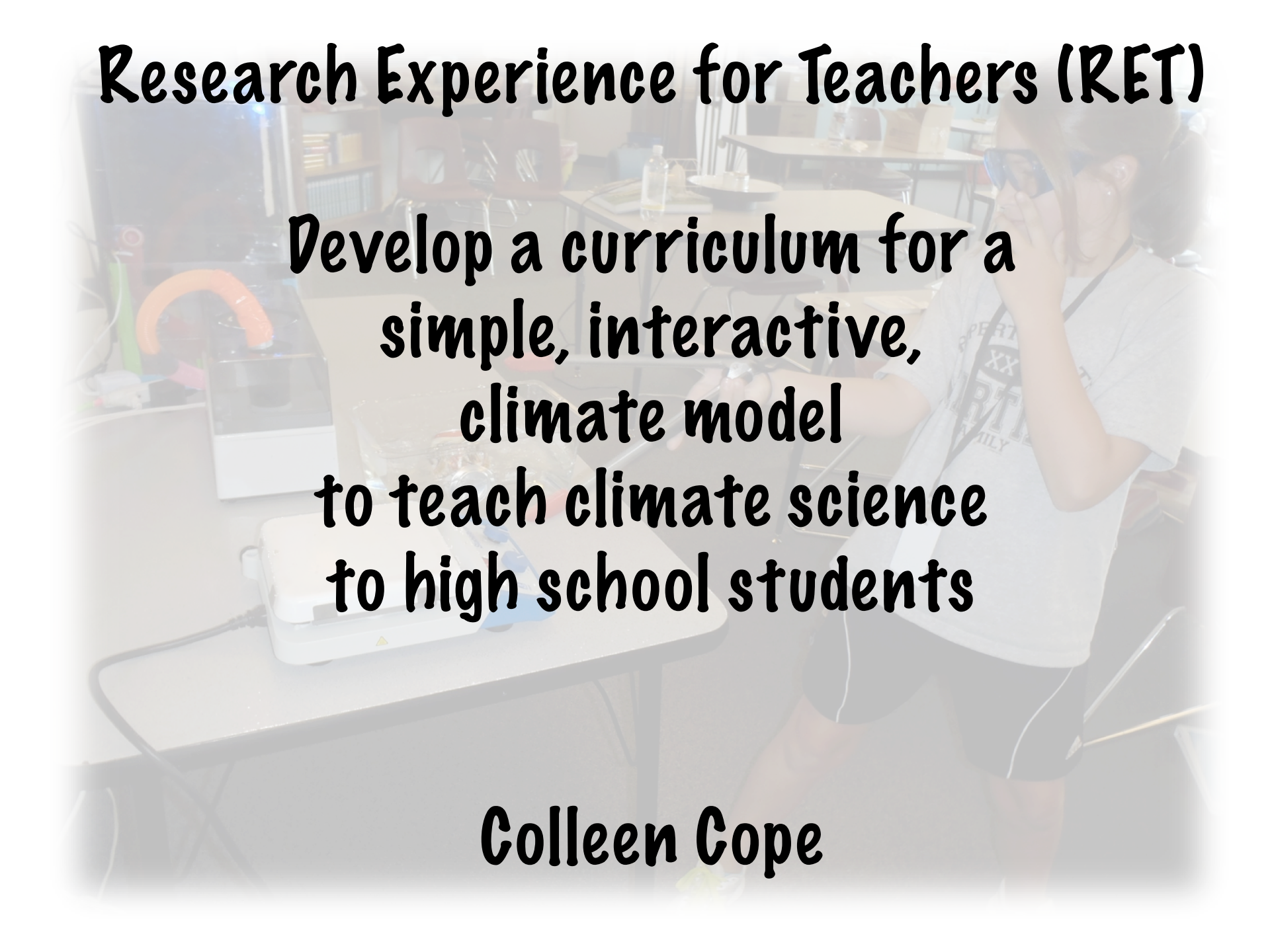
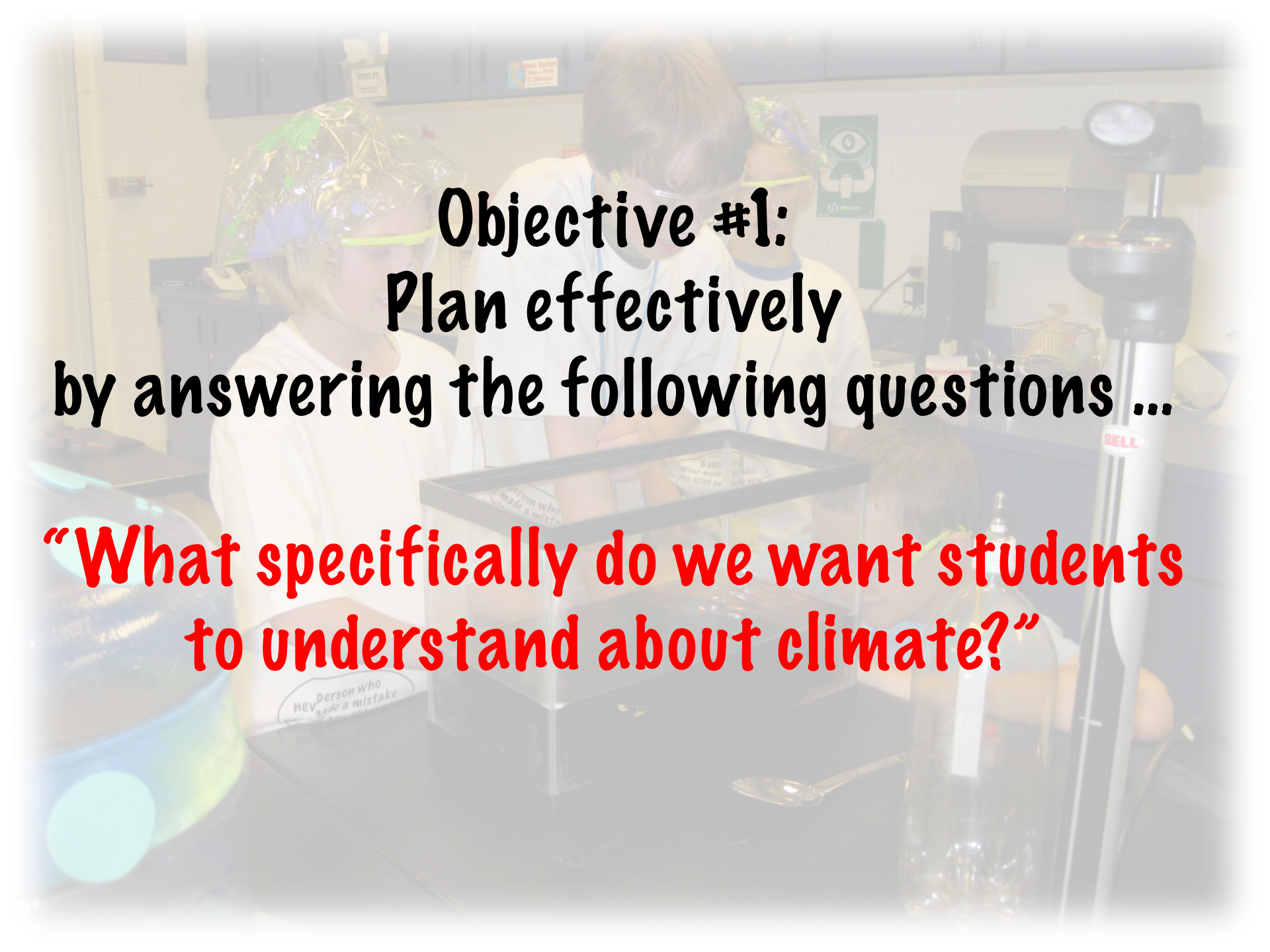
Research Experience for Teachers (RET)



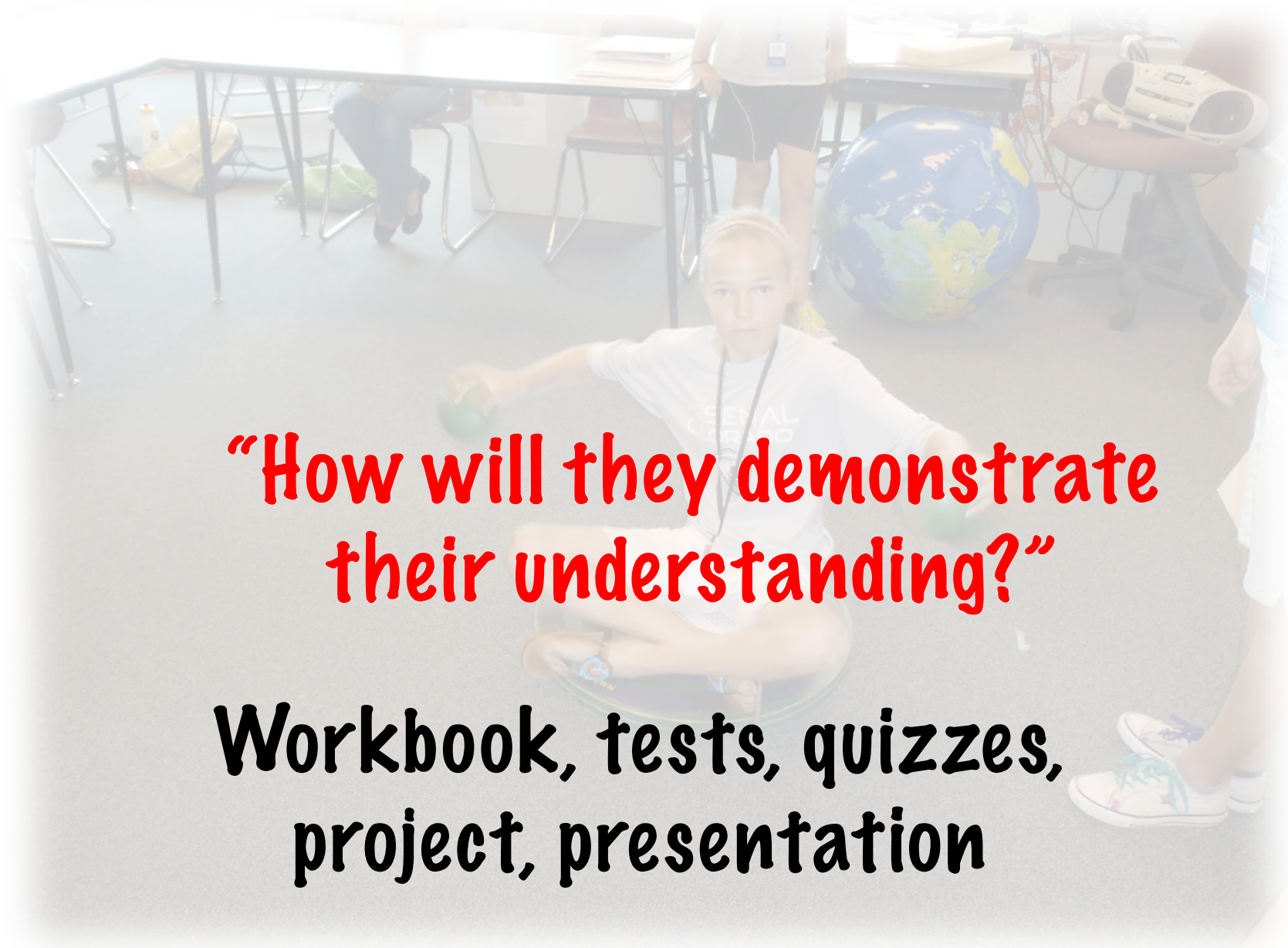
Develop a curriculum for a simple, interactive, climate model to teach climate science to high school students

Colleen Cope



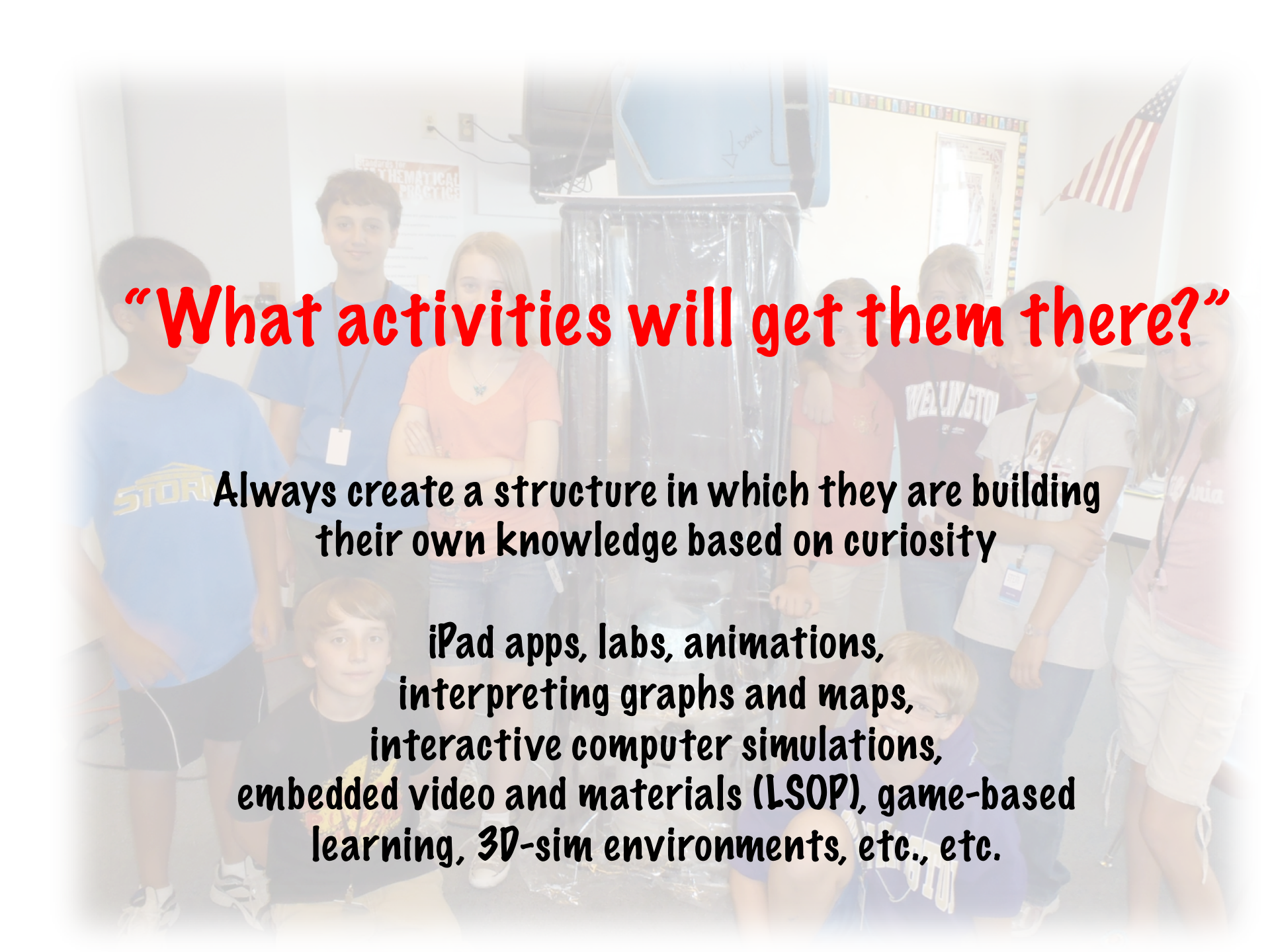
Objective #1:
Plan effectively
by answering the following questions …

"What specifically do we want students to understand about climate?"



"How will they demonstrate their understanding?"

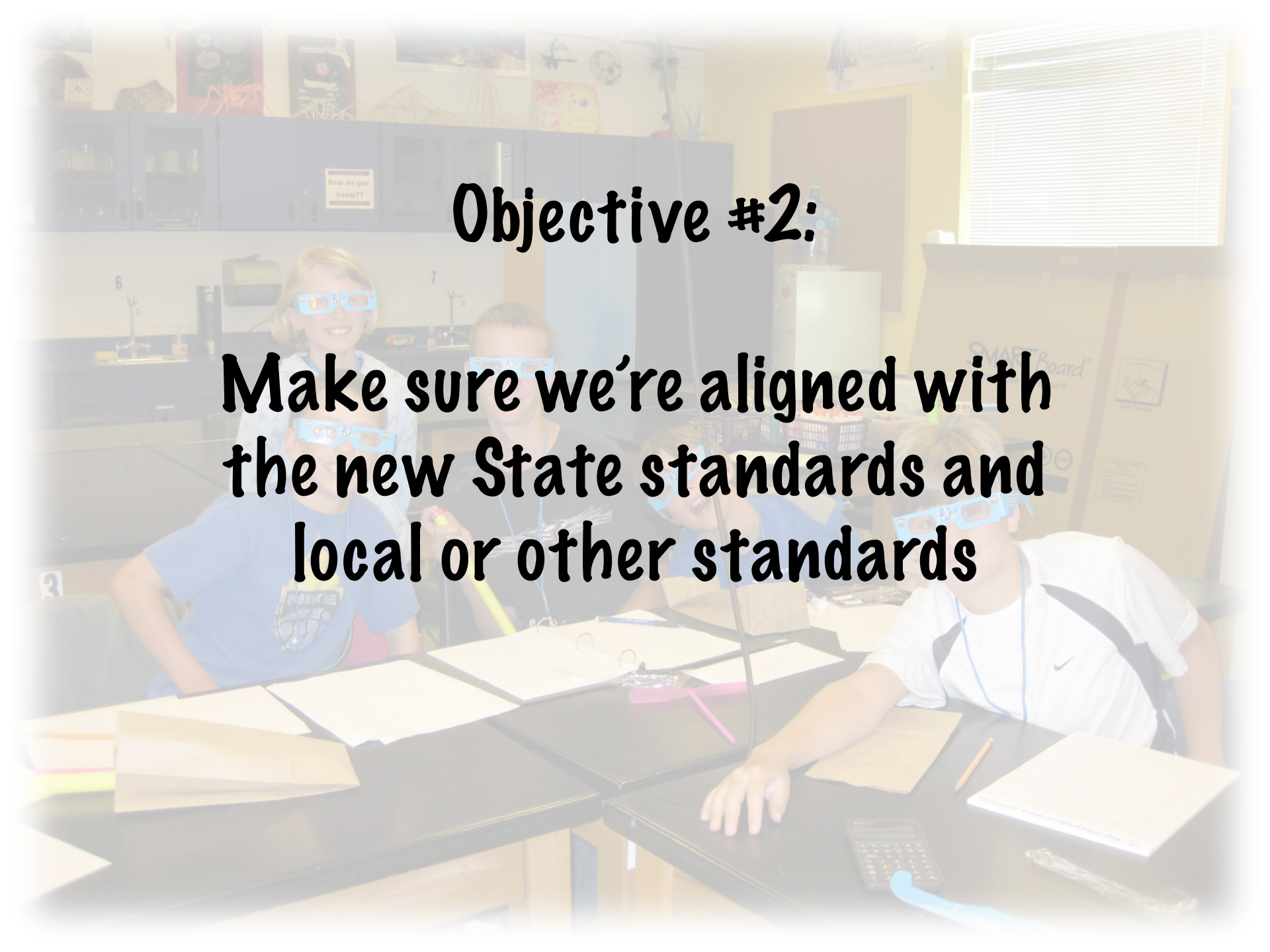
Workbook, tests, quizzes, project, presentation



"What activities will get them there?"

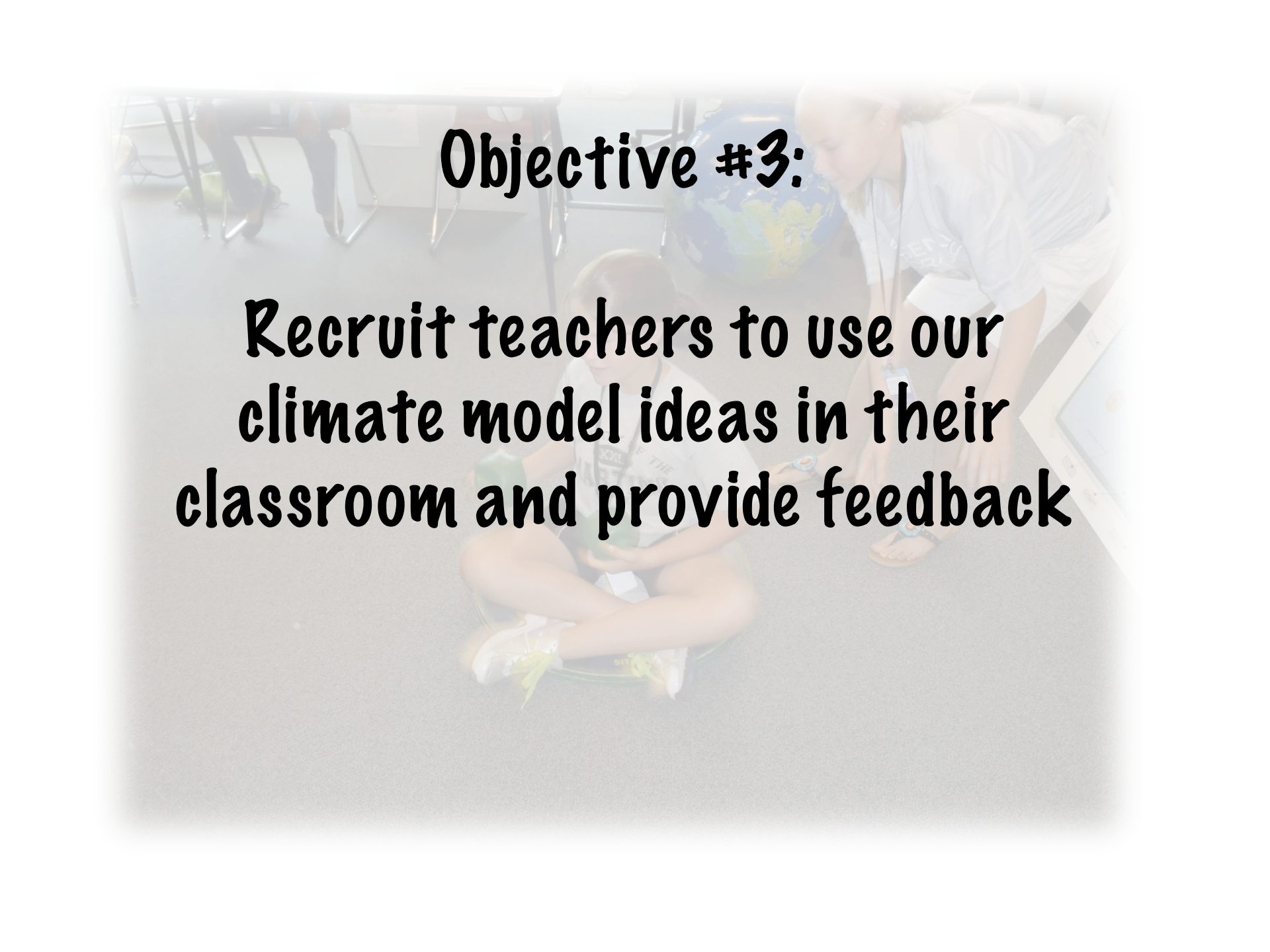
Always create a structure in which they are building their own knowledge based on curiosity

iPad apps, labs, animations, interpreting graphs and maps, interactive computer simulations, embedded video and materials (LSOP), game-based learning, 3D-sim environments, etc., etc.



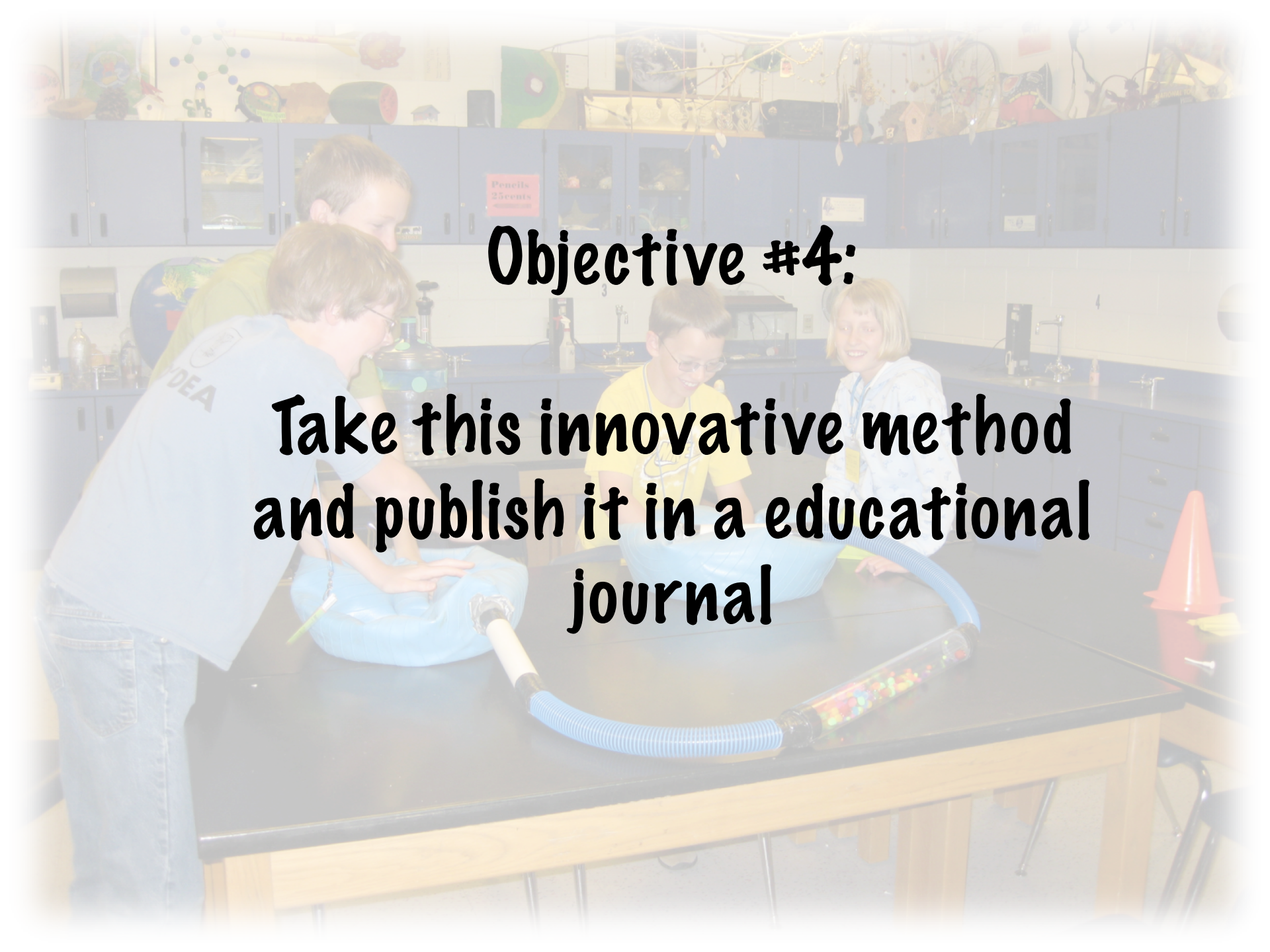
Objective #2:

Make sure we're aligned with the new State standards and local or other standards



Objective #3:

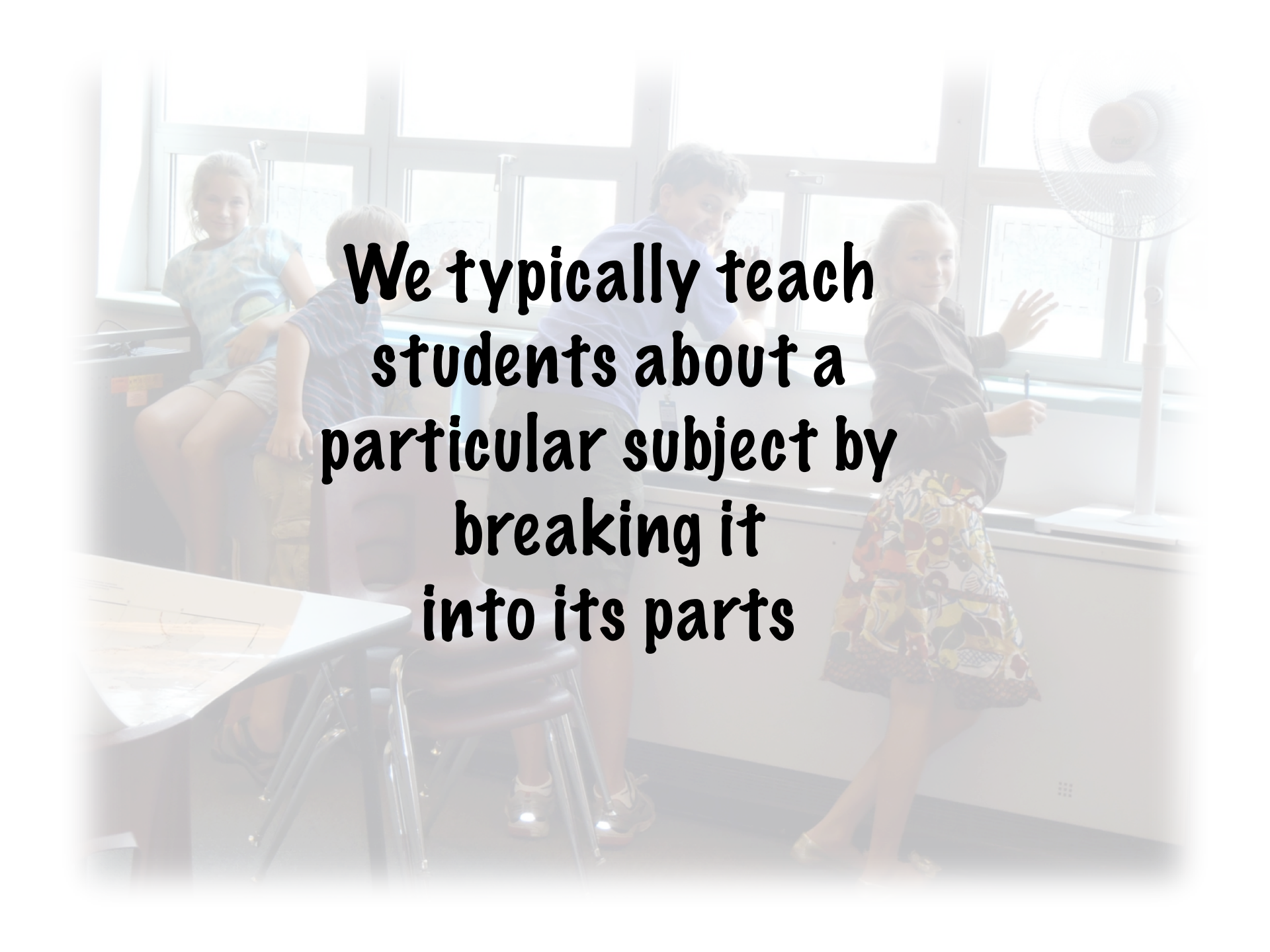
Recruit teachers to use our climate model ideas in their classroom and provide feedback

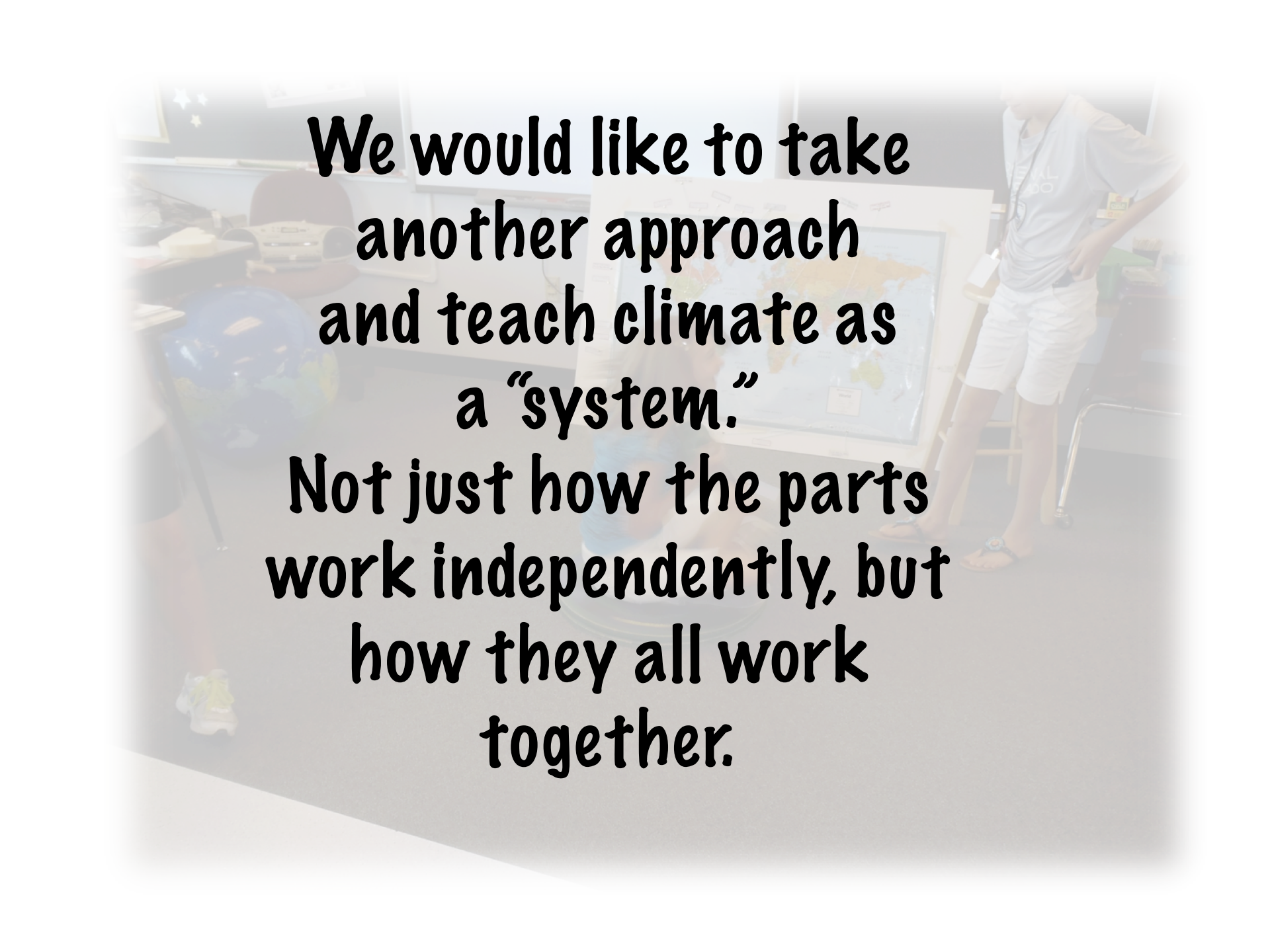


Objective #4:

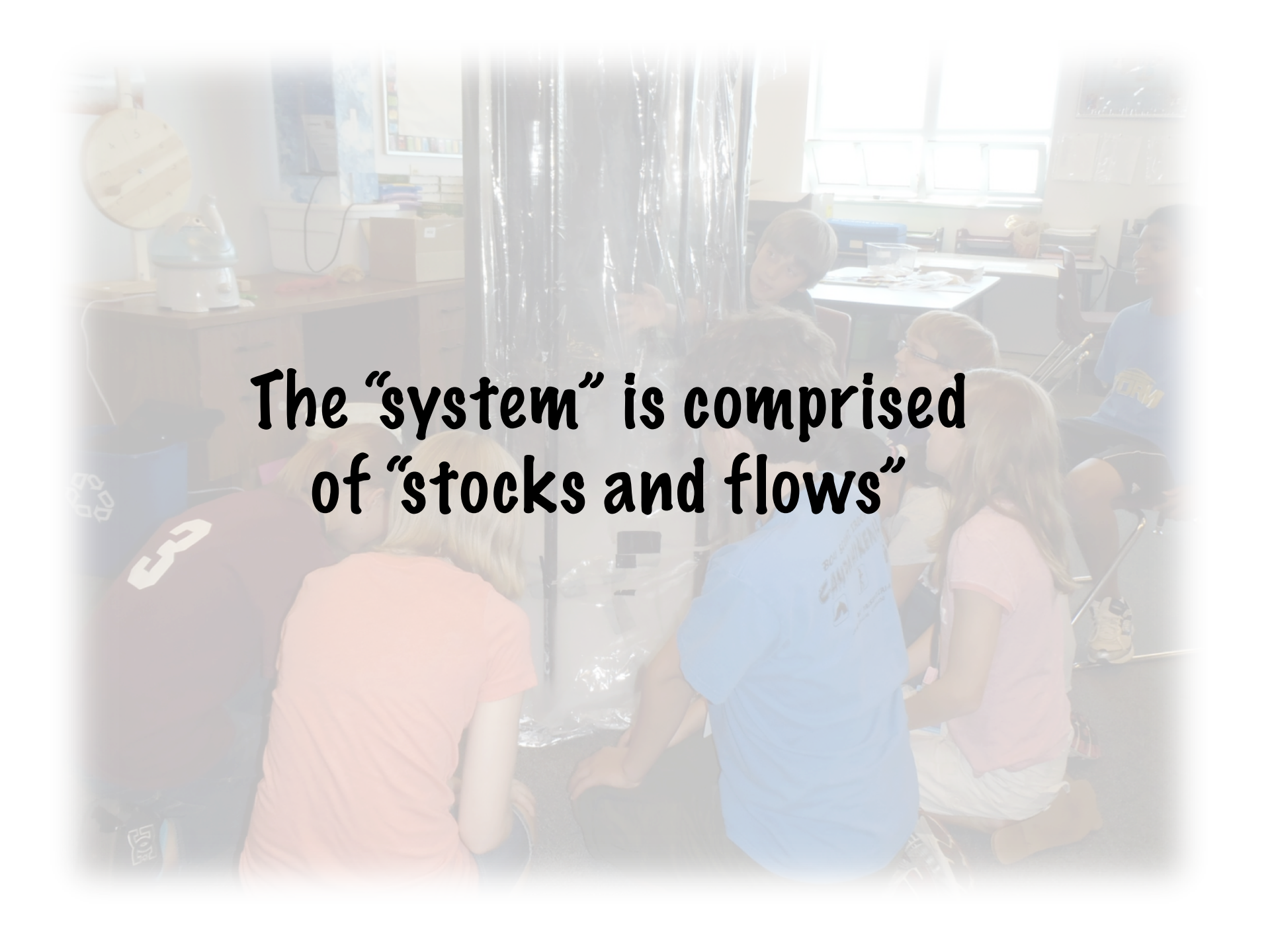
Take this innovative method and publish it in a educational journal

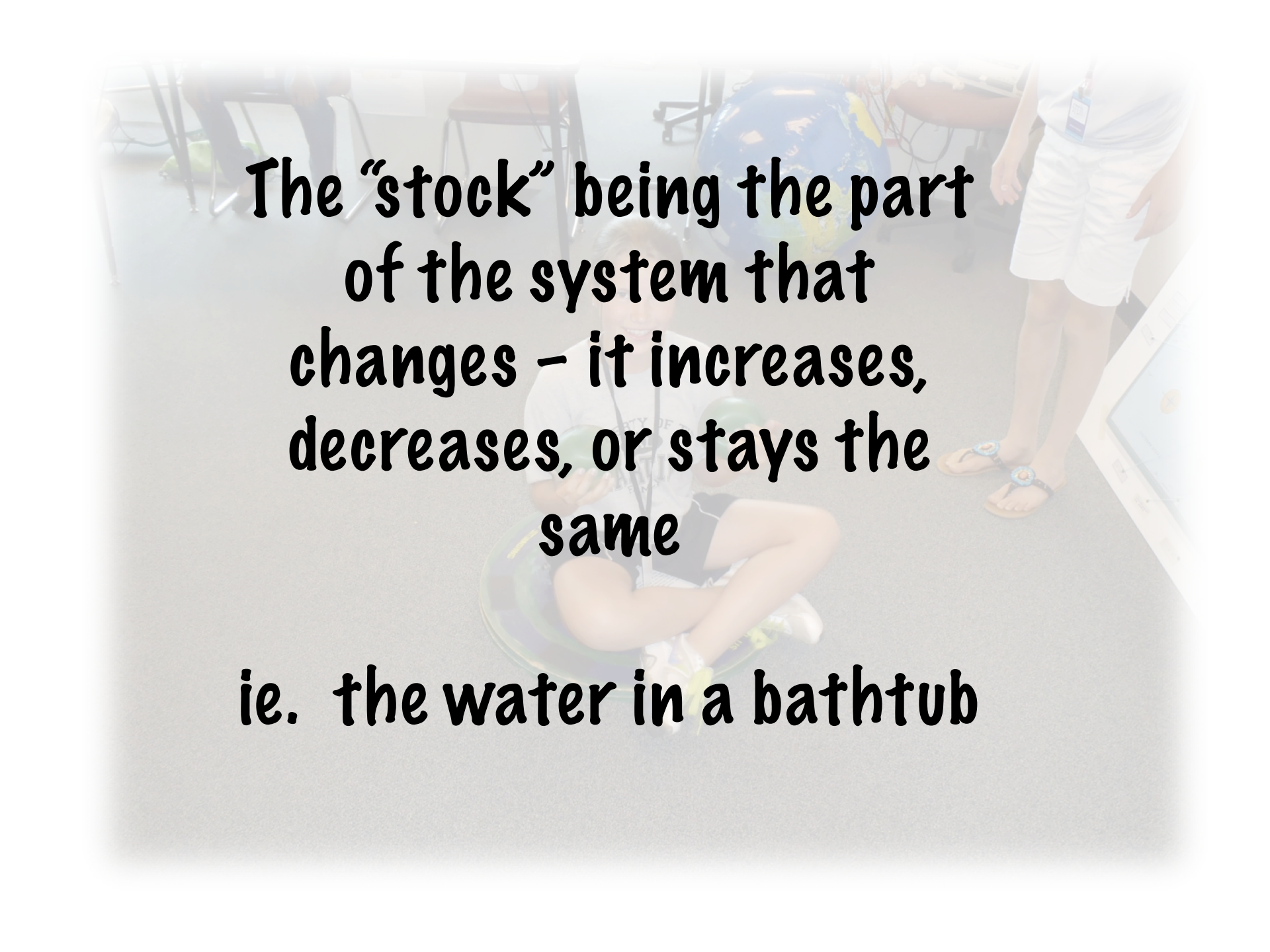

So where do we start?


We typically teach
students about a
particular subject by
breaking it
into its parts



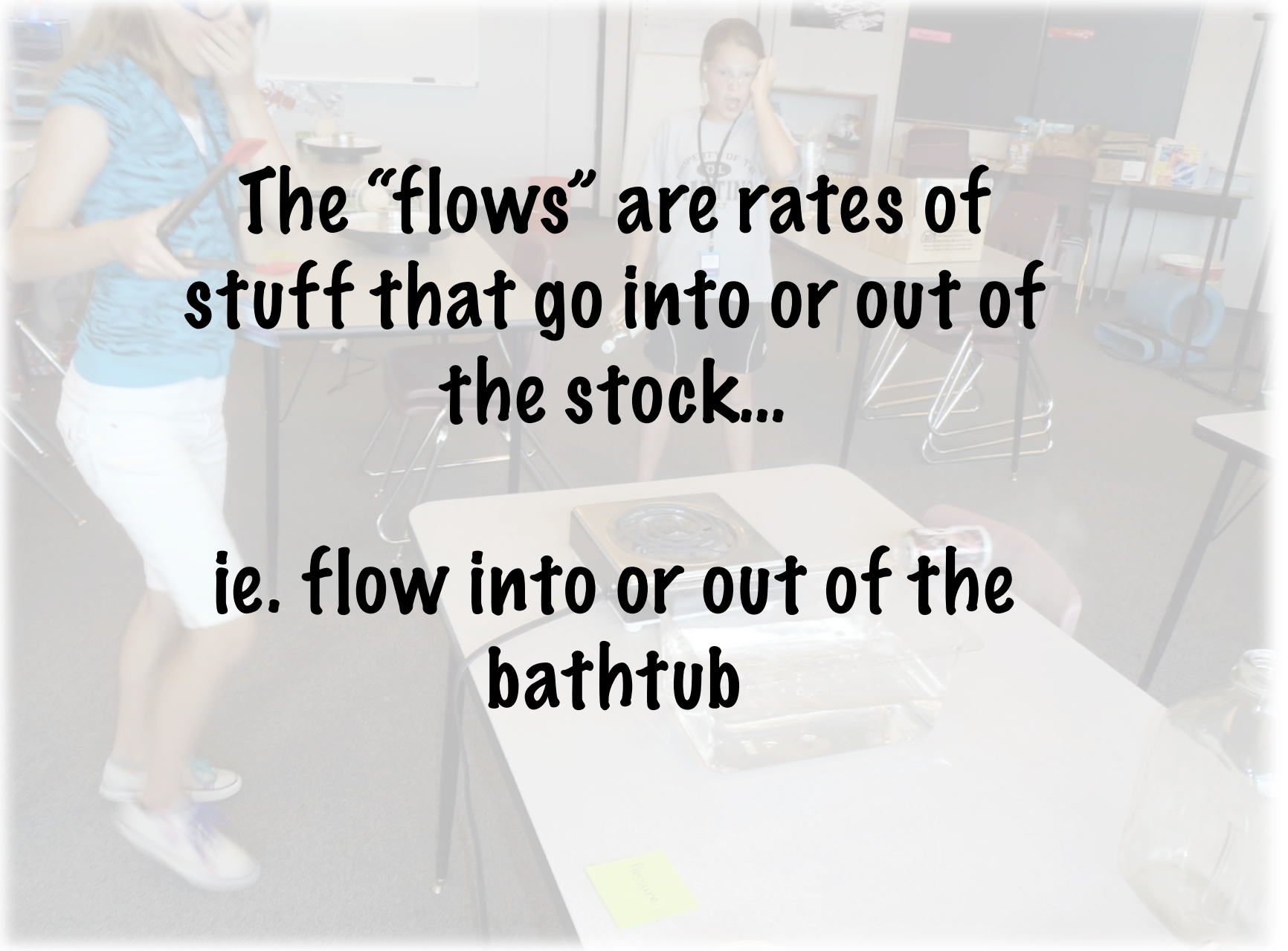
We would like to take another approach and teach climate as a "system." Not just how the parts work independently, but how they all work together.


The "system" is comprised
of "stocks and flows"



The "stock" being the part of the system that changes - it increases, decreases, or stays the same

ie. the water in a bathtub

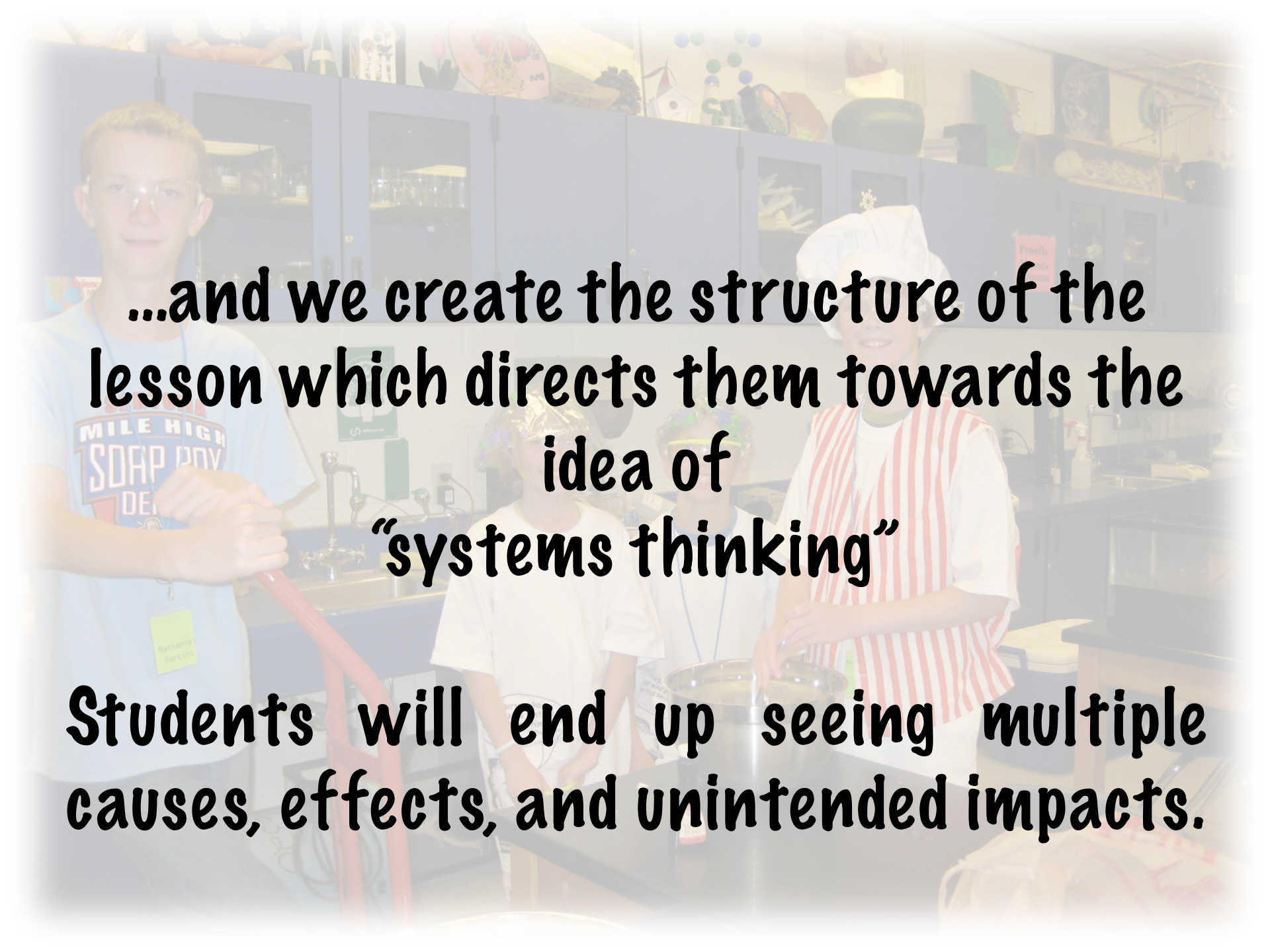


The "flows" are rates of stuff that go into or out of the stock...

ie. flow into or out of the bathtub

We can get creative with the metaphors by modeling anything measureable.

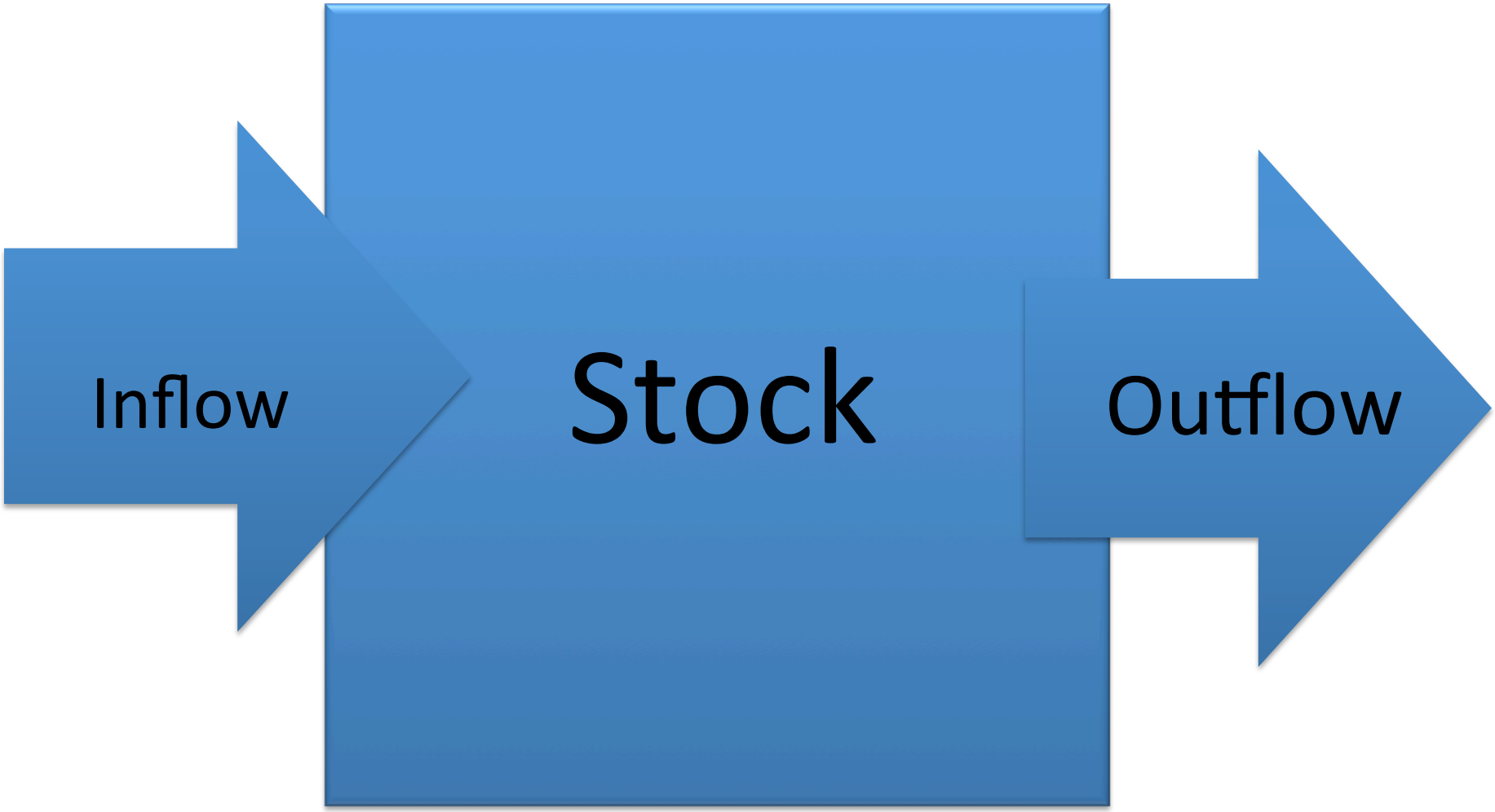
So we start by having the students create their own stocks...out of anything.



...and we create the structure of the lesson which directs them towards the idea of "systems thinking"

Students will end up seeing multiple causes, effects, and unintended impacts.

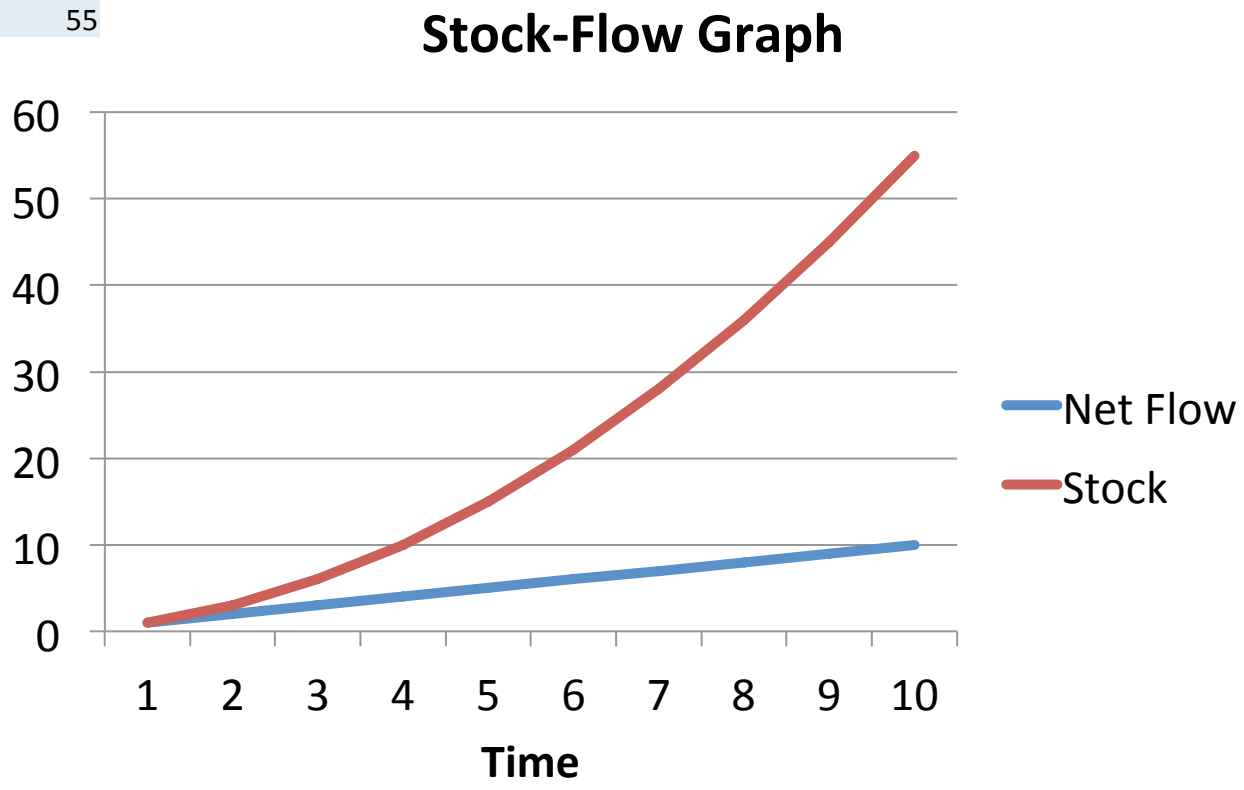
Students will realize when they start moving stuff into and out of stocks and keeping track in tables and graphs, that...

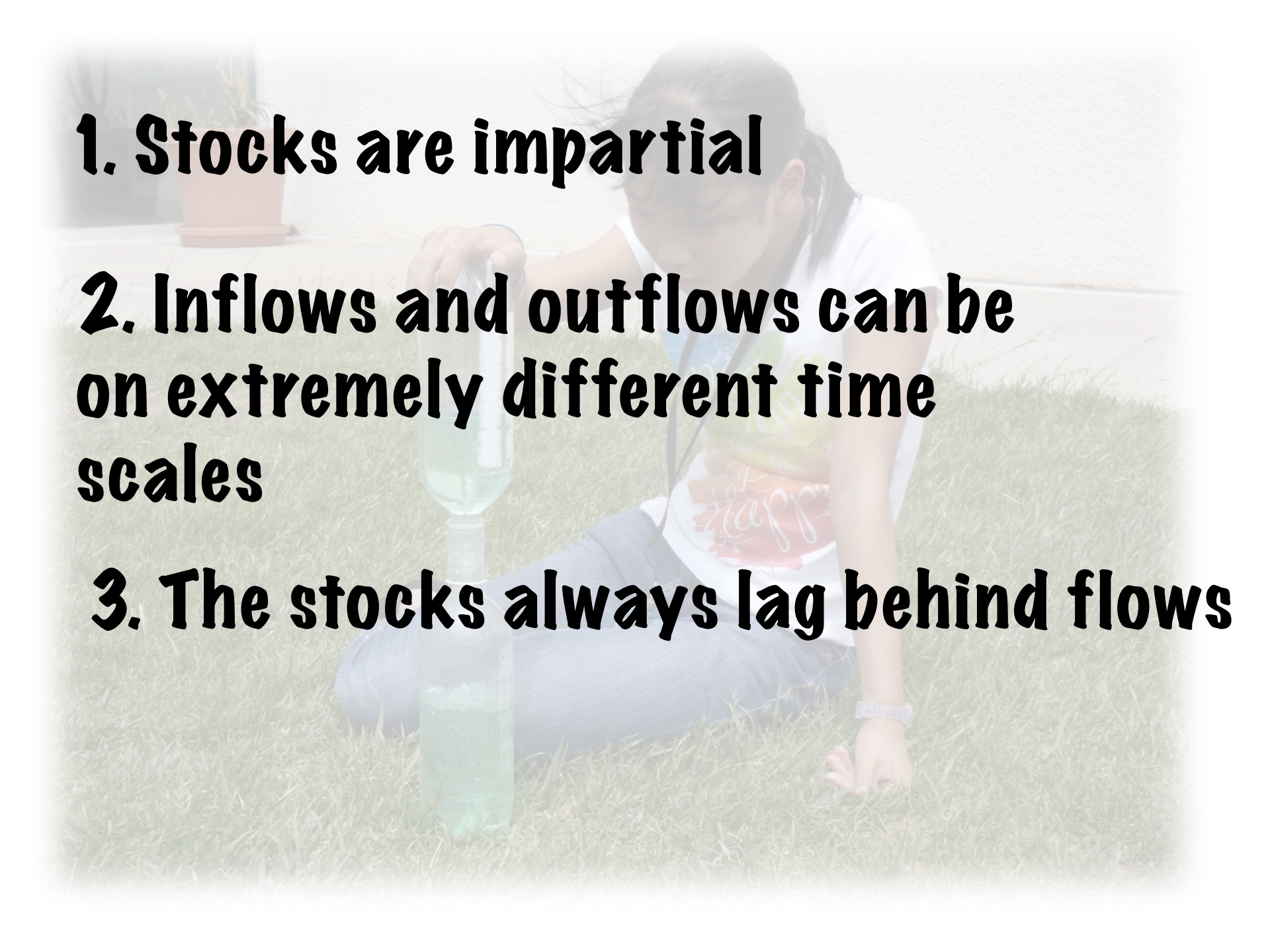


1. Stocks are impartial

Time	Net Flow	Stock
1	1	1
2	2	3
3	3	6
4	4	10
5	5	15
6	6	21
7	7	28
8	8	36
9	9	45
10	10	55

"But my flow only increased by a "little" each year?? "





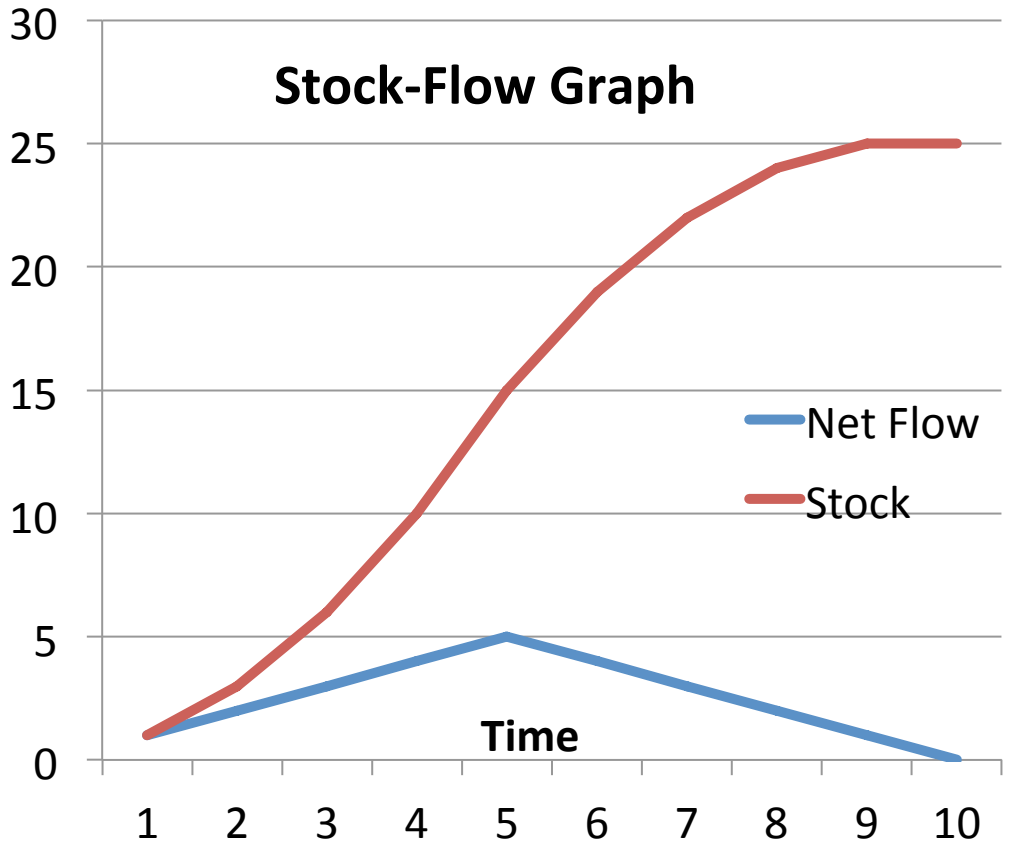
1. Stocks are impartial

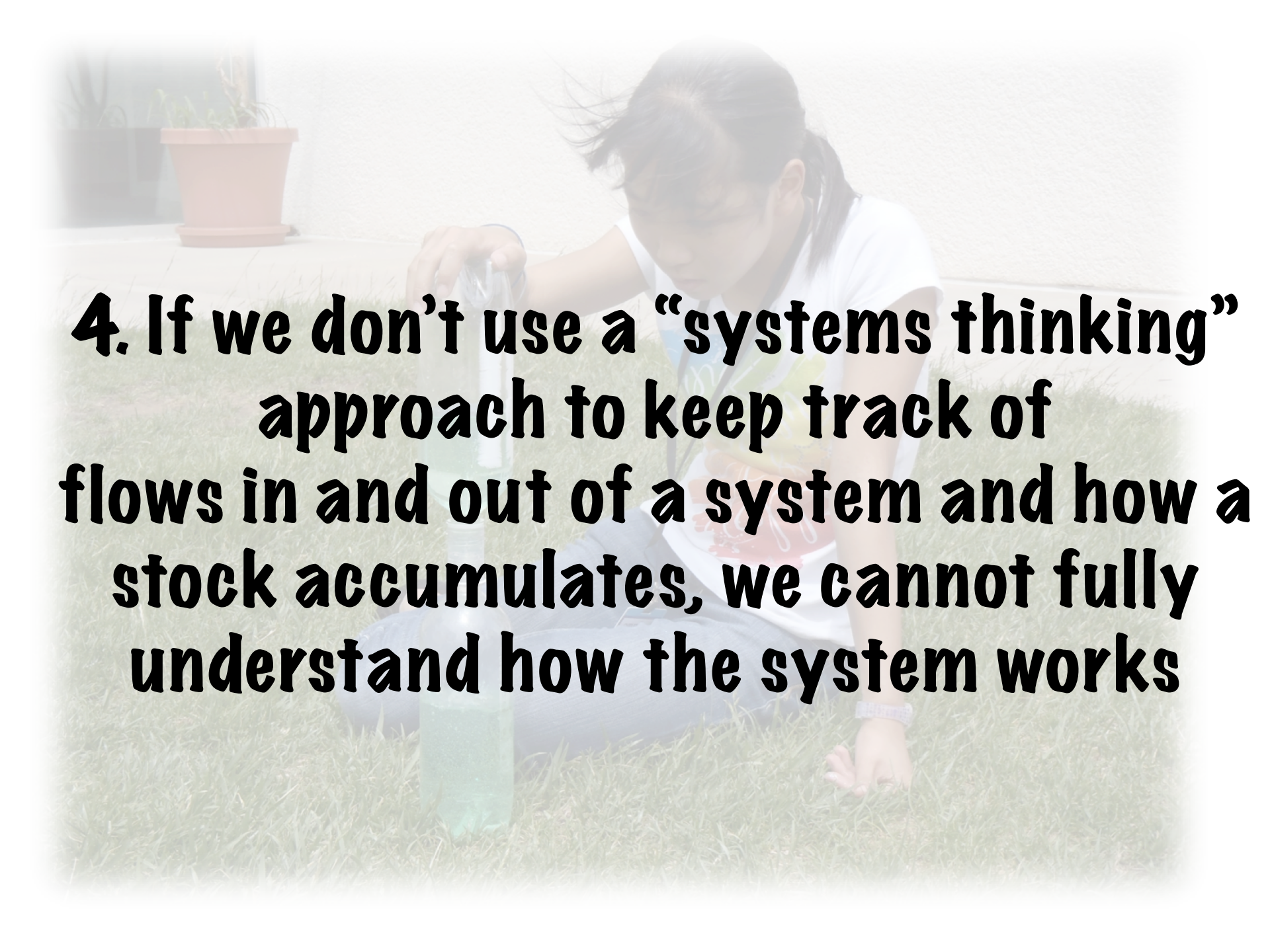
2. Inflows and outflows can be on extremely different time scales

3. The stocks always lag behind flows

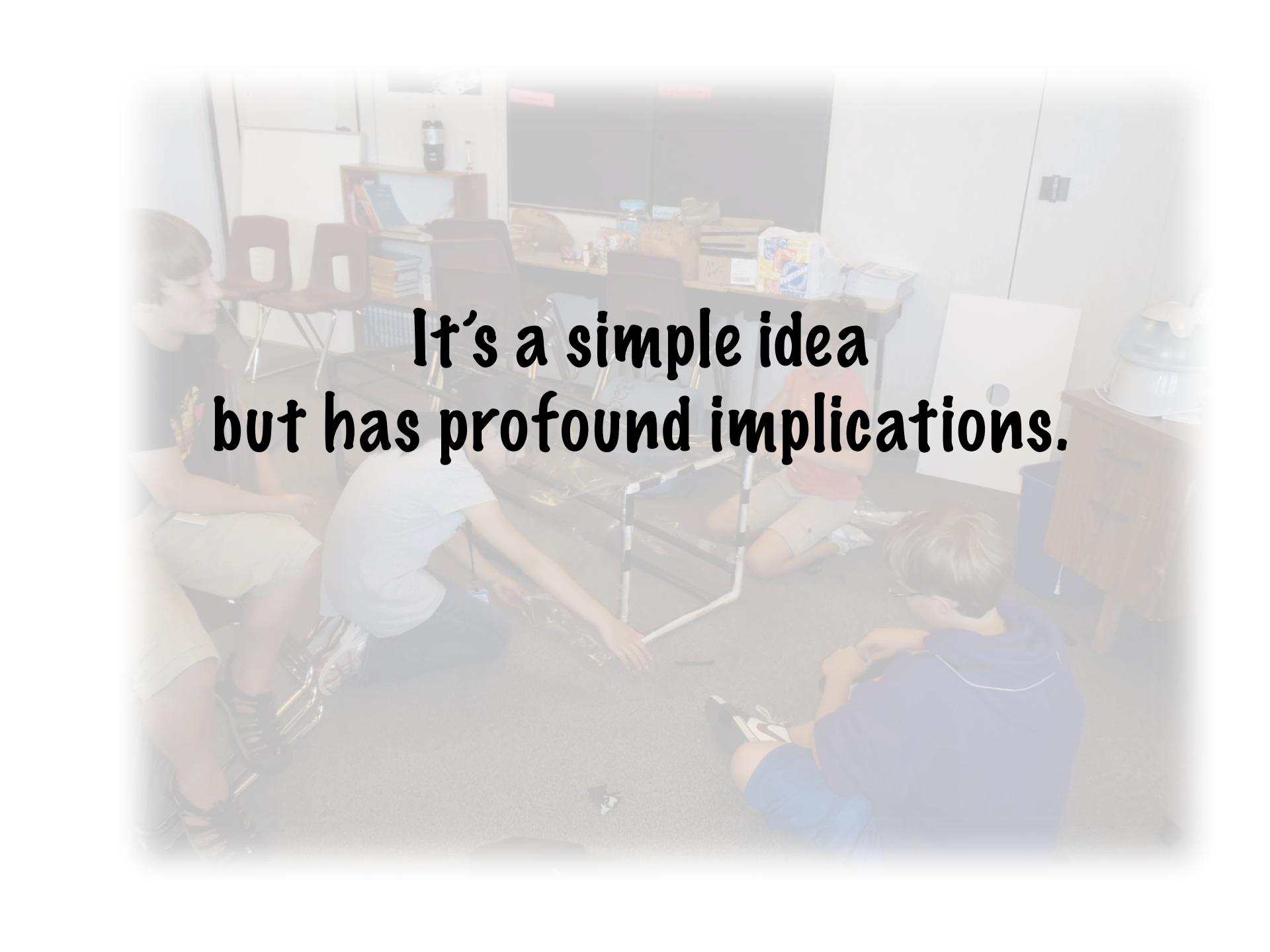
Time	Net Flow	Stock
1	1	1
2	2	3
3	3	6
4	4	10
5	5	15
6	4	19
7	3	22
8	2	24
9	1	25
10	0	25

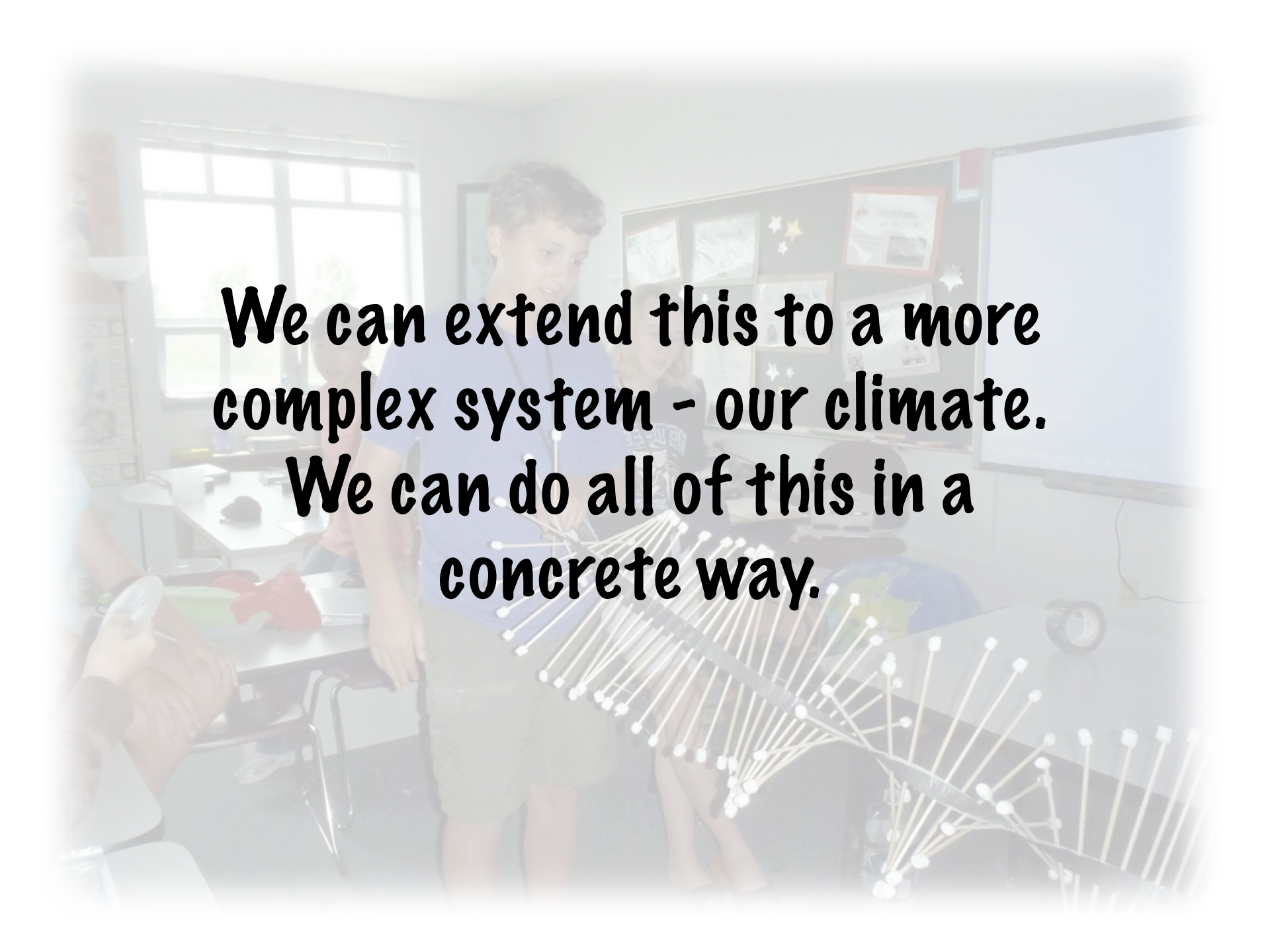
"My flow rate decreased to ZERO but my stock remains?"



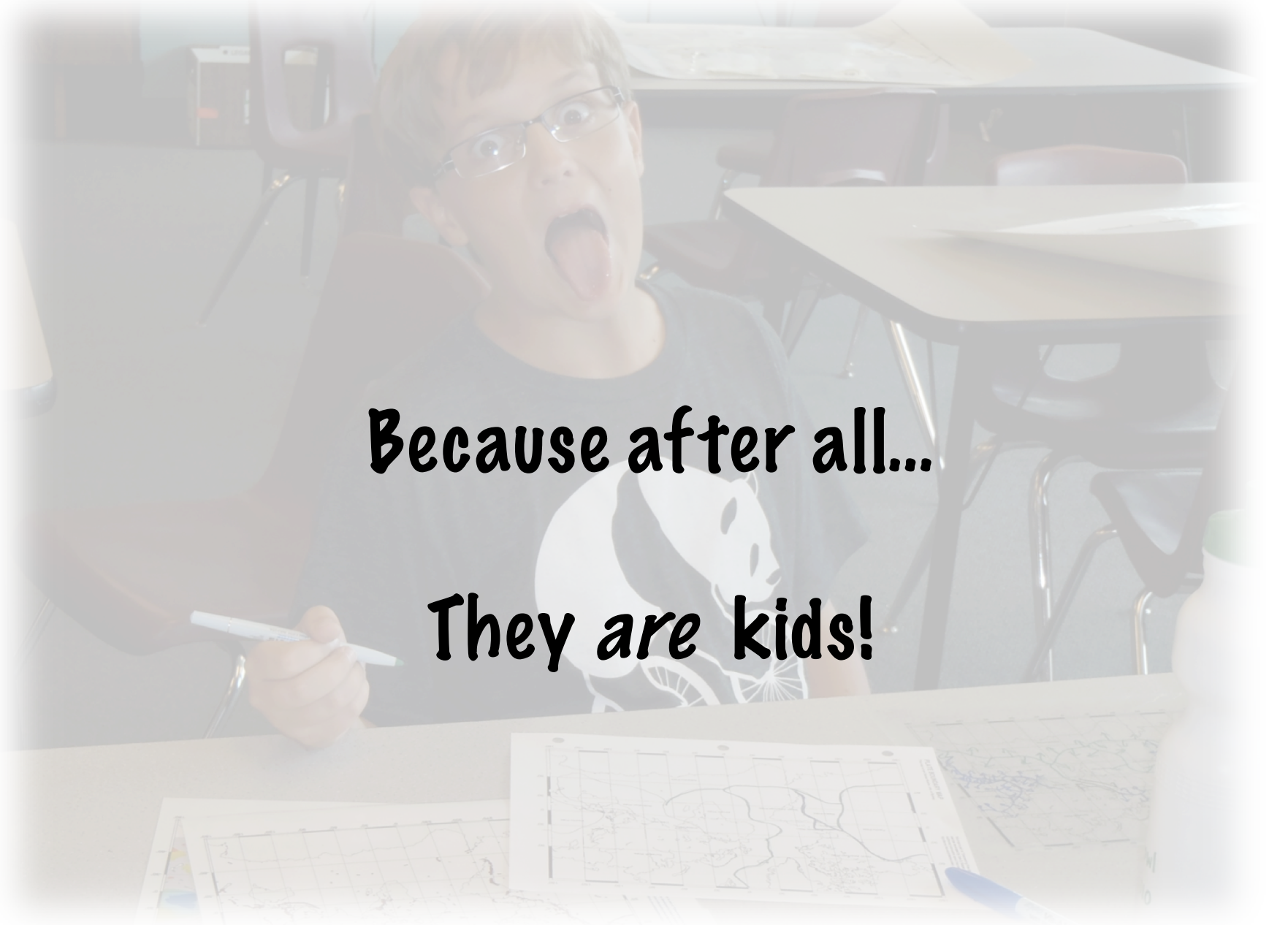


4. If we don't use a "systems thinking" approach to keep track of flows in and out of a system and how a stock accumulates, we cannot fully understand how the system works

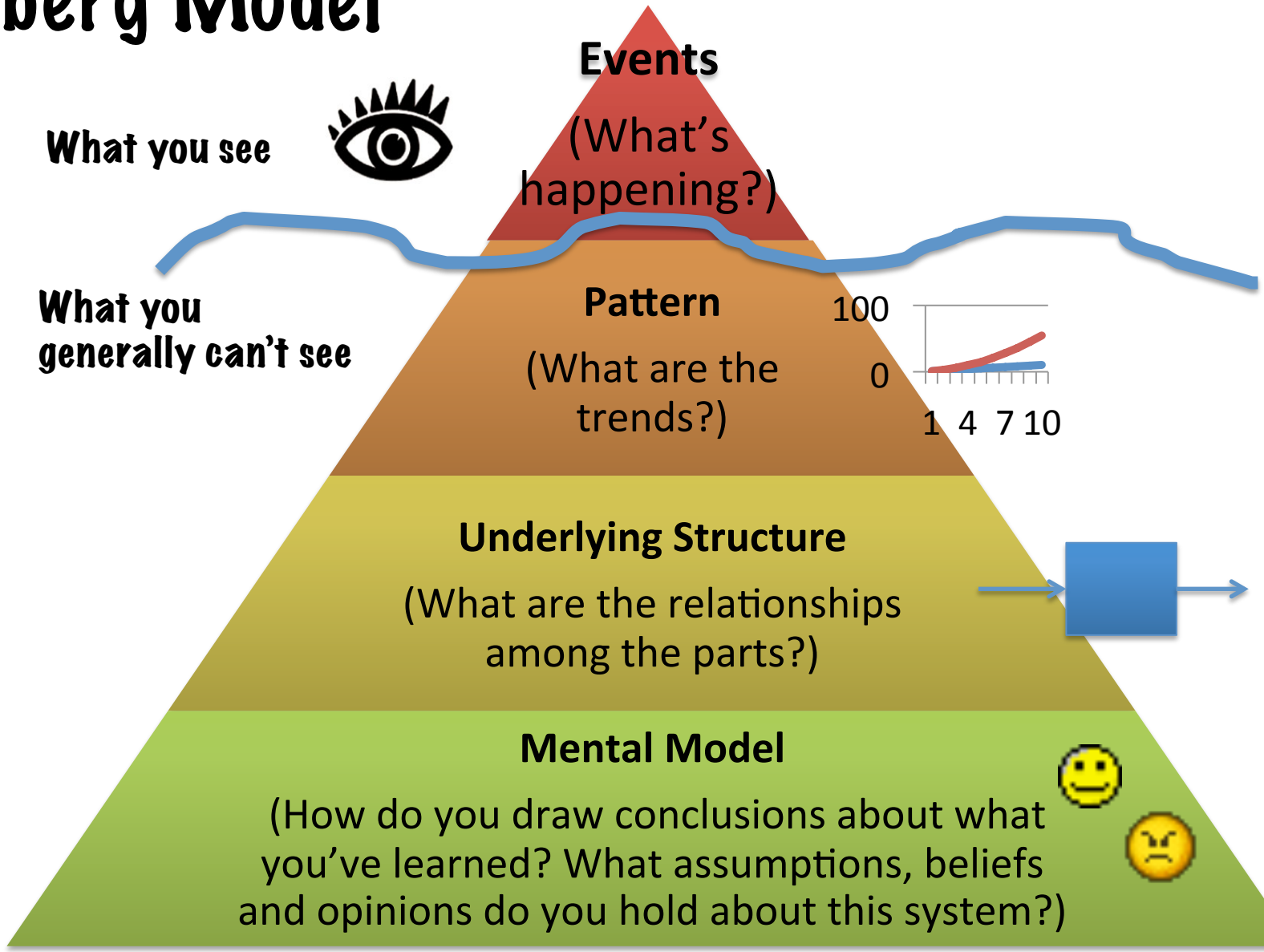

It's a simple idea
but has profound implications.

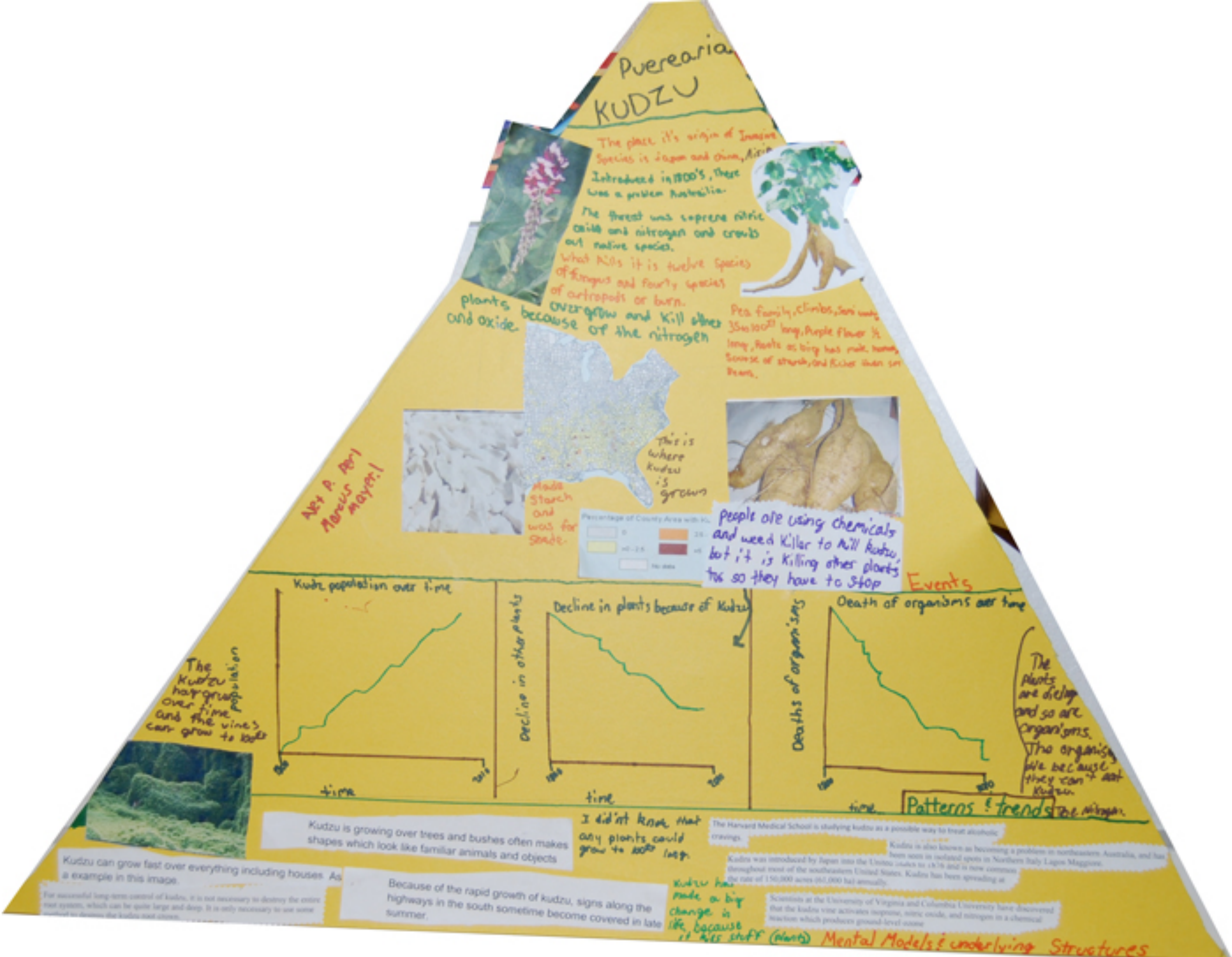

We can extend this to a more complex system - our climate.
We can do all of this in a concrete way.

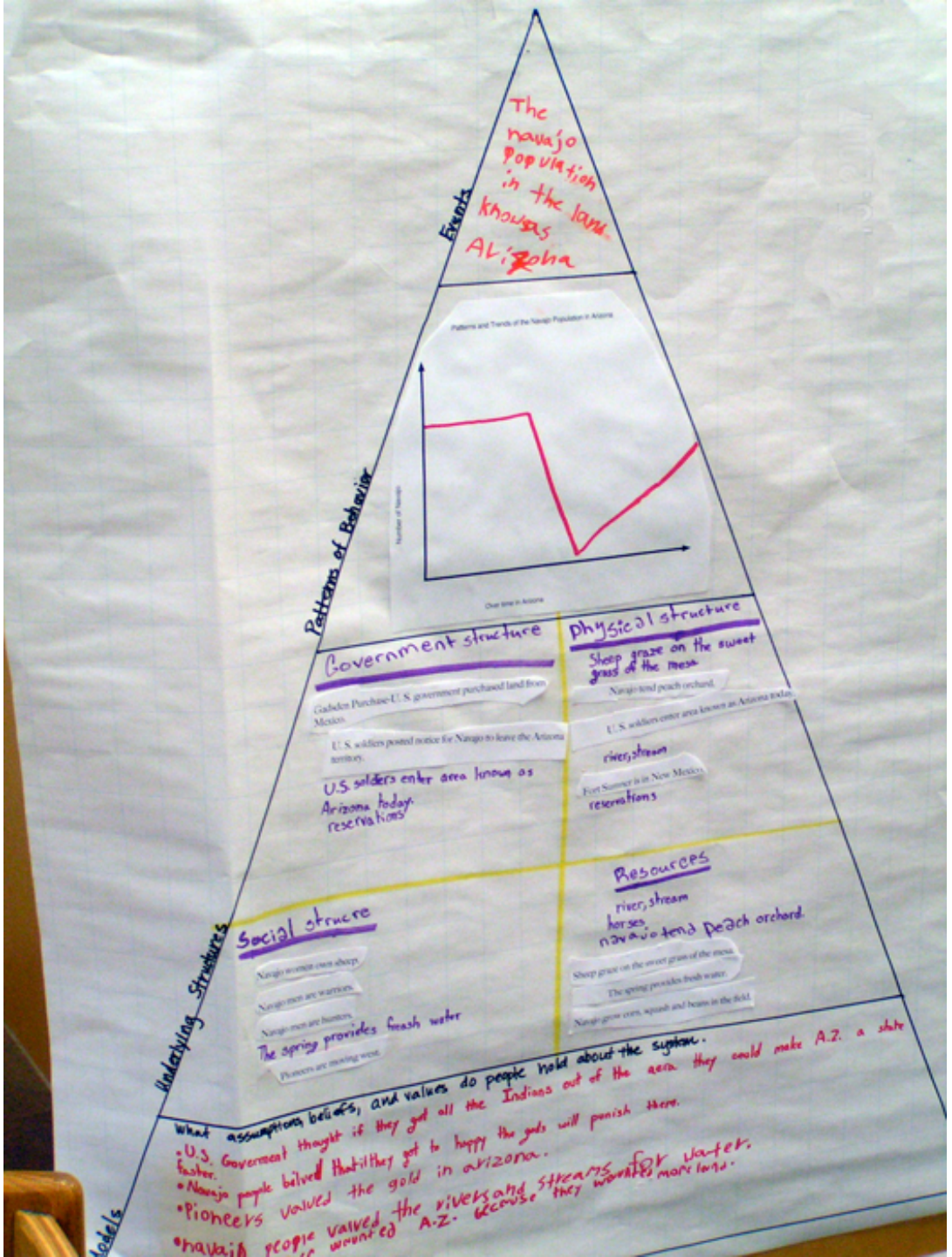
Still have fun learning about it


Because after all...
They *are* kids!

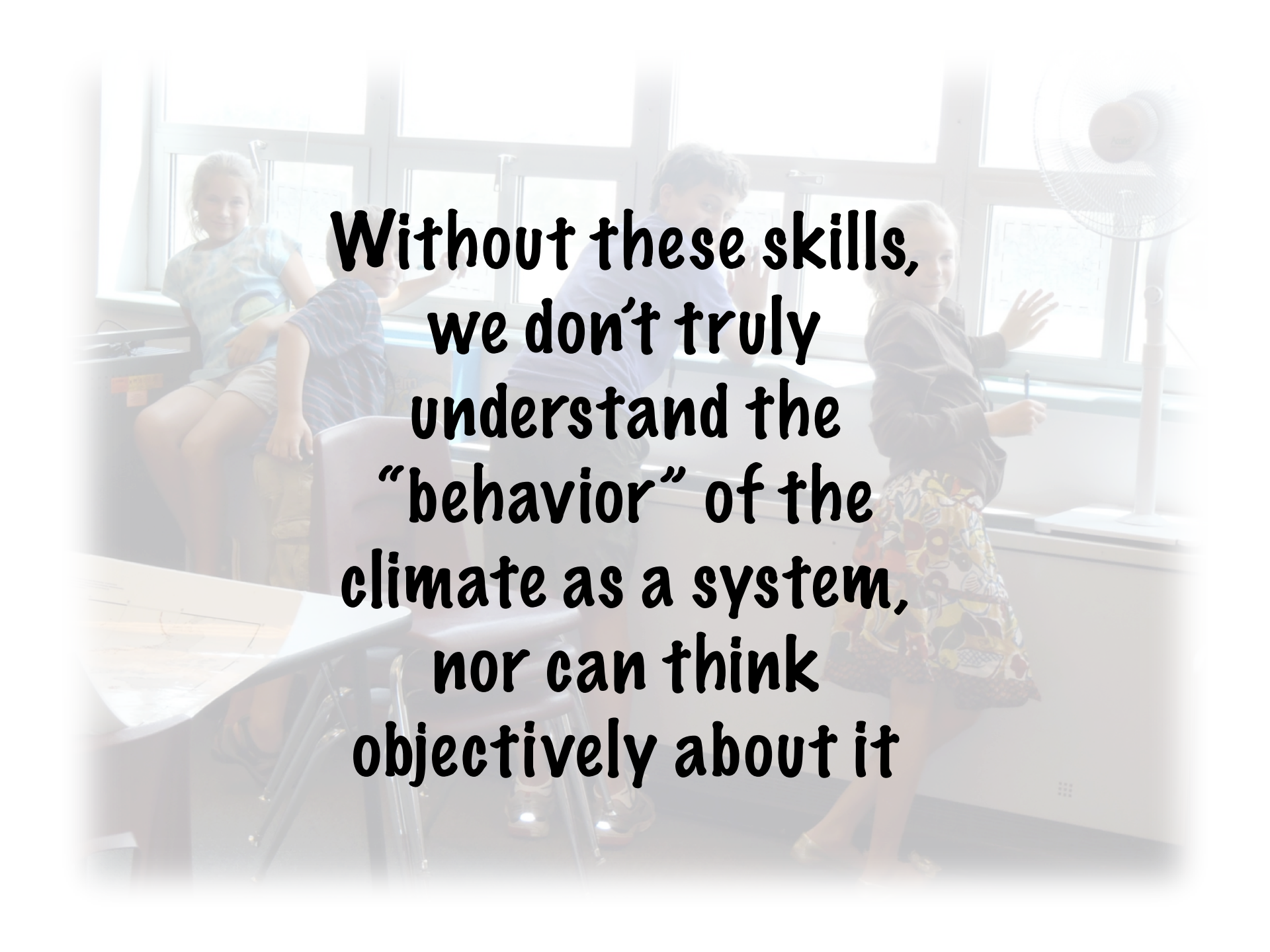
Iceberg Model




KUDZU
plants overgrow and kill other plants because of the nitrogen and oxide.
This is where kudzu is grown
Made starch and was for seeds.
Percentage of County Area with K
people are using chemicals and weed killer to kill kudzu, but it is killing other plants too so they have to stop
Events
Kudz population over time
The kudzu has grown over time and the vines can grow to
population
time
Decline in plants because of Kudzu
Decline in other plants
time
Death of organisms over time
Deaths of organisms
time
The plants are dieing and so are organisms.
Patterns & trends
Kudzu is growing over trees and bushes often makes shapes which look like familiar animals and objects
I did'nt know that any plants could grow to
Kudzu can grow fast over everything including houses. As a example in this image.
Because of the rapid growth of kudzu, signs along the highways in the south sometime become covered in late summer.
The Harvard Medical School is studying kudzu as a possible way to treat alcoholic cravings.
Mental Models & underlying Structures


Events
The navajo population in the land knowas Arizona
Patterns of Behavior
Patterns and Trends of the Navajo Population in Arizona
Number of Navajo
Over time in Arizona
Underlying Structures
Government structure
Gadsden Purchase-U.S. government purchased land from Mexico.
U.S. soldiers posted notice for Navajo to leave the Arizona territory.
U.S. soldiers enter area known as Arizona today.
reservations
physical structure
Sheep graze on the sweet grass of the mesa
Navajo tend peach orchard.
U.S. soldiers enter area known as Arizona today.
river, stream
Fort Sumner is in New Mexico
reservations
Social structure
Navajo women own sheep.
Navajo men are warriors.
Navajo men are hunters.
The spring provides fresh water
Pioneers are moving west.
Resources
river, stream
horses
navajo tend peach orchard.
Sheep graze on the sweet grass of the mesa
The spring provides fresh water.
Navajo grow corn, squash and beans in the field.
Mental Models
What assumptions, beliefs, and values do people hold about the system.
•U.S. Government thought if they got all the Indians out of the area they could make A.Z. a state faster.
•Navaja people belived that if they got to happy the gods will punish them.
•Pioneers valued the gold in arizona.
•navaja people valued the rivers and streams for water.
wounted A.Z. because they wanted more land.


Iceberg...
Seeing What's Below the Surface
What is seen
What is generally unseen
Events
Patterns of Behavior
Underlying Structures
Mental Models
Current Reality
Desired Results
Deep Learning
Adapted by Systems Thinking in Schools, Waters Foundation, from Innovation Associates, Inc. Clip art was obtained from microsoft.com and used according to rules of use. August 2006.



Without these skills,
we don't truly
understand the
"behavior" of the
climate as a system,
nor can think
objectively about it


We can extend this awareness
into a
service learning project

For example:

- researching policy
- interviewing scientists
- speaking to elected officials
- creating short PSA videos
- maybe even sponsor a school project

Time to get started