

# Empathizing with energy: Understanding physics by identifying with hypothetical entities

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AAPT Summer Meeting, Portland, OR

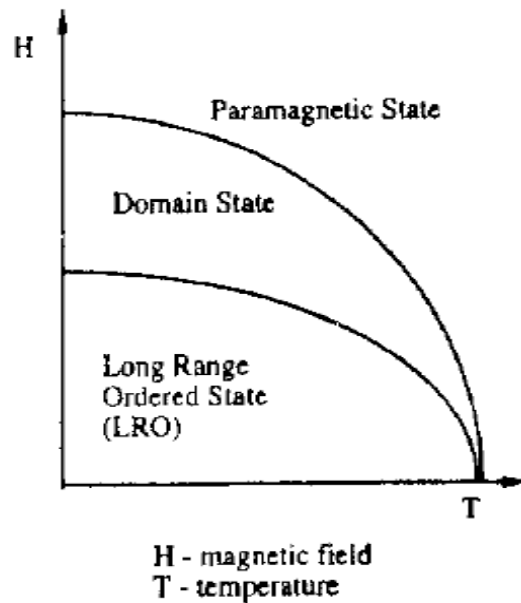
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## ENERGYPROJECT



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# How scientists build meaning together



A study of how a group of physicists talk about their research.

Figure 7.1 Phase transitions in a diluted antiferromagnet (based on Grest et al., 1986)

(1996) Ochs, E., Gonzales, P., & Jacoby, S. "[When I come down I'm in the domain state: Talk, gesture, and graphic representation in the interpretive activity of physicists](#)" in *Interaction and grammar*, ed. by E. Ochs, E. Schegloff, & S. Thompson. Cambridge: Cambridge University Press.

# Two centers of grammar

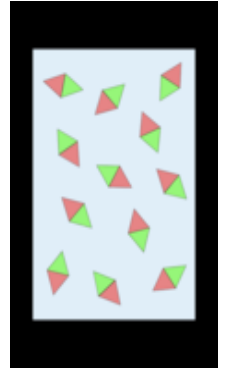
The physicist:



*We lowered the field.*

*I'm amazed by his  
measurements.*

The physical system:



*The system is in the  
paramagnetic regime...*

*Then it crosses to the  
domain state.*

*The system may never  
have the time to experience  
those random fields.*

# Indeterminate grammatical constructions

*When I come down, I'm in the domain state.*

*Why don't I go to the long-range ordered state...?*

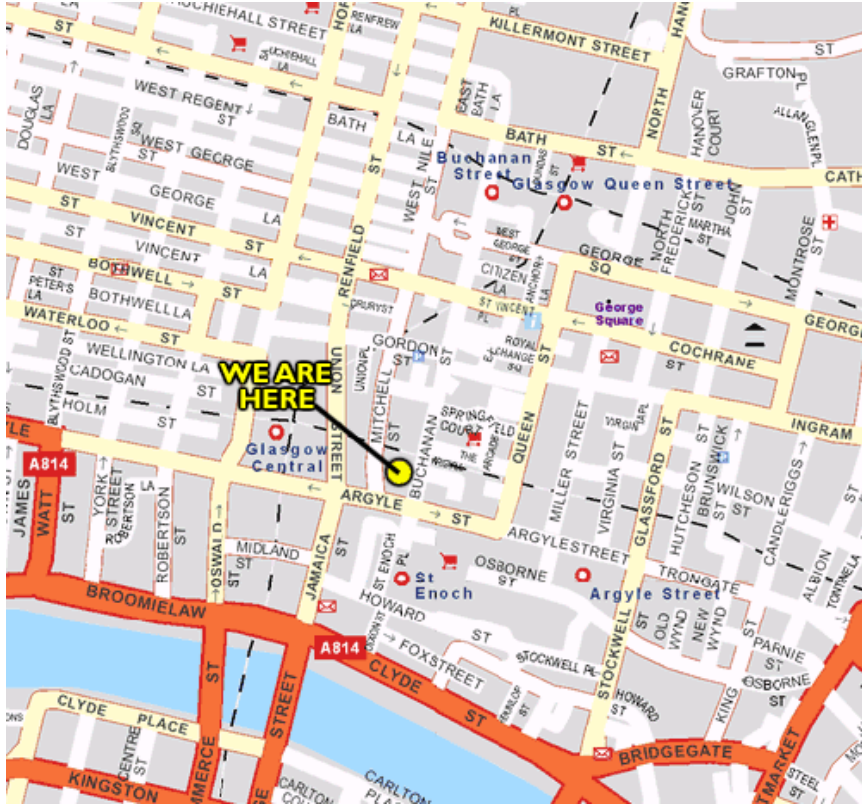
*Here when you reach this point we are in the domain state.*

- Animate subjects
- Present tense
- Inanimate predicates

***These constructions are ubiquitous.***

***Nobody is confused.***

# Everybody does it, a lot



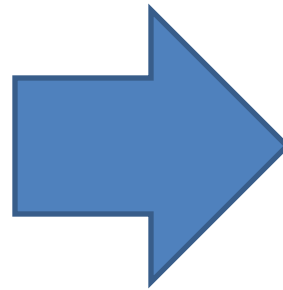
# Why do we talk like this?

*By using indeterminate constructions as a linguistic heuristic, ...*

*...scientists constitute an empathy with entities they are struggling to understand.*  
(Ochs, 1996)

## **Indeterminate construction**

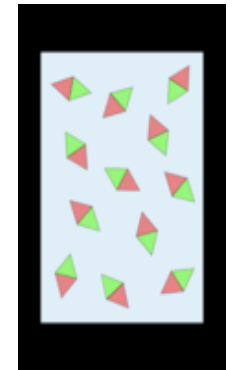
- Observable grammatical phenomenon



## **Blended identities**

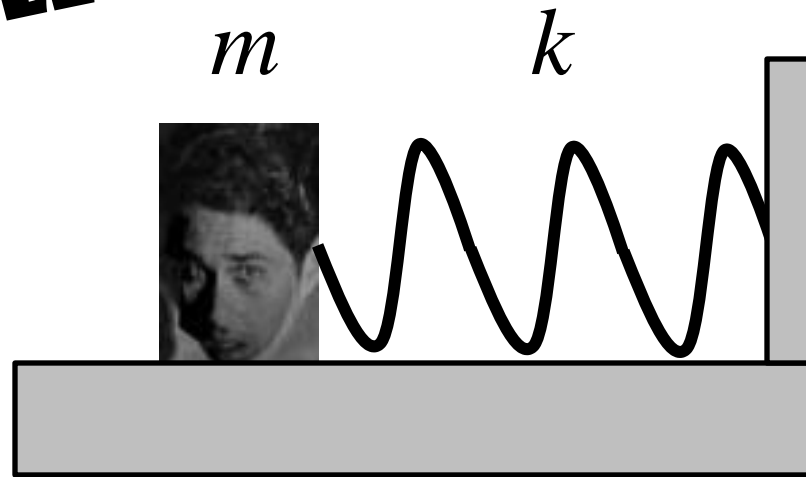
- Hypothetical inner experience

# Blended identities



# Blended identities

## THE "SIMPLE" HARMONIC OSCILLATOR



**IT LITERALLY  
WANTED TO  
RETURN  
TO THE  
EQUILIBRIUM  
POSITION!**



# Why do we talk like this?

*Such a referential poetics allows interlocutors to symbolically participate in events from the perspective of entities in worlds no physicist could otherwise experience.*  
(Ochs, 1996)



# When do we talk like this?

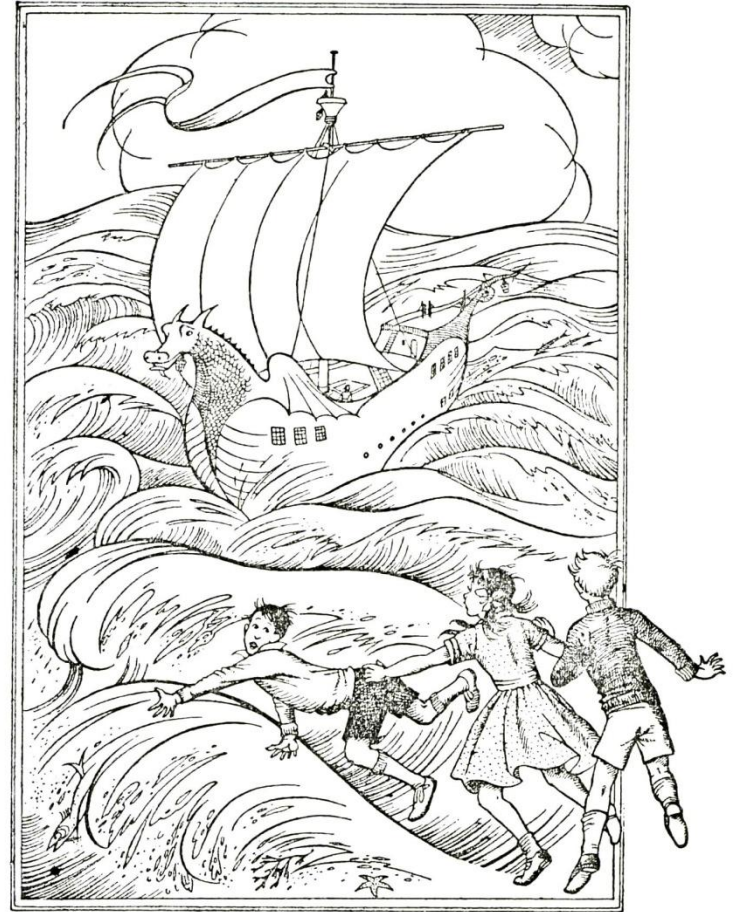
*...Indeterminate constructions seem...  
especially suited to the activity of **thinking**  
through research problems **together**.*

(Ochs, 1996)

# When do we talk like this?

*...We cannot stress strongly enough that the pervasive context for the emergence of indeterminate constructions is participants' **orientation to a visibly available graphic representation.***

(Ochs, 1996)



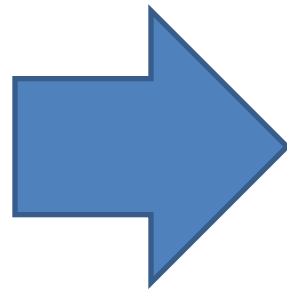
The Voyage of the Dawn Treader

C. S. Lewis, 1952

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# Instructional design principle

Behavior of  
scientists in their  
natural habitat

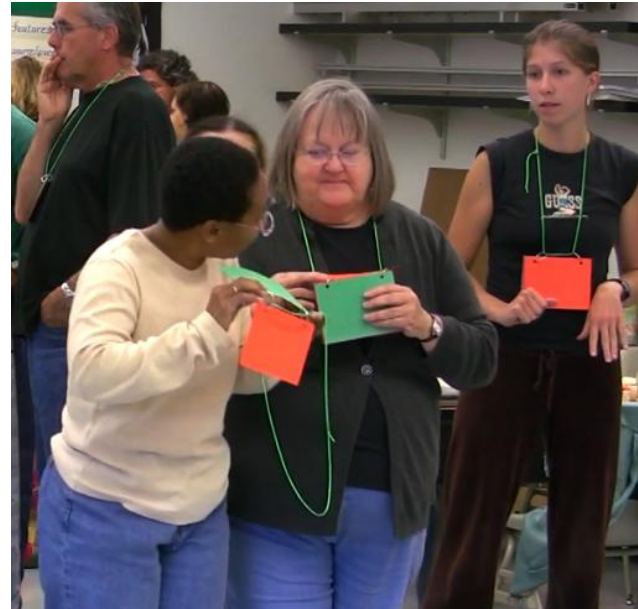


Directed behavior  
for science  
students

Formally  
incorporating  
into instruction

# Blended identity in instruction

Energy Theater is designed to promote symbolic participation in physical events from the perspective of energy.



# What value in instruction?

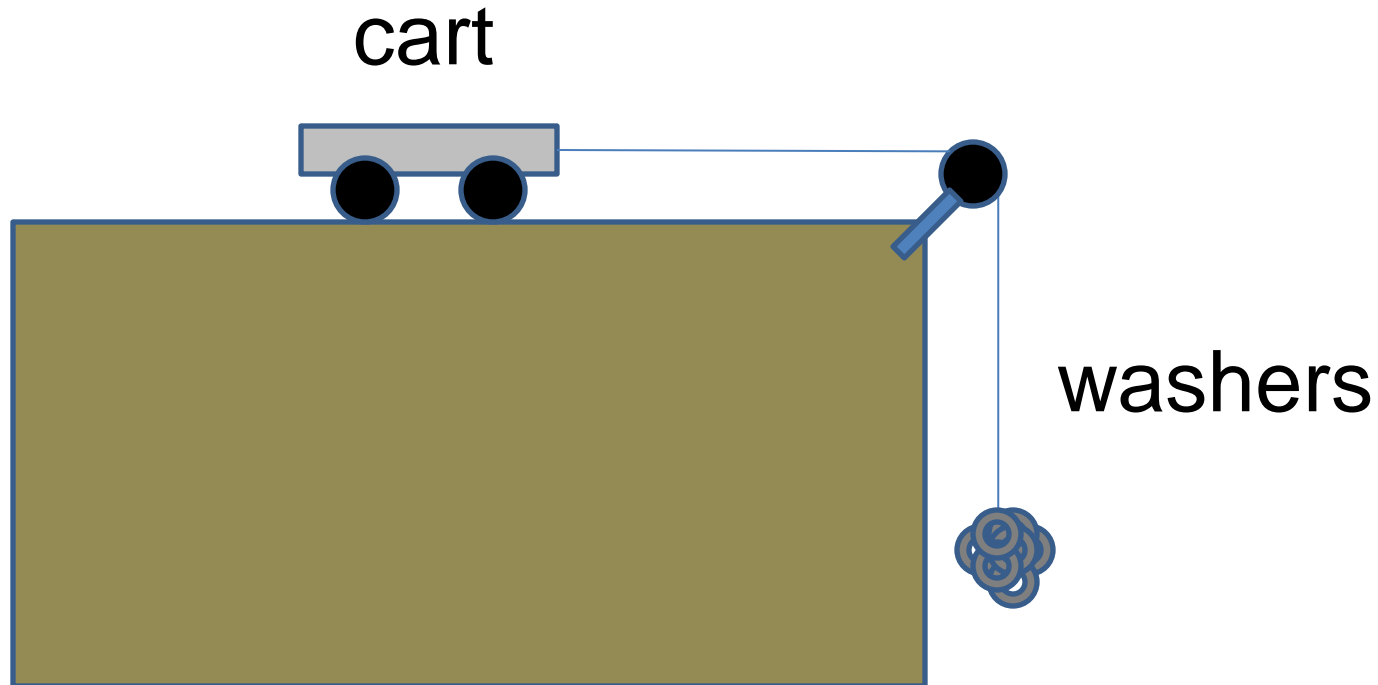
Claim:

Symbolic participation through blended identities allows for much greater access to conceptual learning.

(Today's) evidence:

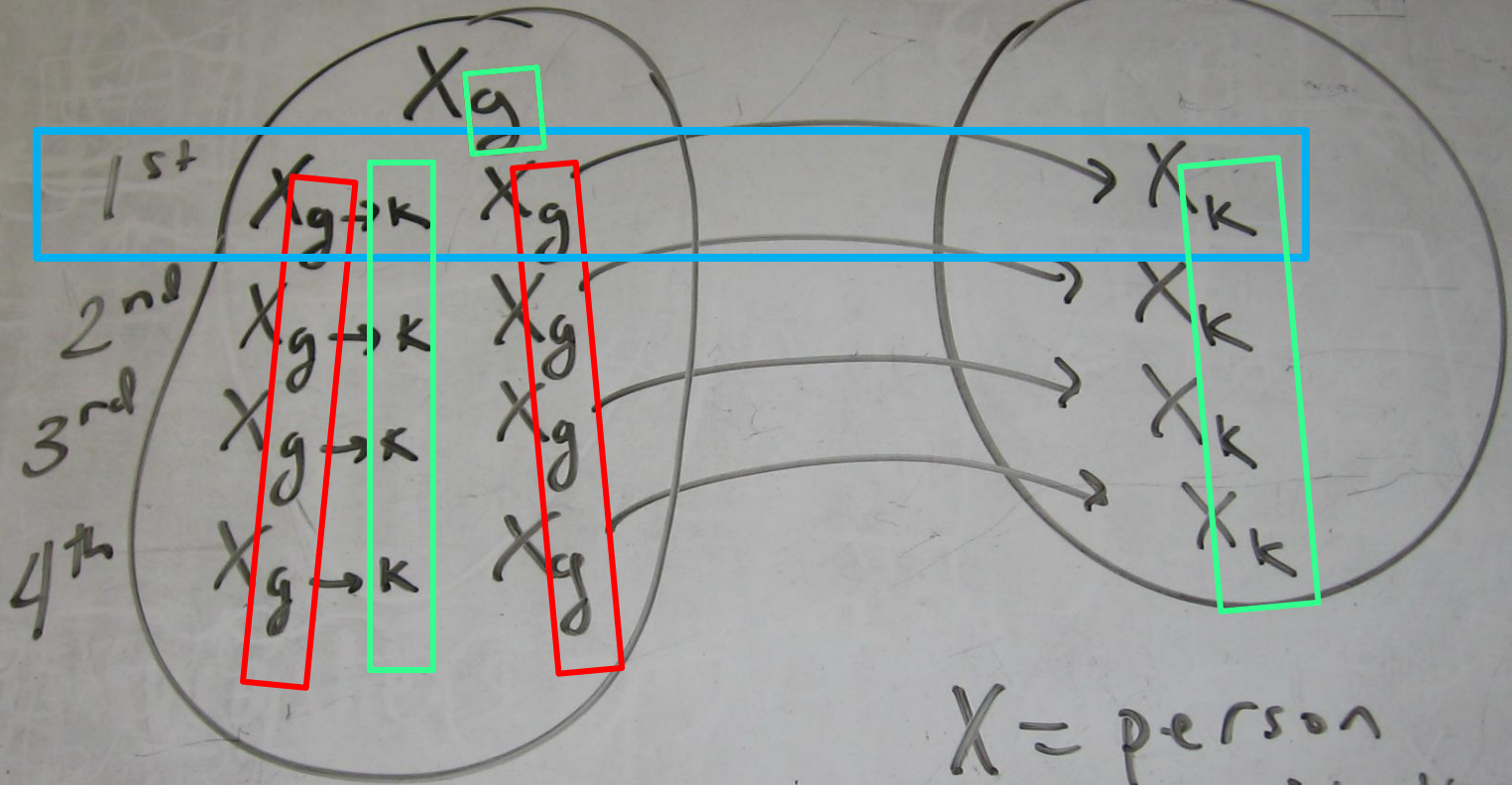
Sophisticated graphic displays designed by elementary teachers beginning to learn about energy.

Describe what happens to the energy.



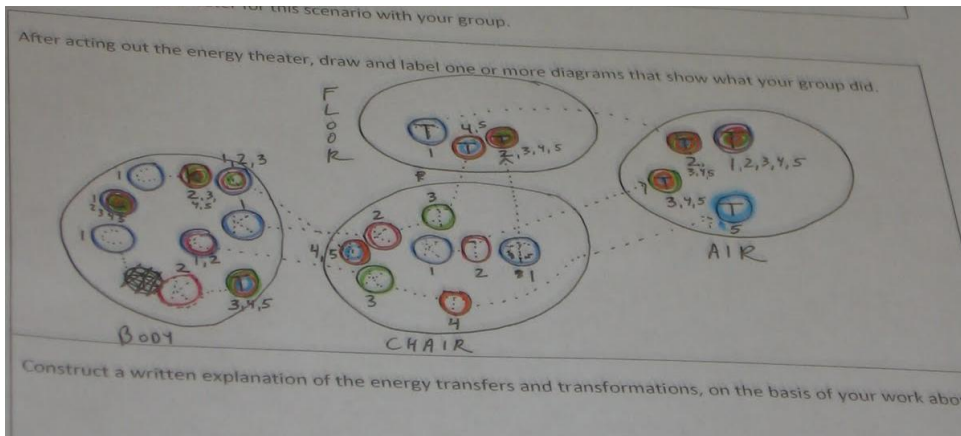
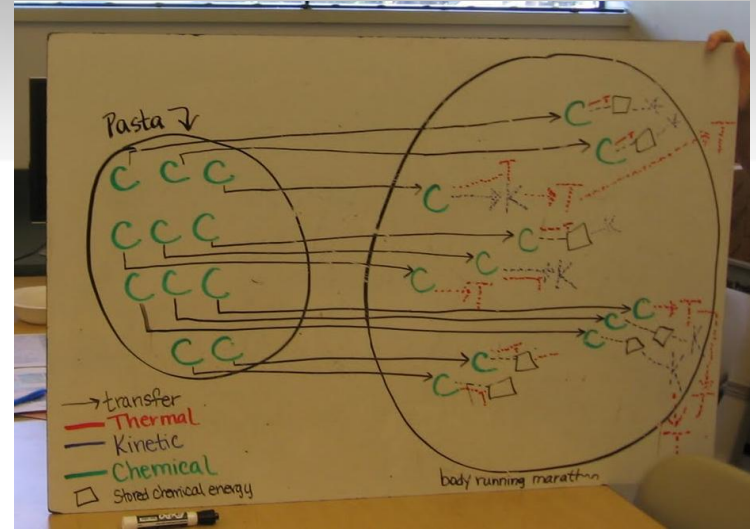
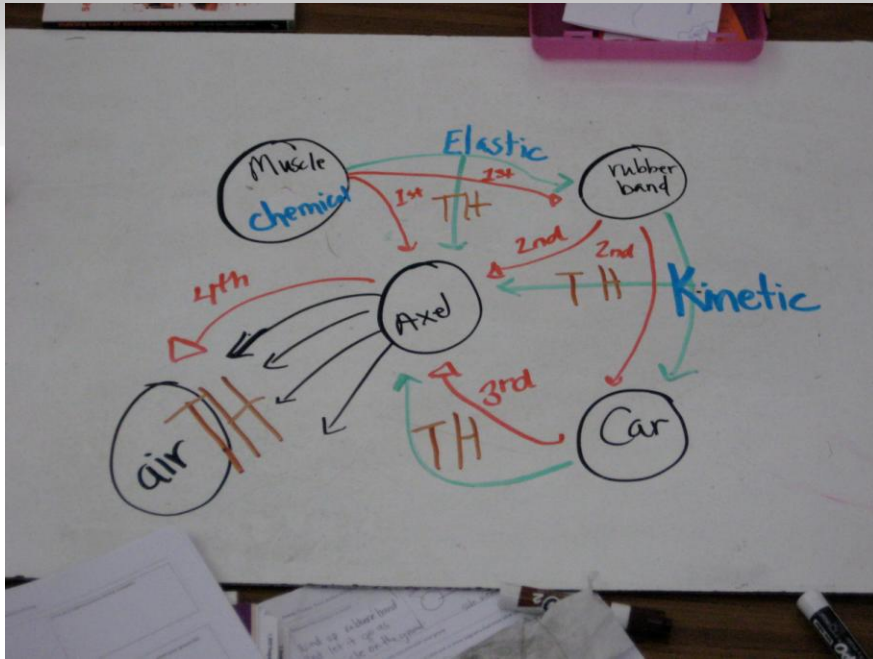
Washers

Cart

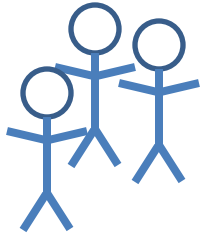


$X$  = person  
 $g$  = gravitational  
 $k$  = kinetic

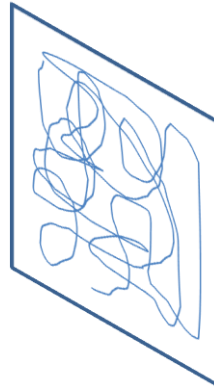




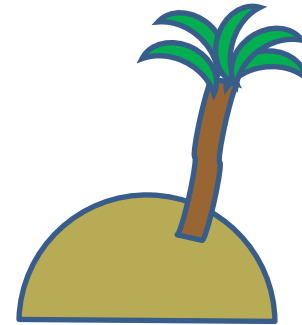
Scientists



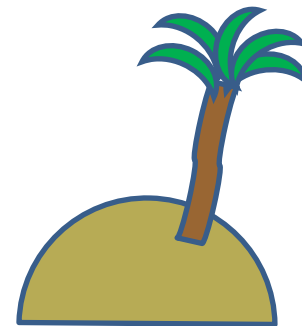
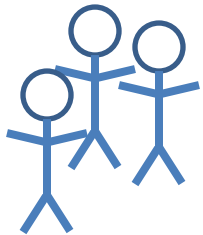
Graphic  
representation



Other world  
being studied



Science  
students



# Summary

When learners pretend to be the energy, they generate more complex diagrams.

# My PERC poster

***Copying the lab key, or:  
How to apply the Algebra  
Project to science teacher  
professional development***

**Thursday 10:30 – 12:00,  
Session 2D**

