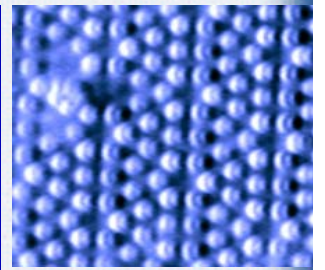
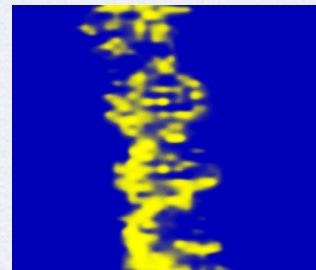
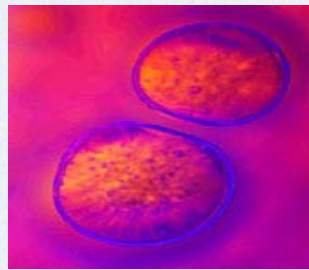


A systematic approach for developing assessment



**Shawn Stevens, Joe Krajcik
& Jim Pellegrino**

Why focus on assessment?

Concept Inventory

- using assessments as diagnostic aids for instructors

Learning Progression

- assessing student knowledge to understand how students' knowledge builds over time
- develop assessments from learning progression

Curriculum Development

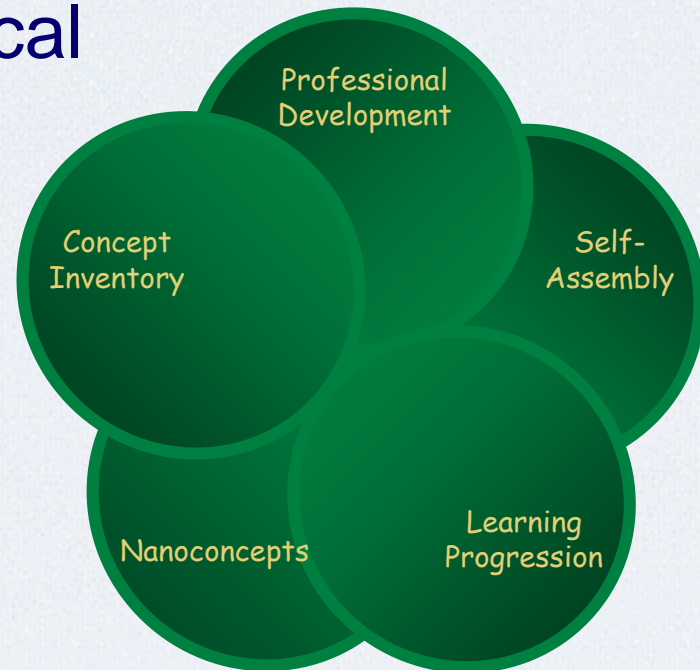
- how do you know that your curriculum materials, technology tool, etc. was successful?
- provide feedback for learners

Professional Development

- how do we assess teacher learning?
- provide feedback for learners

A need

Developing good assessments for evaluating student understanding is critical for all aspects of NCLT

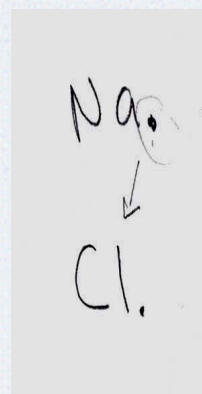
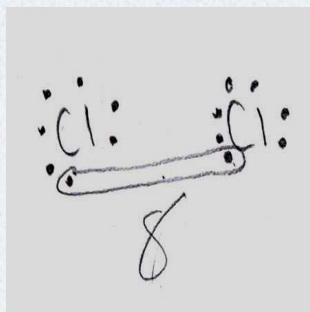


Therefore, we need a consistent, principled way for developing assessments

An example

Task: Explain how chlorine and sodium interact to form Cl_2 and NaCl .

“shared electrons”

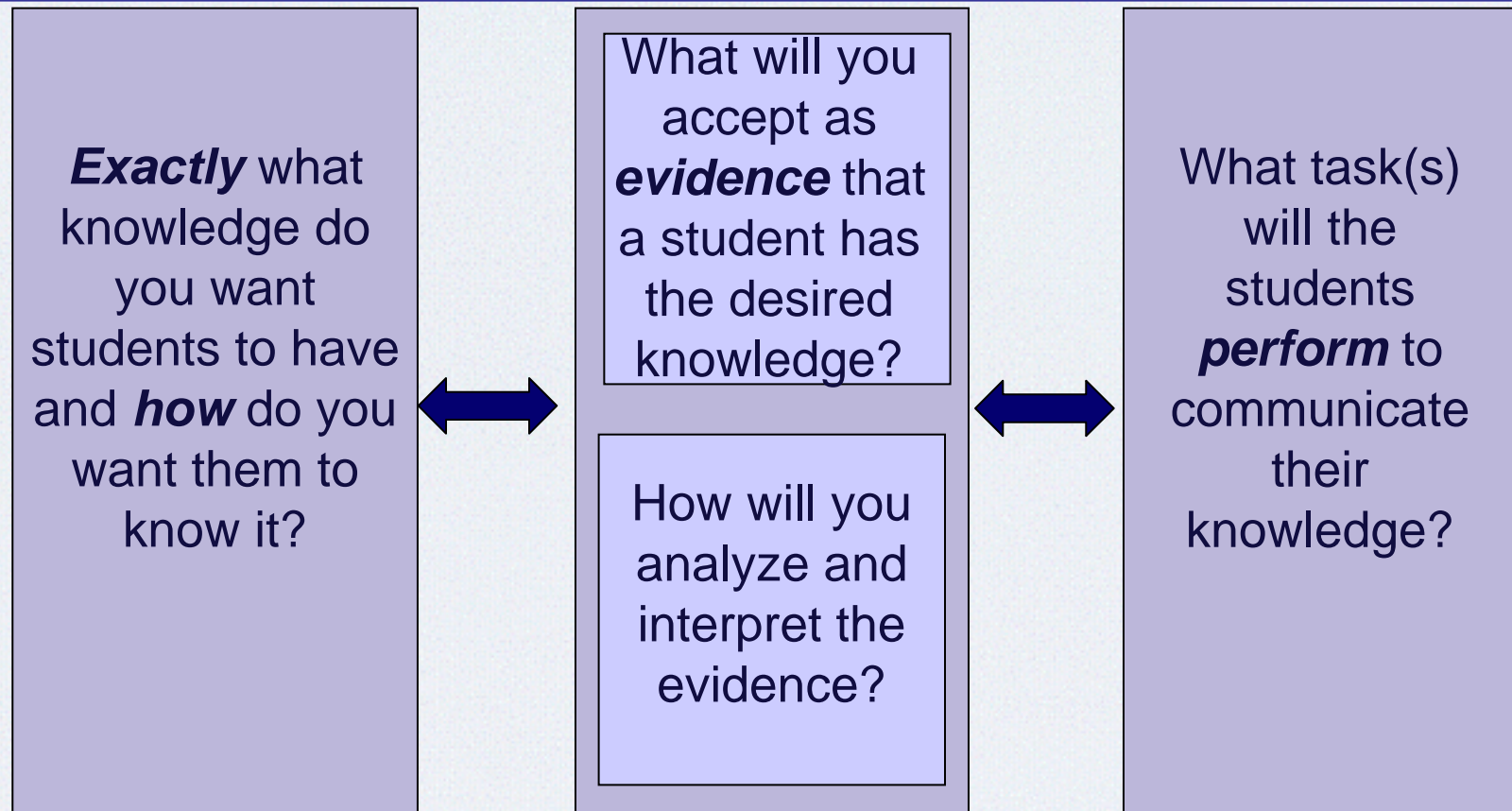


“transferred electron”

student response

Does this response provide evidence that the student understands bonding and how atoms interact?

Evidence-Centered Design



claim space
OR
construct

evidence

task

Frase, L.T., Chudorow, M., Almond, R.G., Burstein, J., Kukich, K., Mislavy, R.J., Steinberg, L.S., & Singley, K. (in press). Technology and assessment. In H.F. O'Neil & R. Perez (Eds.), Technology applications in assessment: A learning view.

Claim space--Construct

What do you want to assess?

Exactly what knowledge do you want the student to have?

How do you want the student to know it?

- content
- practice

What level is appropriate for the student?

Evidence-- part I

What would you accept as appropriate evidence that a student has the desired knowledge?

What does it mean to know that?

What kind of behaviors or performances are necessary to demonstrate that knowledge?

Use words like:

state

analyze

explain

apply

evaluate

model

Evidence-- part II

What would you accept as appropriate evidence that the student has the desired knowledge?

What does it mean to know that?

What kind of behaviors or performances are necessary to demonstrate that knowledge?

Once the student has performed the task, how are you going to interpret and analyze it to decide whether he has the desired knowledge?

Task

What particular tasks, questions or situations will bring about a response that provides the type of evidence you want?

A single task may provide evidence for more than one claim

Multiple tasks may be necessary to assess a single claim

For example-

multiple-choice

open-ended

short answer

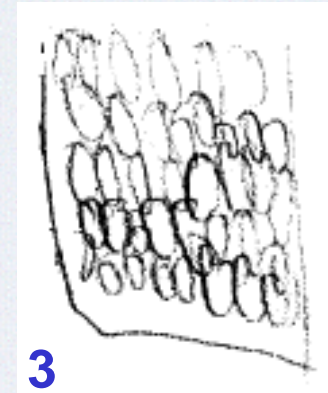
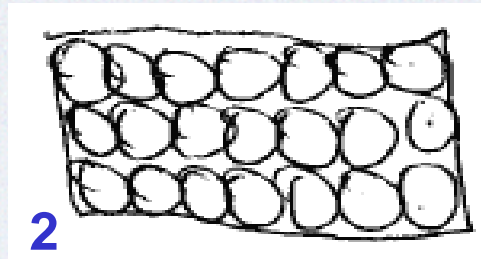
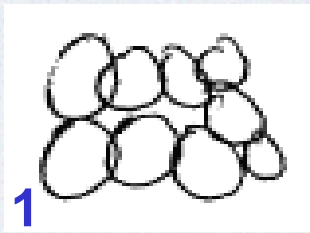
interview

written

performance

more examples

Task: Draw what you would see if you zoomed in so much that you could see what the surface of this metal is made of and explain it.



Student responses

Do these responses provide evidence that the student understands the particle model of matter?

What does it mean to understand the particle model of matter for solids?

Matter is made of particles

Particles are closely/densely packed??

Particles are arranged in an ordered way

Interactions controlled between individual atoms– bonding

what do you mean by interaction, atoms, bonding?

Determine structure on the nanoscale

what's structure, nanoscale?

Bonding predictive of properties

what properties?

Interaction between charged particles?

What should they know about charge? Do they need to know about ions, polarizability, etc?

Fixed...

What does it mean to understand the particle model of matter for solids?

- all matter is made of particles
- in solids, the particles (atoms) are arranged in an ordered compact way
- the particles (atoms) are in constant motion; the degree of motion is dependent on temperature
- the particles (atoms) are the fundamental building blocks of matter
- all particles (atoms) of the same type are the same shape and size
- the arrangement of particles (atoms) determines the substance and can affect its properties

What will be the evidence of understanding?

Students will communicate their model of solids.

Their model should contain:

- particles that are arranged in an ordered, compact way
- particles that are in constant motion the degree of which is dependent on temperature
- particles of the same type are the same shape and size

In addition,

- the arrangement of particles determines the substance
- the arrangement of particles affects the properties
- atoms are fundamental building blocks of matter

A sample item

Task: Describe the process of sodium chloride dissolving in water.

Does this provide evidence that the student understands what we want her to understand?

Matching the task to the claim

- all matter is made of particles
- in solids, the particles (atoms) are arranged in an ordered compact way
- the particles (atoms) are in constant motion; the degree of motion is dependent on the temperature
- the particles (atoms) are the fundamental building blocks of matter
- all particles (atoms) of the same type are the same shape and size
- the arrangement of particles (atoms) determines the substance and its properties

Also need knowledge of ionic solids, ionic bonding, inter-atomic interactions, equilibrium, etc.

Creating tasks to collect evidence

-all matter is made of particles

-in solids, the particles (atoms) are arranged in an ordered compact way

-the particles (atoms) are in constant motion; the degree of motion is dependent on the temperature

- the particles (atoms) are the fundamental building blocks of matter

- all particles (atoms) of the same type are the same shape and size

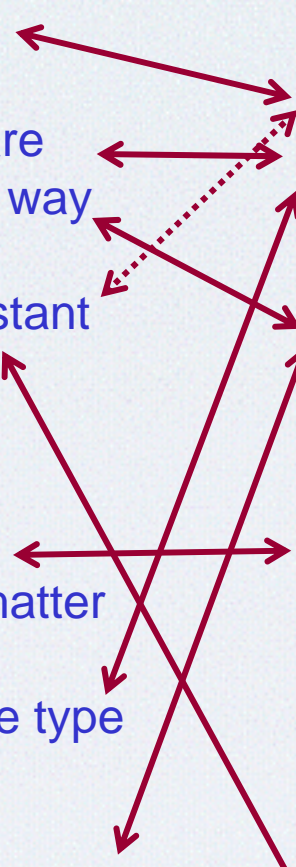
- the arrangement of particles (atoms) determines the substance and its properties

If we could zoom in so much to see what this metal is made of, what would it look like? Please draw it for me and explain it.


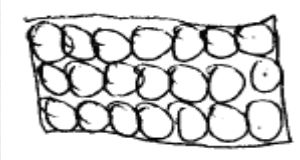
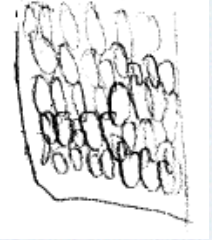
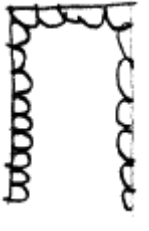
Does the arrangement of particles matter? Why?

The edge in your drawing looks kind of lumpy, but the edge of the metal feels smooth. How can you reconcile that?

Now, if we heat up the metal until it melts, what happens? (once they mention motion of particles (atoms) in liquids, then ask-- are the atoms in the solid moving too?)



A range of understanding

	Student 1	Student 2	Student 3
Structure of solid			
Arrangement of atoms	ordered packing, more compact	doesn't matter, seen it drawn that way	doesn't matter, could be sideways
Composition of atoms	electrons, neutrons & protons	nucleuses, cytoplasm	atoms inside atoms, inside atoms...
Size of atoms (0.5 mm thick)	~200	1000	1
Smooth edge	too small to feel	too small to feel	

The task

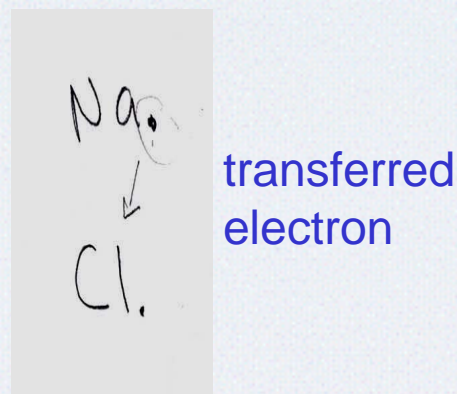
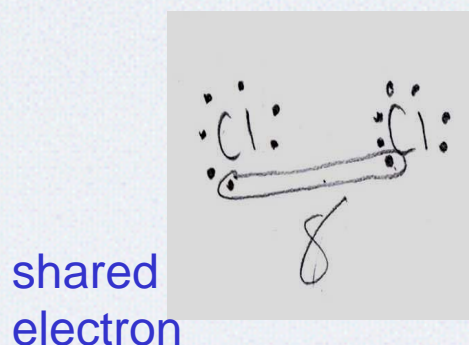
Choose one of the three learning goals provided and unpack it to define the construct, or claim space.

Decide what you what you would accept as appropriate evidence that a student has the desired knowledge.

Design some tasks, questions or situations will bring about a response that provides the type of evidence you want.

Our first example

Task: Explain how chlorine and sodium interact to form Cl_2 and NaCl .

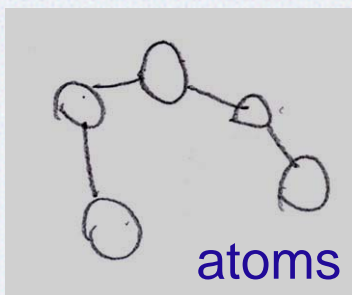
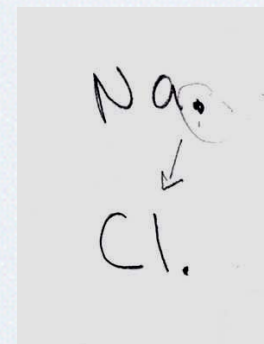
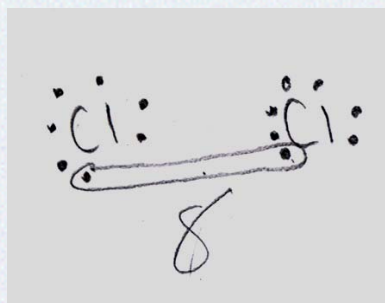


student response

Does this response provide evidence that the student understands bonding and how atoms interact?

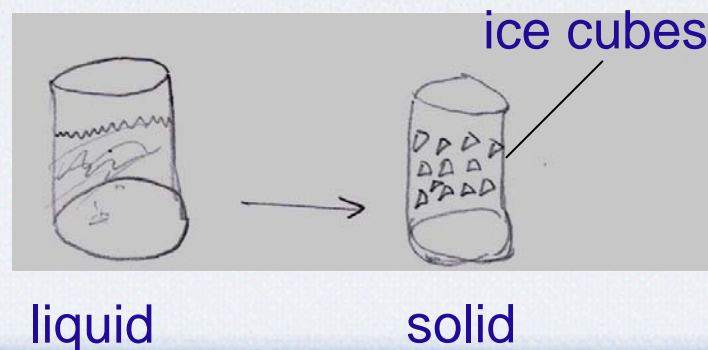
More information

- octet model
- electron transfer (NaCl)
- electron sharing (Cl_2)
- elements, not atoms bond



- atoms just spheres
- connected by lines
- color of spheres is important

Inconsistent particle model of matter



Summary

Students will live up to, (or down to) expectations-- if you want them to have a deeper understanding, it must be reflected in both instruction and assessment

In order to measure student understanding, you must define exactly what you want to assess, and how you can get evidence that students understand it before developing the assessment item