of Integrated Dimension Maps and Learning Performances
- Summary of Key Points and Implications for Task Design and Alignment

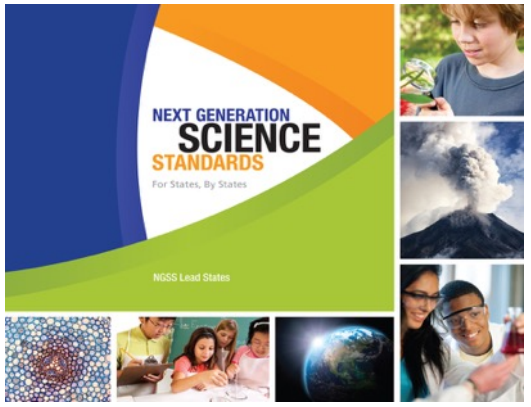
The Vision Behind NGSS

Knowing how to use and apply what you know…

empowers you – in your own learning about the world and your participation in it.

Goal is for every student, from the earliest grades onward, to have coherent and sequenced instruction that provides opportunities to do the "walk and talk" of science and engineering.





How NGSS is Different

Standards expressed as <u>performance expectations</u>:

- Combine practices, core ideas, and crosscutting concepts into a single statement of ***what is to be assessed***
- Requires students to demonstrate ***knowledge-in-use***
- Performance Expectations are not instructional strategies or objectives for a lesson – ***they describe achievement, not instruction***
- Intended to describe the end-goals of instruction – ***the student performance at the conclusion of instruction***

How do we **Assess** *toward* the PEs?

Assess toward Performance Expectations

Assessment Design Challenges

- *How can we design integrated assessment tasks* in which students make sense of phenomena or design solutions to problems so that they provide evidence of 3-dimensional learning?
- *How can we use performance expectations in order to construct assessment tasks* so that teachers can gauge students' progress toward achieving the performance expectations?
- *How can we ensure alignment with performance expectations within the design process?*

Next Generation Science Assessment

Guiding Question:

How can we create assessments that integrate the three dimensions of the NGSS and help teachers assess student's progress toward achieving the performance expectations?

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NGSA Project's Overall Goals

Our project addresses three main goals:

(1) Construct a comprehensive design model, using an evidence-centered design (ECD) approach, to guide the development of tasks aligned with the NGSS performance expectations

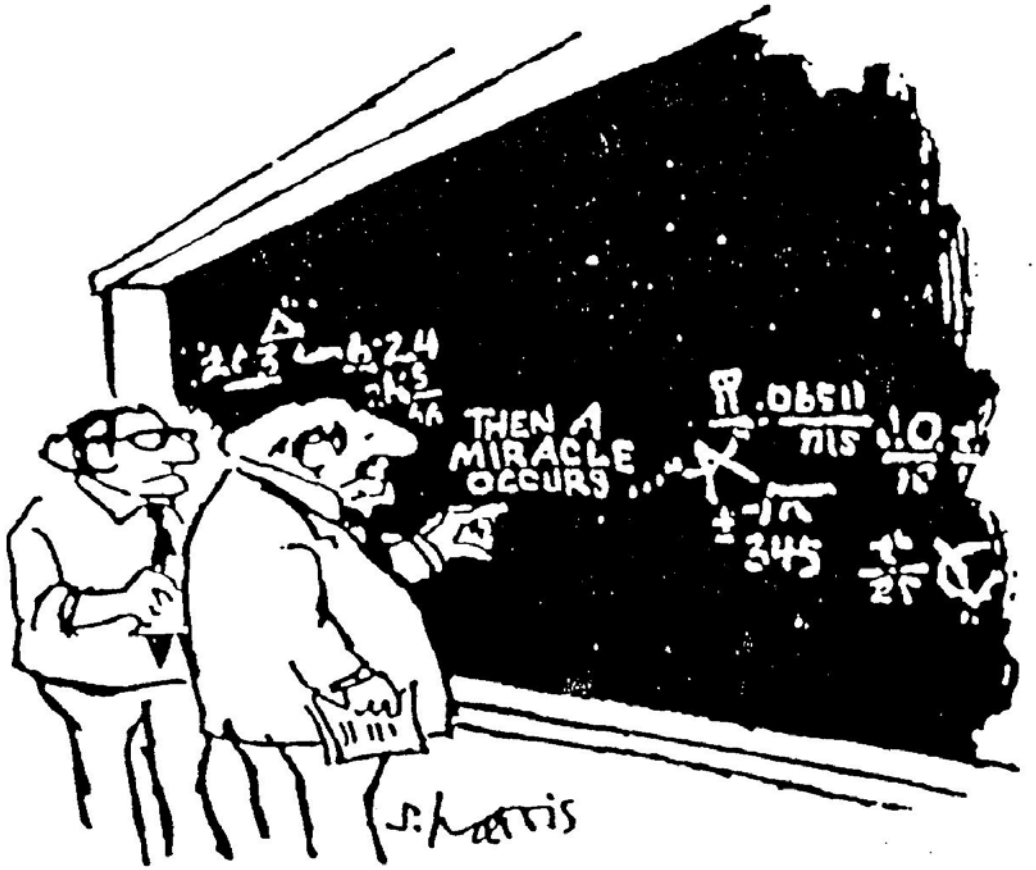
(2) Develop and test technology-based assessment tasks and rubrics related to these performance expectations,

(3) Develop guidelines and materials for teachers to use these assessments in the classroom for diagnostic and formative purposes.

Typical Assessment Design

1 Identify Target Performance Expectations

3 Develop Tasks and Rubrics



"I think you should be more explicit here in Step Two."

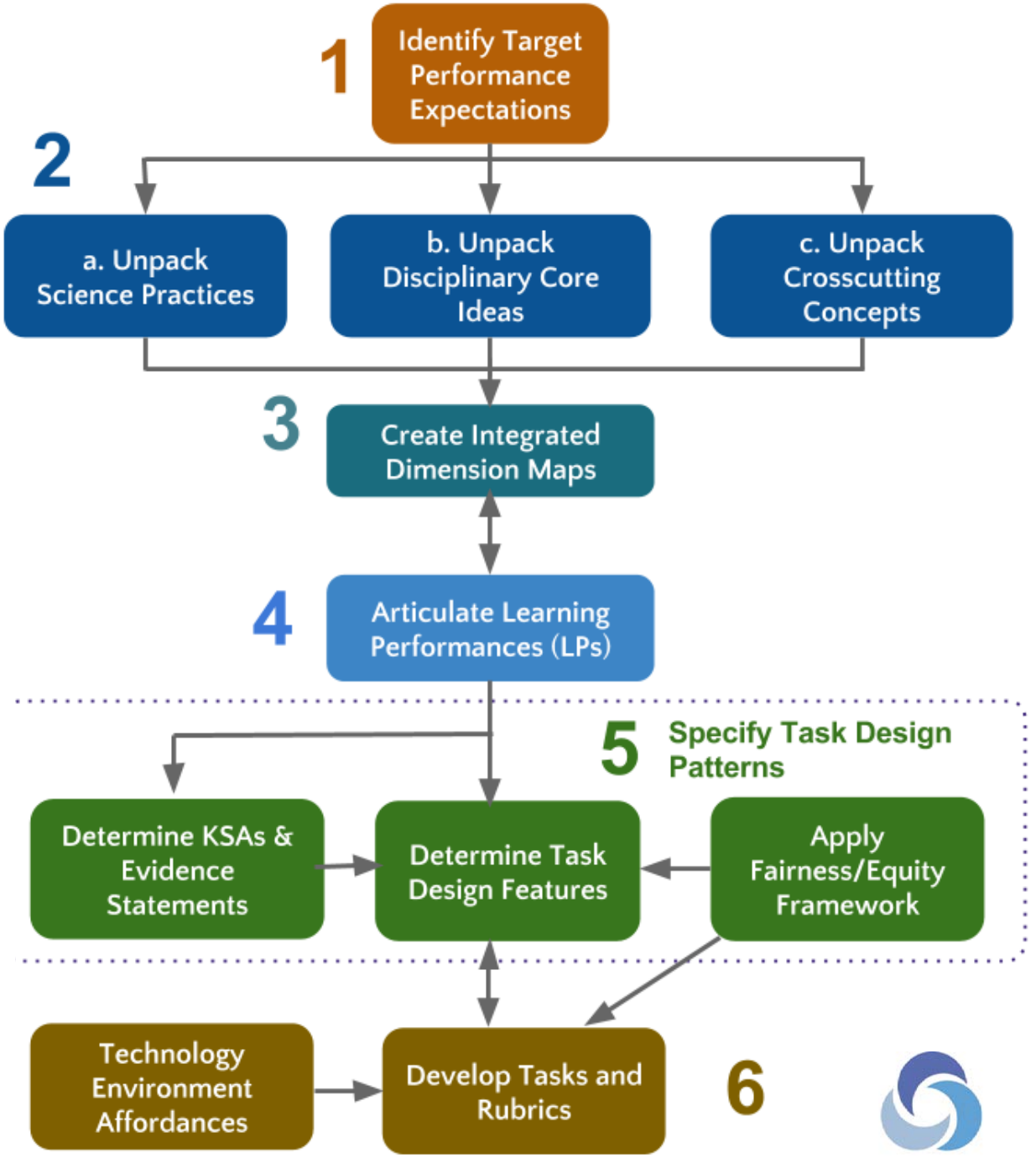
Design Approach

Intentional and Explicit

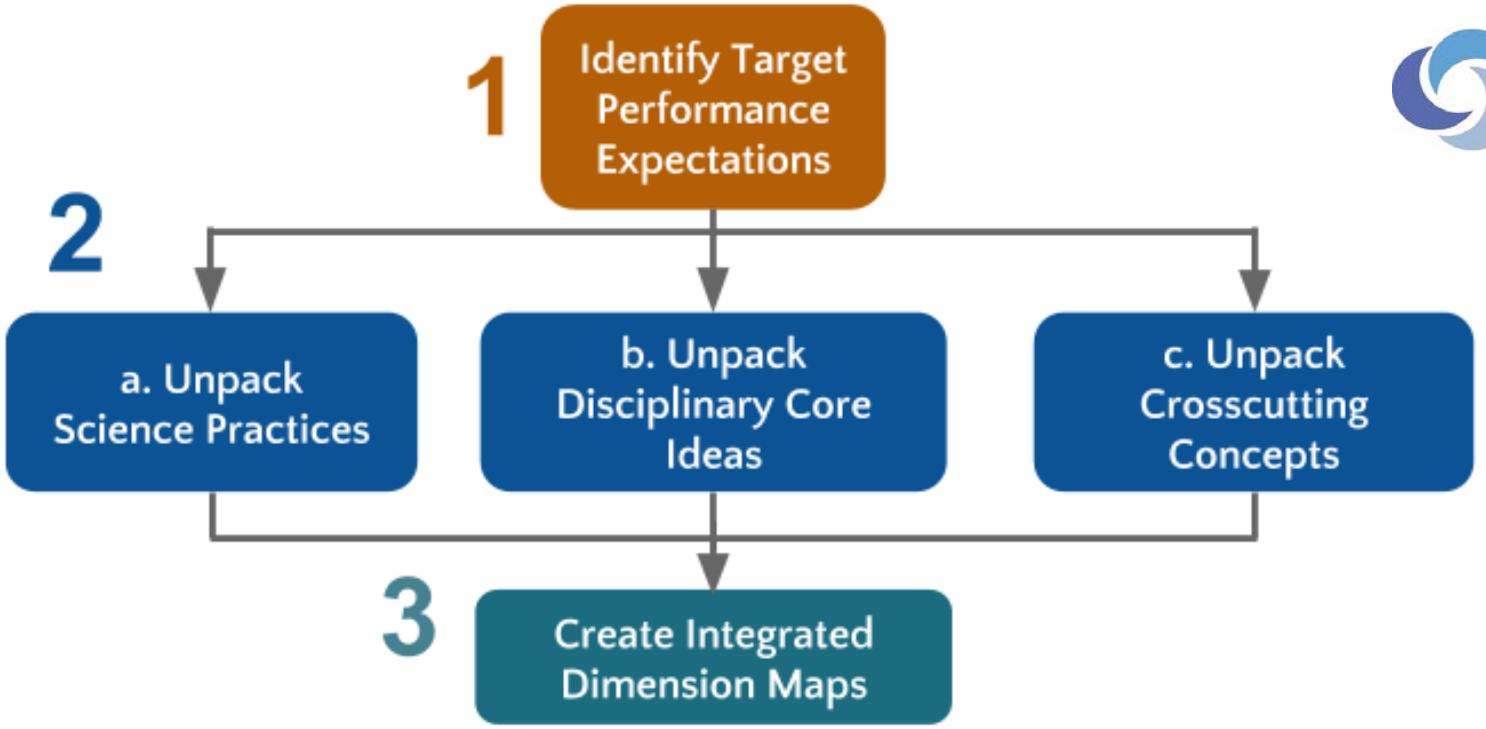
Phase 1: *Domain Analysis*

Phase 2: *Domain Modeling*

Phase 3: Create tasks and rubrics



NGSA Design Process: Domain Analysis



We draw from the unpacking to lay out the dimensional "terrain" of the performance expectations:

- Lay out the essential disciplinary relationships
- Link the disciplinary relationships to the crosscutting concepts and practices

Creating Integrated Dimension Maps

Each map is intended to represent the "terrain" of the Performance Expectation

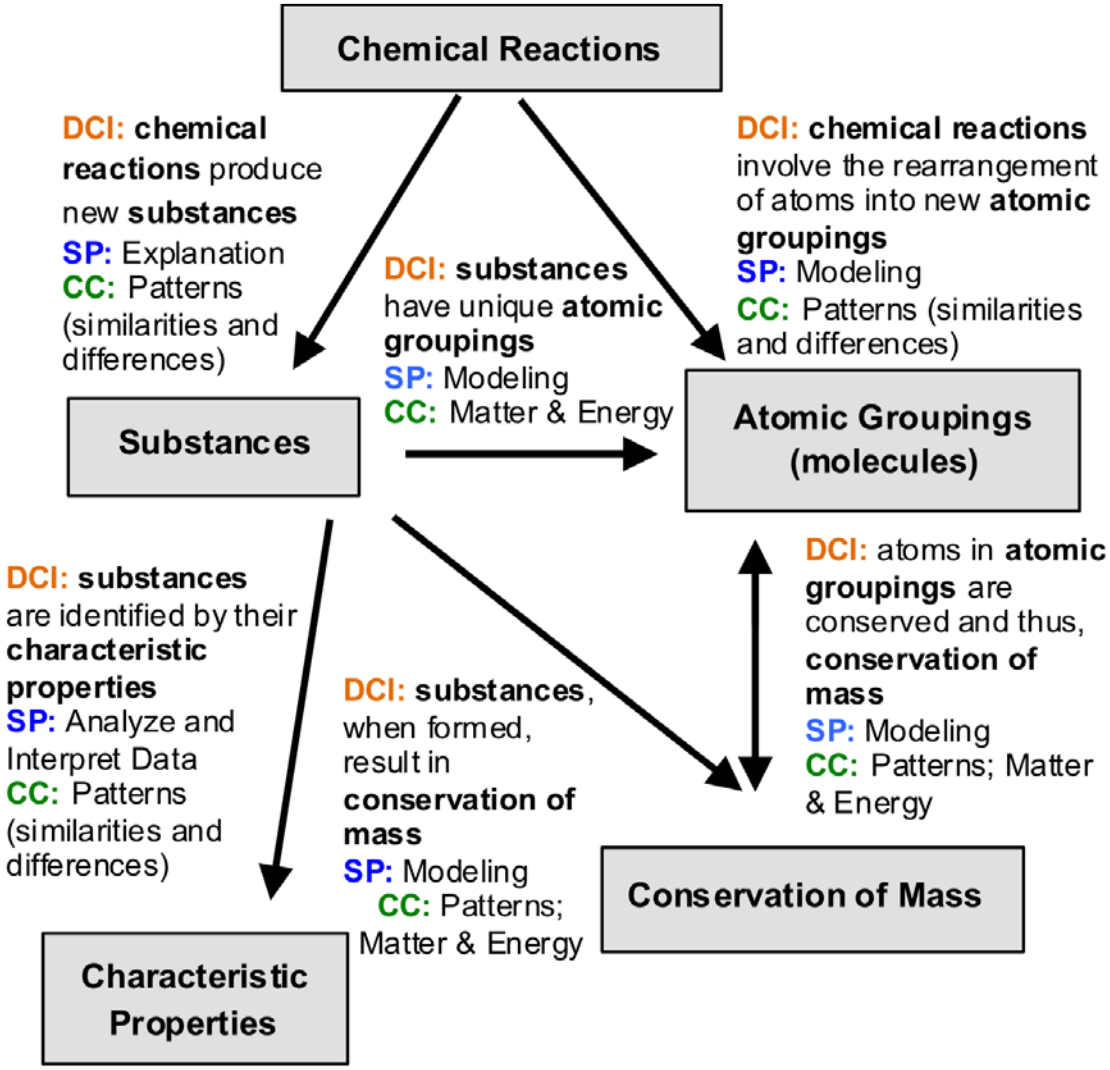
- Illustrates how the 3 dimensions are intended to work together to demonstrate proficiency with a performance expectation
- Shows the possible ways for combining aspects of the 3 dimensions

Creating a map entails:

① Mapping out the essential disciplinary elements and relationships (very much like a typical concept map)

② Layering on top of the DCI map the crosscutting concepts and practices

Integrated Dimension Map

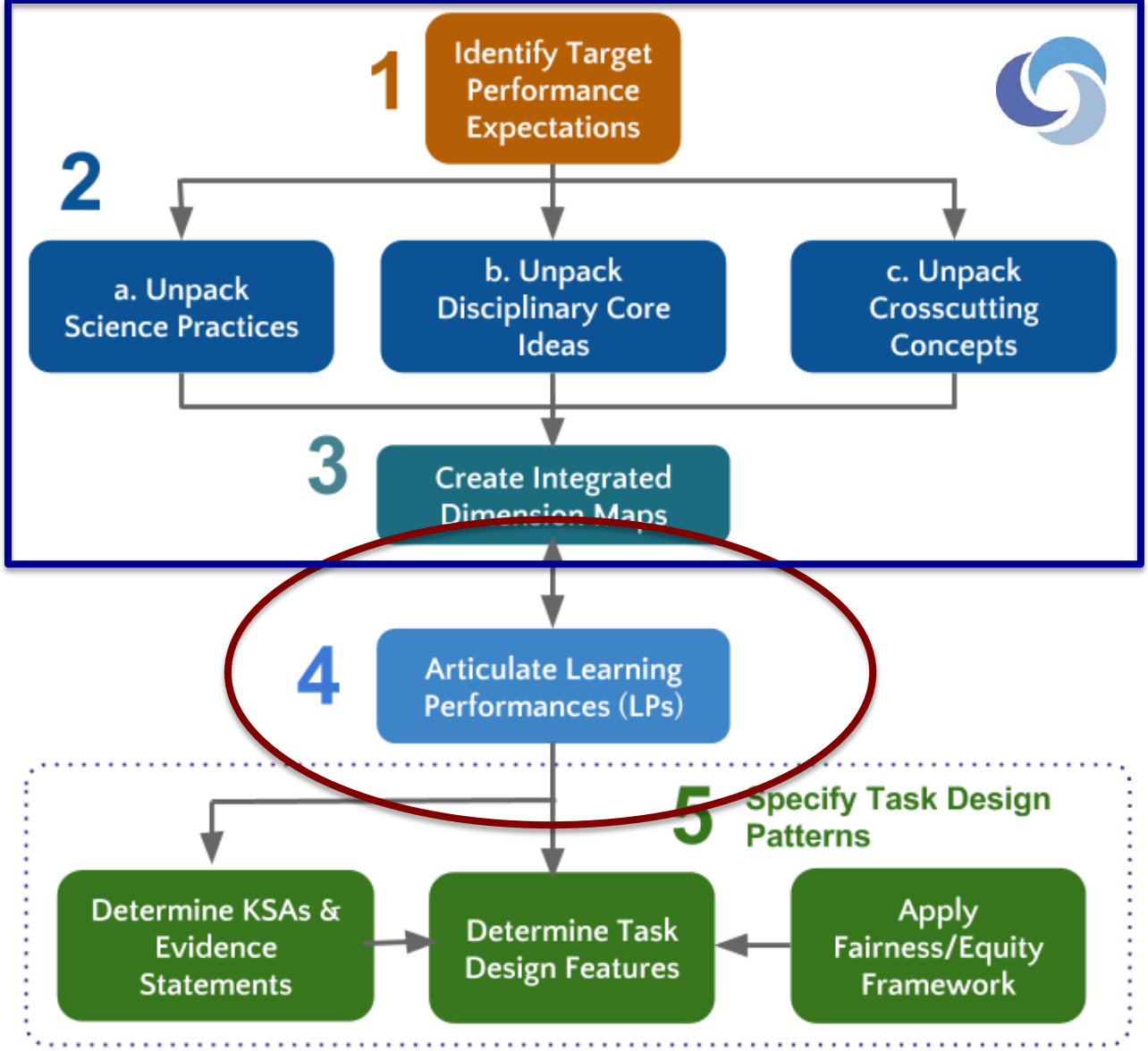


NGSA Design Process

Intentional and Explicit

Phase 1: *Domain Analysis*

Phase 2: *Domain Modeling*
(*Develop Learning Performances and design Patterns*)



Learning Performances

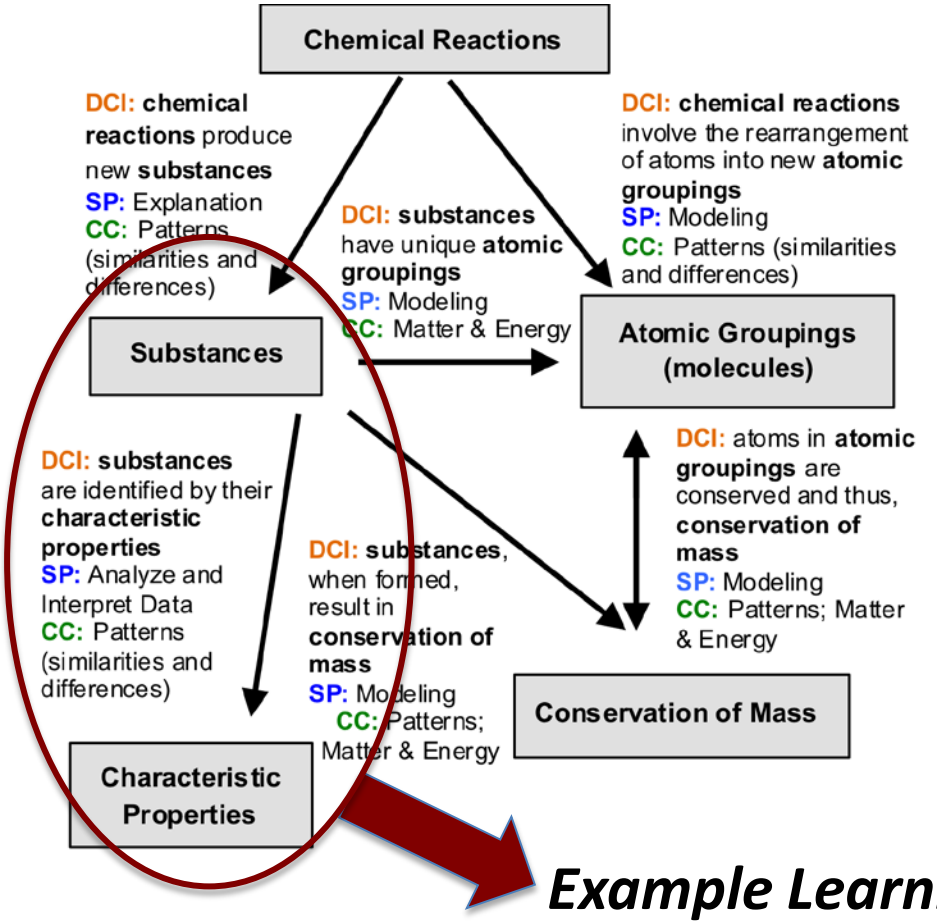
What is a Learning Performance?

- Knowledge-in-use statement that integrates *aspects* of a disciplinary core idea, practice, and crosscutting concept encompassed in a performance expectation
- Smaller in scope and partially represents a performance expectation
- A related set of learning performances function together to describe the performances needed or "what it takes" to achieve a performance expectation(s)

Why use Learning Performances?

- Ideal for classroom-based assessment – answers the question: *How will I know if students are making progress toward this large performance expectation?*
- Specifies "knowledge-in-use" – using "know" or "understand" is too vague
- Emphasizes understanding as embedded in practice and not as memorizing static facts

Constructing a set of Learning Performances



a. Lay out the key components from the unpacking in an integrated dimension map

b. Use the integrated dimension map to construct statements of student performance

Example Learning Performance:

Students analyze and interpret data to determine whether substances are the same or different based upon patterns in characteristic properties.

MS-PS1-2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
MS-PS1-5	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Learning performances (LPs)

LP 1: Analyze and interpret data to determine whether substances are the same based upon patterns in characteristic properties.

LP 2: Construct a scientific explanation about whether a chemical reaction has occurred using patterns in data on properties of substances before and after the substances interact.

LP 3: Use reasoning from patterns to evaluate whether a model explains that a chemical reaction produces new substances and conserves atoms.

LP 4: Use a model to explain that in a chemical reaction atoms are regrouped and this is why mass is conserved.

LP 5: Develop a model of a chemical reaction that explains that new substances are formed by the regrouping of atoms and that mass is conserved.

LP 6: Use reasoning about matter and energy to evaluate whether a model explains that a chemical reaction produces new substances and conserves mass because atoms are conserved.

Key Points

Performance Expectations

- Provide clear targets to be achieved ***by the end*** of instruction

Integrated Dimension Maps

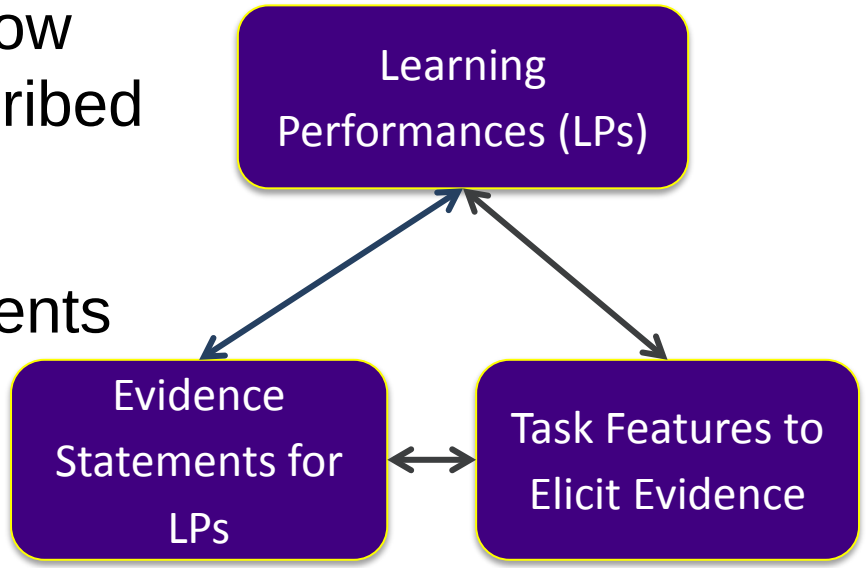
- Illustrate how the 3 dimensions are intended to work together to demonstrate proficiency with PEs
- Show possible ways for combining aspects of the 3 dimensions

Learning Performances

- Integrate aspects of all 3 dimensions of a given performance expectation
- Function in relation to other LPs to cover the “terrain” of a performance expectation (or set)
- Provides guidance to assessment designers

Assessment as an Argument from Evidence: 3 Connected Questions

- What do we want students to know and be able to do? (Claims described by our learning performances)
- What kinds of evidence will students need to provide to demonstrate proficiency?
- What kinds of tasks / task features will elicit the desired evidence?



When we have logical and coherent answers connecting these three questions, we have an *assessment argument*.

LPs are the cornerstone for task design

- Claims described by the Learning Performances, and their associated evidence statements, are used to identify task characteristics
- One LP will have multiple tasks that can be designed – can be designed to vary in difficulty
- Exemplar responses written for each task, checked against the LP and accompanying evidence statements
- Multidimensional rubrics are specified for scoring
- Student data are collected to refine task design and scoring rubrics

NGSS PE	**MS-PS1-5:** Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
Learning Performance	**LP 5:** Develop a model of a chemical reaction that explains that new substances are formed by the regrouping of atoms, and that mass is conserved.

Battery in Tap Water: Rosy put a battery in a beaker of tap water. She observed gas bubbles coming from the positive and negative ends of the battery, as shown in the video below.

She tested the bubbles and found that some of the bubbles were made of hydrogen gas and some were made of oxygen gas.

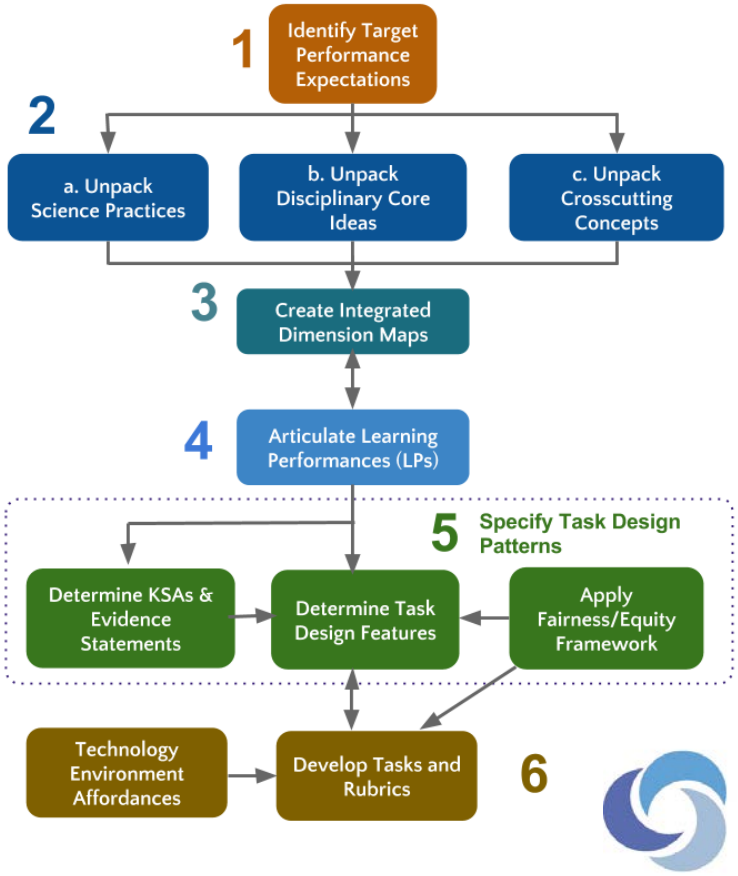
- Draw a model that shows the chemical reaction of water changing into hydrogen and oxygen gas.
- Based on your model, describe
  - what happens during the reaction to the atoms of the water molecules, and
  - how your model explains why mass is conserved during this reaction.

The Value of an ECD Process

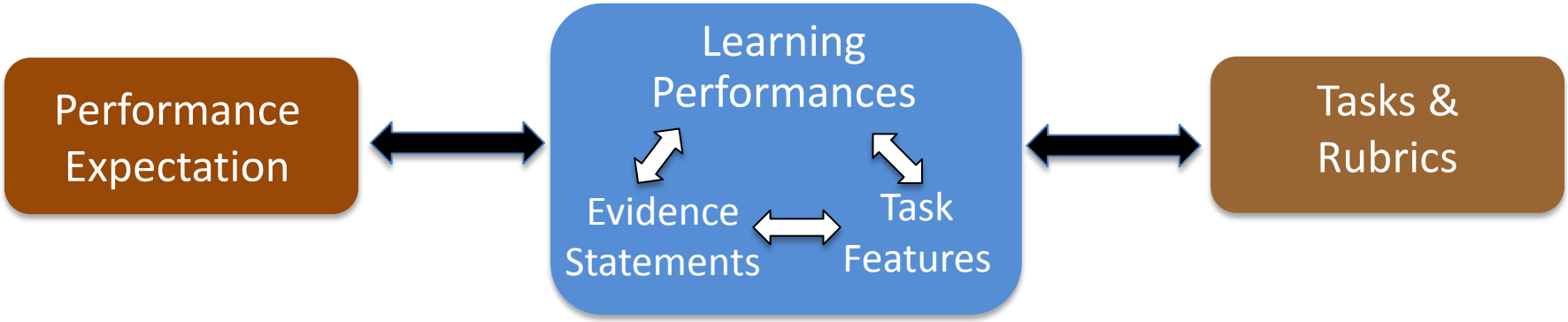
A systematic process to facilitate consensus about the design principles of tasks (in this case, 3-dimensional classroom-based assessments) and strengthen alignment to performance expectations

Benefits

- Broadly accessible vision of how to design NGSS assessments
- Documents principled design decisions
- Creates well-aligned tasks that are usable across varied classroom environments
- Generalizes to other core ideas, crosscutting concepts, and practices



Ensuring Alignment in the Design Process



During the design process we conduct an expert alignment review of:

(1) Learning Performances and their alignment to Performance Expectations (individual LP alignment and LP set alignment)

(2) Tasks and their alignment to the Learning Performances, including the assessment argument (the claim, the evidence, and the task features to judge alignment of specific tasks to the domain model argument for an LP)

Five Critical Questions to Consider in Evaluating Assessment Tasks

- What claim (or claims) about student proficiency underlie this task?
- Which three NGSS dimensions are targeted?
- Does this assessment task require access to all three targeted NGSS dimensions in order for students to complete the task?
- Does this assessment task require students to integrate the three targeted NGSS dimensions?
- Is the task likely to elicit the desired evidence?

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Contact Information

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