

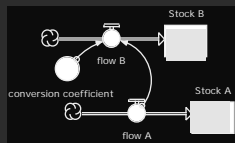
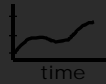
Hands-on Systems Applications In Elementary Classrooms

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Systems Mentors
Waters Grant Project

Today you will:

- **Participate in activities using systems concepts that match curriculum standards**
- **See examples of how these same concepts have been used in lessons across...**
 - different grade levels**
 - different subject areas**

Systems Concepts



- Change over time
 - patterns and trends
 - accumulations
- Feedback
 - interdependencies
 - reinforcing and balancing relationships
- Leverage
 - structure generates behavior
 - short and long term consequences
 - trade-offs
 - temporal and spatial boundaries

CONCEPTS	TOOLS
<p><u>Change over time</u></p> <ul style="list-style-type: none"> • patterns and trends • accumulations 	<ul style="list-style-type: none"> • Behavior-over-time graphs (BOTGs) • Stock/flow diagrams • Ladder of Inference • Models - 3-D, mental, computer • Other simulations
<p><u>Feedback</u></p> <ul style="list-style-type: none"> • interdependencies • reinforcing and balancing relationships 	<ul style="list-style-type: none"> • Causal Loop Diagrams (CLDs) • Systems Archetypes • Stock/flow diagrams • Models -3D, mental, computer • Other simulations
<p><u>Leverage</u></p> <ul style="list-style-type: none"> • structure generates behavior • short & long term consequences • trade-offs • temporal and spatial boundaries 	<ul style="list-style-type: none"> • Iceberg • Ladder of Inference • Stock/flow diagrams • BOTGs • Models- 3D, mental, computer • Other simulations

Systems Thinking Tools Can Support The Reading Standards

Standard 1:
Students comprehend, interpret, evaluate,
and appreciate a variety of classic and
contemporary literary texts employing
skills, strategies, and knowledge.



Standard 2:
Students comprehend, interpret, and evaluate
a variety of informational texts using skills,
strategies, and knowledge.

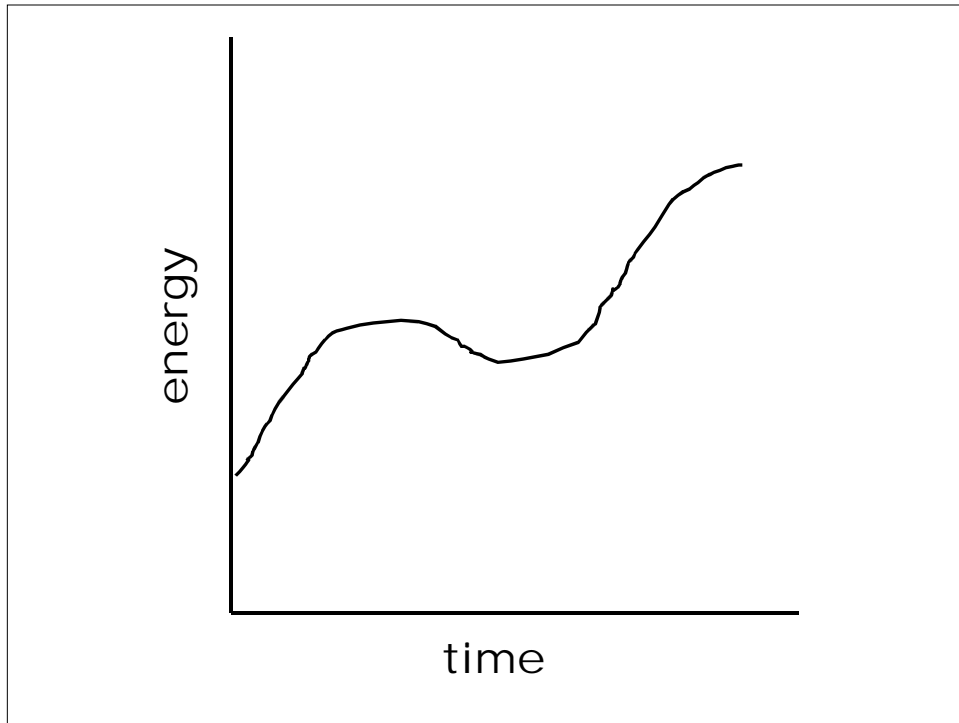
Standard 3:
Students read and/or experience texts
to understand themselves, others,
and the world around them.



Standard 4:
Students use the general skills
and strategies of the reading process.

Systems Concepts

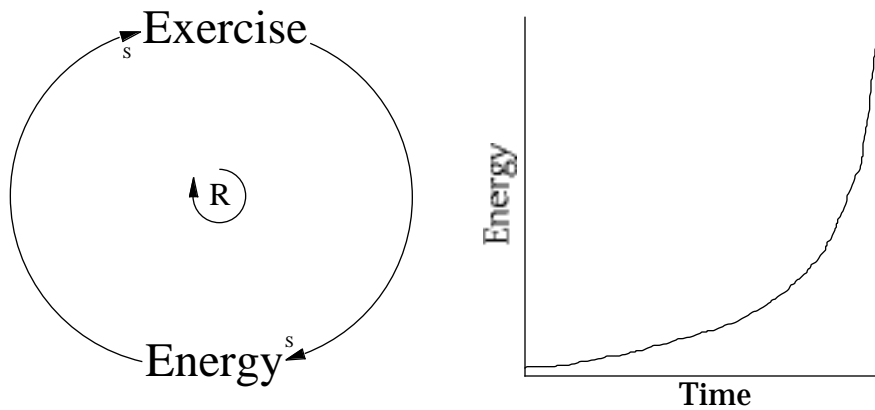
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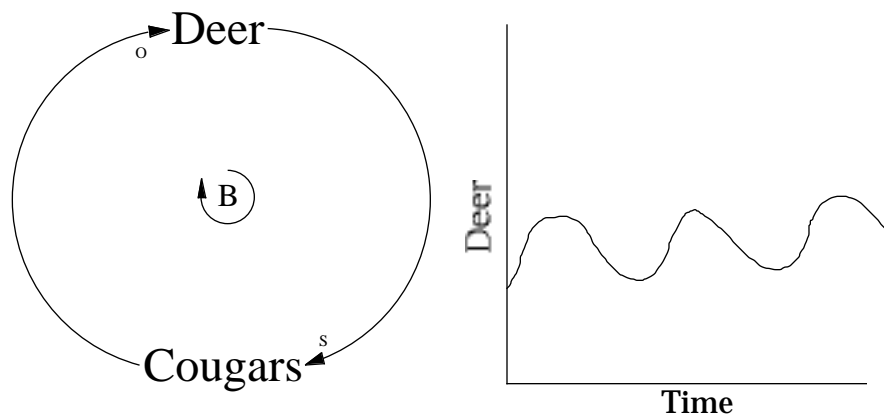
Systems Concepts

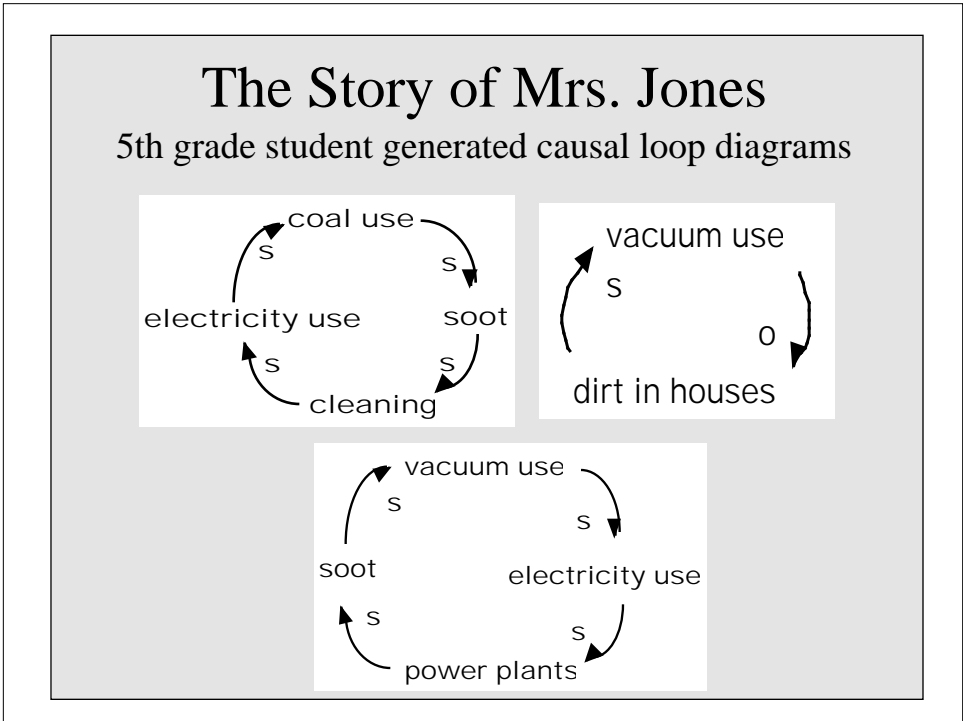
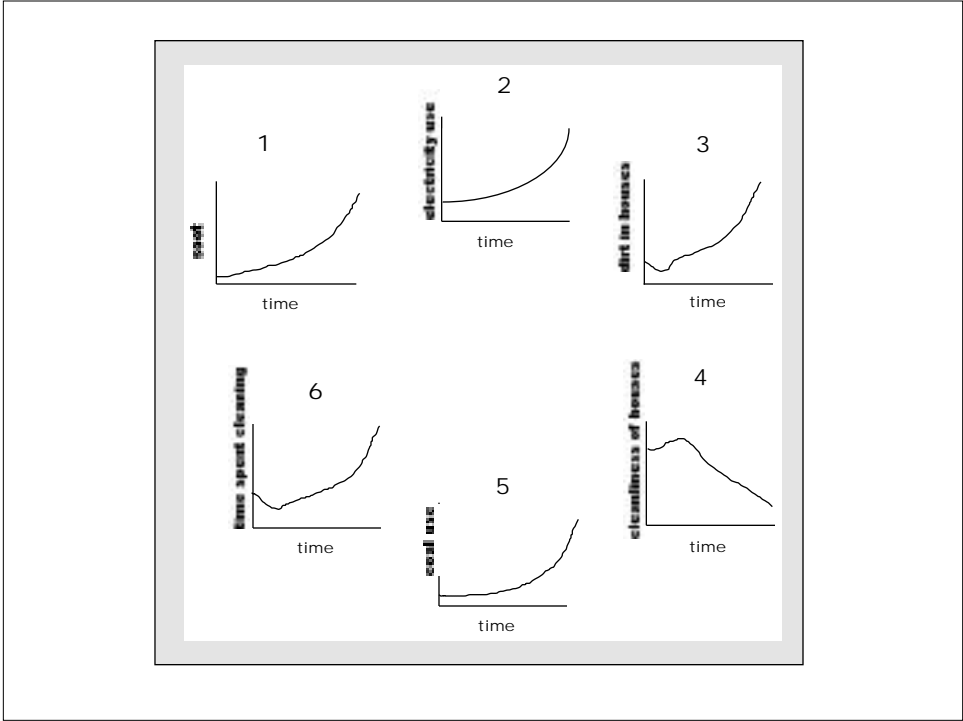
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Reinforcing Causal Loop Diagram

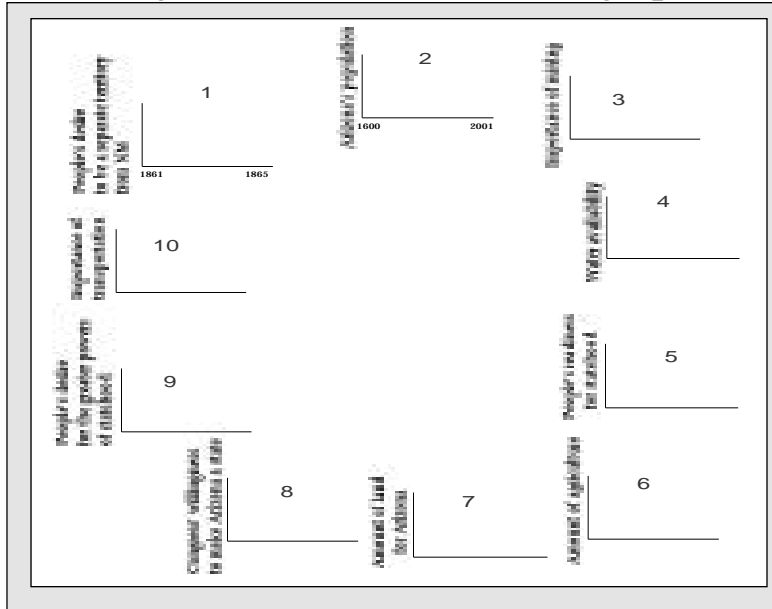


Balancing Causal Loop Diagram: “Predator-prey”





Arizona Statehood lesson 4th grade behavior-over-time graphs

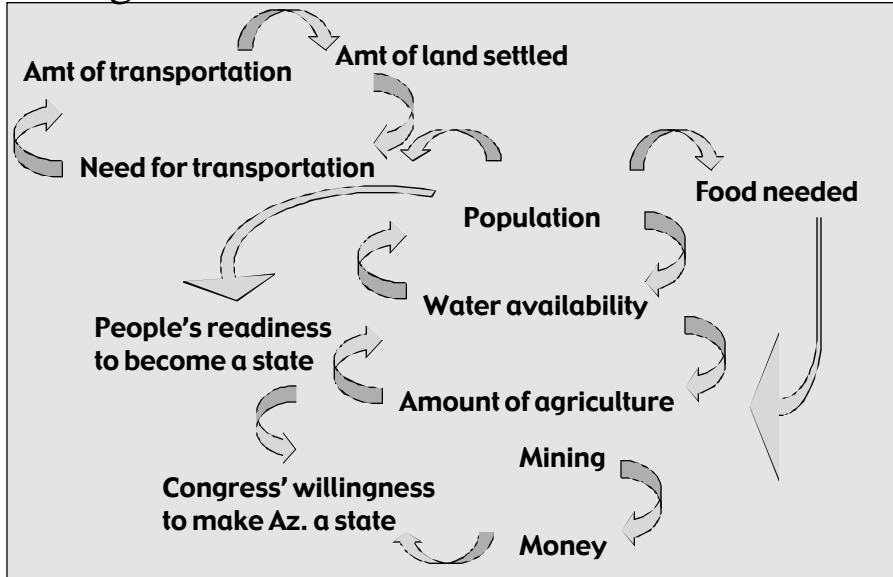


4th grade student generated causal loop diagram from Arizona Statehood lesson

Water availability

Amount of agriculture

4th grade student generated causal loop diagram from Arizona Statehood lesson



Stream Study

Animals in an Arizona mountain stream

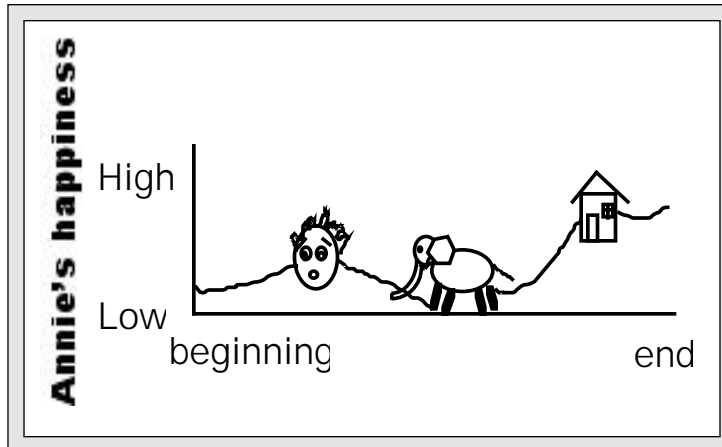
The graph plots the number of animals (y-axis, from Low to High) against time (x-axis, from January to December). The curve shows a low number of animals in January, a steady increase through the spring, a peak in June, and a gradual decline through the fall and winter months.

Stream Study

What are the limits to this system?

A circular diagram representing the life cycle of insects. The stages are: **Adult insects** (top), **Reproduction** (right), **Eggs** (bottom), and **Baby insects** (left). Arrows with the letter 's' connect the stages in a clockwise cycle: Adult insects to Reproduction, Reproduction to Eggs, Eggs to Baby insects, and Baby insects to Adult insects.

Kindergarten example



Systems Concepts we practiced

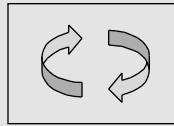
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Questions? Comments?

Systems Thinking Tools Can Support The Science Curriculum

Standard 2:

Students understand the collaborative aspects of science, the scientific enterprise, and the interdependence of science, society and the environment.

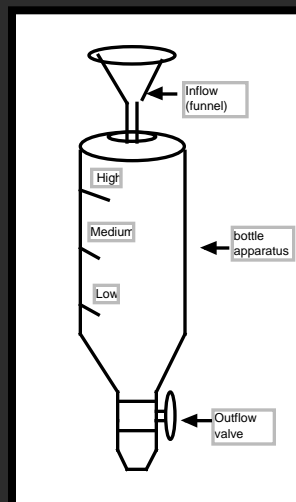
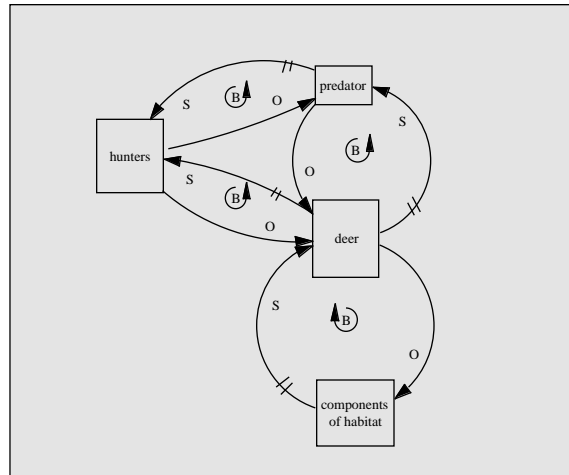


Standard 3: Students understand that science is the study of systems and their components using the themes of constancy and change, interaction and interdependence, and energy.

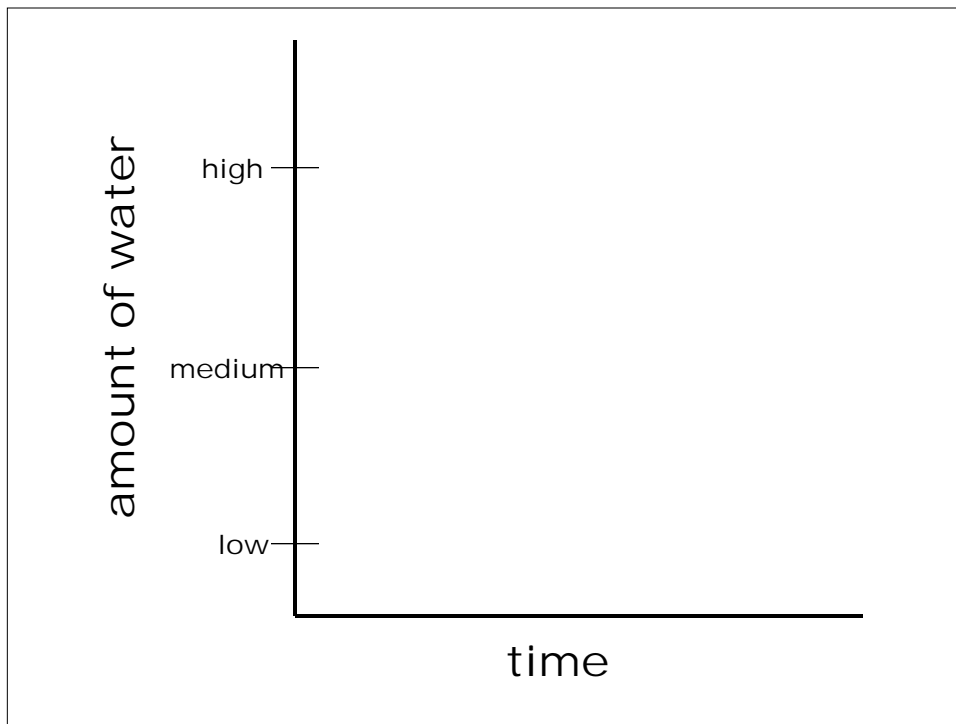
Deer Activity



Extension to the deer causal loop



Water
Lesson
Activity



Sample experiment sheet for 3rd grade Life Cycles Unit

Names _____

Experiment

#1 Read the problem to the group:

There are 10 animals in the population. What would happen to the number of animals in the population if 2 animals are born and 5 die?

Prediction:

#1 Talk to your group and circle the graph that shows your group's best guess.

Do the experiment:

#1 Put 10 animals (ping pong balls) in the pan.

#2 Roll the number of animals born through the inflow tube into the pan.

#3 Remove the number of animals that die from the pan by rolling them out the outflow tube.

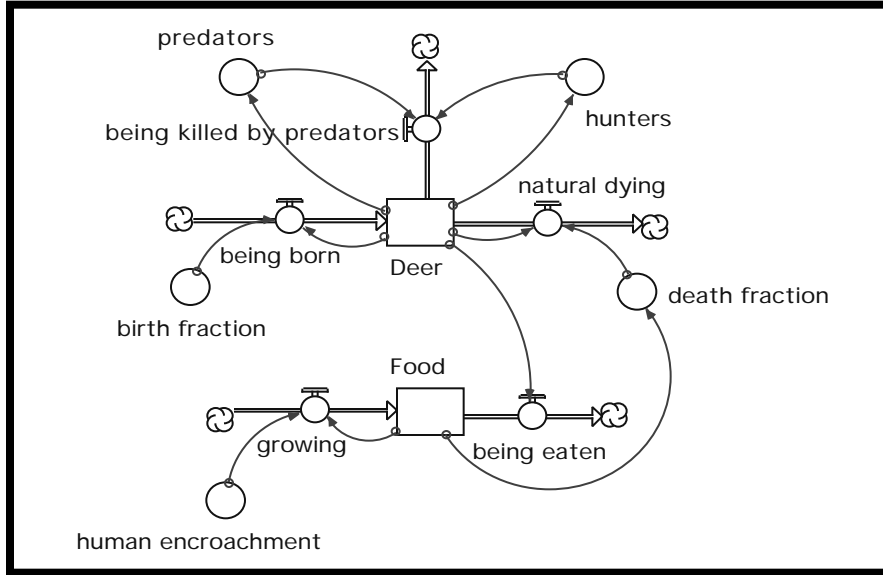
#4 Count the animals that are left in the pan. Talk to your group and decide which graph best represents what happened and why.

Results: #4 Circle the graph that shows what happened:

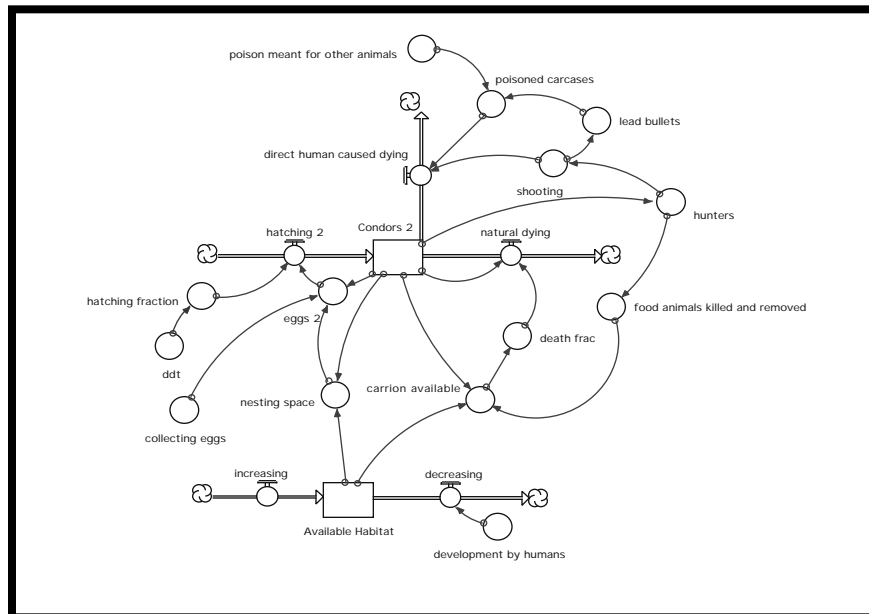
Why do you think that happened?

#4 Write what your group thinks happened:

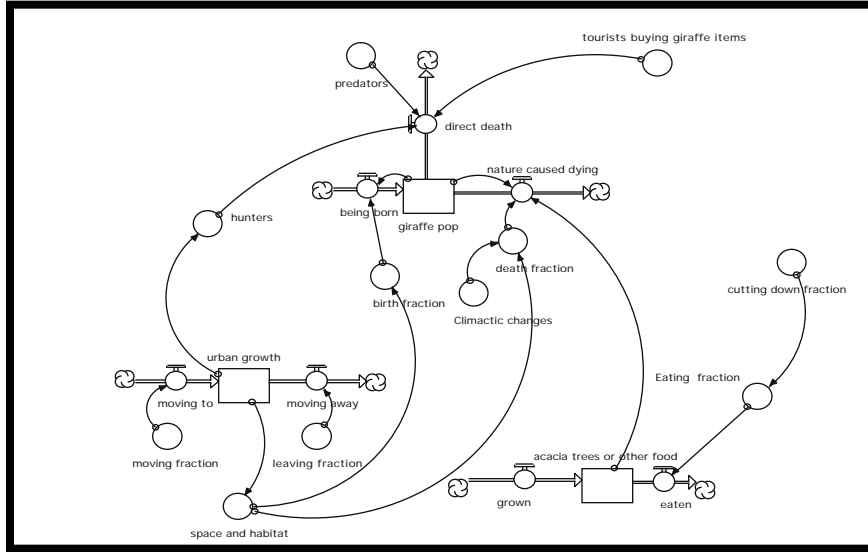
4th grade class generated stock/flow map



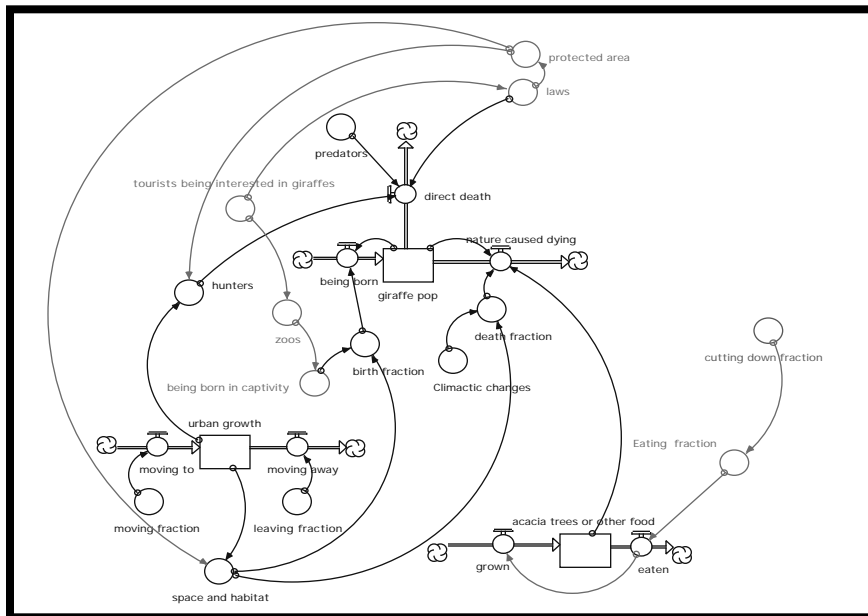
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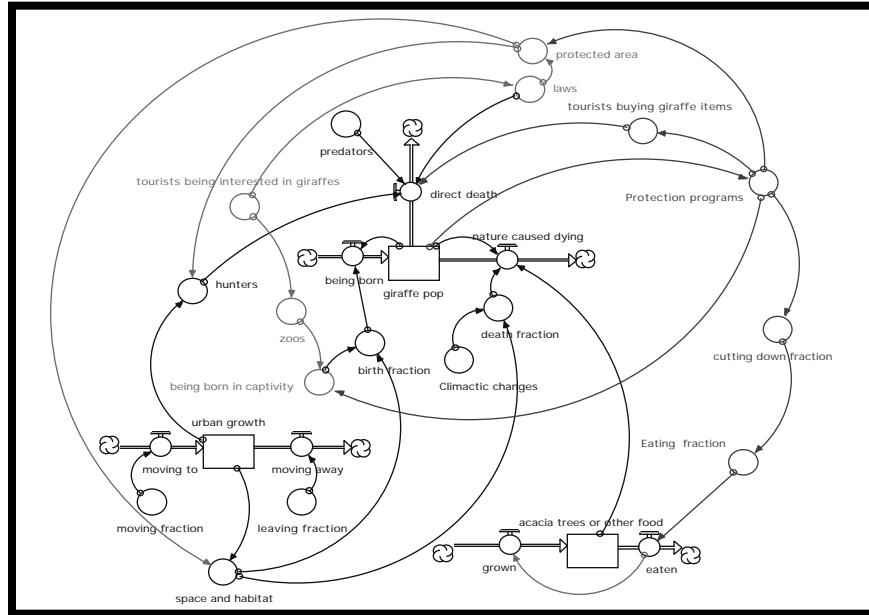
Endangered Species Unit 4th grade student generated stock/flow map

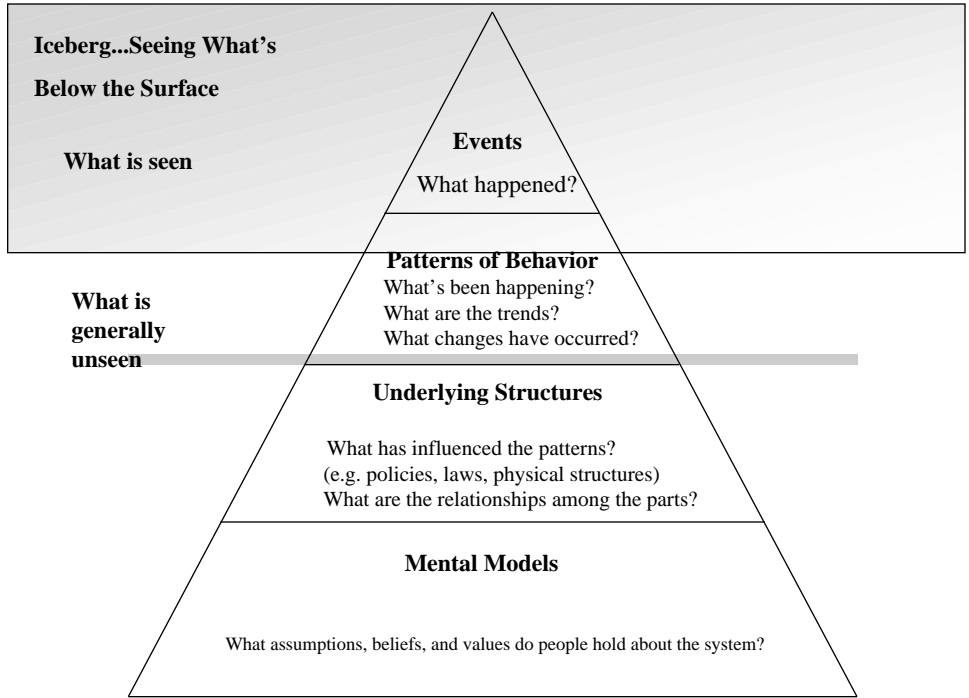


4th grade student generated stock/flow map



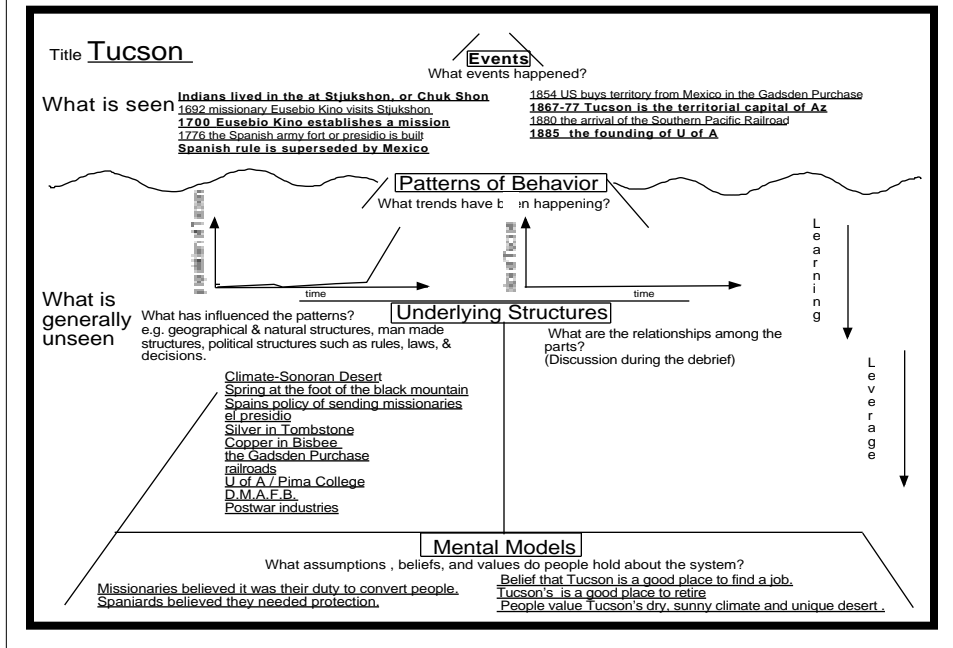
4th grade student generated stock/flow map





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3rd grade Tucson Lesson



Systems Thinking Tools Can Support The Social Studies Curriculum



Standard 1: Students understand the human experience through time; interpret historical events; and make connections among cultures, people, and events.

Standard 2: Students understand the ideals, rights, and responsibilities of citizenship and know how governments are formed and function.



Standard 3: Students know locations, places, and regions and understand how geography affects the ways people live and interact with each other and their environment.

Standard 4: Students use economic concepts to analyze problems and evaluate decisions.



5th grade
teacher's notes

Title: Civil War

Events

What is seen

1960 M. L. King Fight for equal rights. No more segregation
 1865 Sherman's march to the sea. War ends. Lee surrenders to Grant
 1861 Battle at Fort Sumter
 1860 Abraham Lincoln elected pres. S. C. secedes. Later Missi. Flor. Ala. Geor. Louis. Tex
 1857 Dred Scott Decision

1854 Kansas Nebraska Act- "Bleeding Kansas"
 1850 Compromise of 1850
 1820 Missouri Compromise
 1800 Slavery, industry developing, agriculture important, tariffs, states rights, potato famine
 1776 Declaration of Independence

Patterns of Behavior

Amount of slavery in the Union ——— high
 Amount of slavery in the Confederacy ——— med
 low

population not large. Farms just developing

1750 time 1850 1900

What is generally unseen

Underlying Structures

Missouri Compromise
 Slavery is banned north of 36° 60' line of latitude except in Missouri. Maine free state. Number of states trying to stay equal free/slave

Dred Scott Decision
 Supreme court rules congress could not keep slavery out of territories. "All men created equal" not meant for African Americans

Kansas-Nebraska Act
 No line now separating free from slave states. People rush to Kansas to argue and gain votes. Violence, 200 dead. "Bleeding Kansas".

Compromise of 1850
 Slaves who run away-fugitives 30,000

Underground Railroad
 South to North routes, some to Mexico. Caribbean. "Conductors"-freed slaves, white church leaders, Quakers etc. Harriet Tubman-a freed slave

President Lincoln elected
 (Confed. pres. Jefferson Davis) 7 states secede-S. Carolina, Mississippi, Florida, Alabama, Georgia, Louisiana, Texas

Other mental model discussions:

Missouri Compromise.
 States rights.
 War tactics.
 Lee Surrenders

Mental Models

North	Compromise of 1850	South
Angry. Determined to help slaves	Dred Scott Decision	Feeling good. They get their slaves back. More slaves=more money and cotton for more money...
Enraged about slaves not "equal"	Cotton Gin	South happy that slaves aren't considered equal but not happy about no slaves in territories. Shouldn't feel bad about slavery because slaves aren't legally "men"
Good jobs in factories. population increasing. Now South has a little more production	Kansas-Nebraska Act	Great! More cotton, faster production-more money. Though South's population is shrinking
All this bloody violence not great. Go John Brown.		People in N. getting angry/scared. They're starting to take action. We cant let them take slavery away.

4th grade
Use of Electricity
Over Time

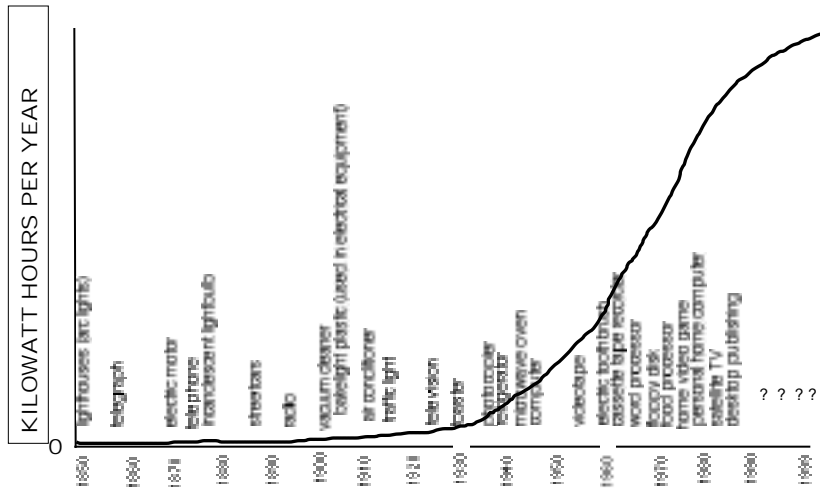
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Mental Models

What assumptions, beliefs, and values do people hold about the system?

We believe we need electrical inventions for convenience, safety, communication, entertainment, comfort, etc.

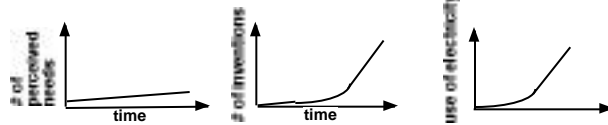
4th grade Use of Electricity Over Time



4th grade Use of Electricity Over Time

Events
 • Individual things are being invented
 • Infrastructure is built

Patterns of Behavior

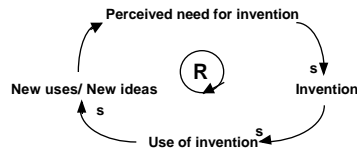


Underlying Structures

What has influenced the patterns? (e.g. policies, laws, physical structures)

What are the relationships among the parts?

- outlets
- wires
- poles
- power plants
- Standardization of current
- etc.

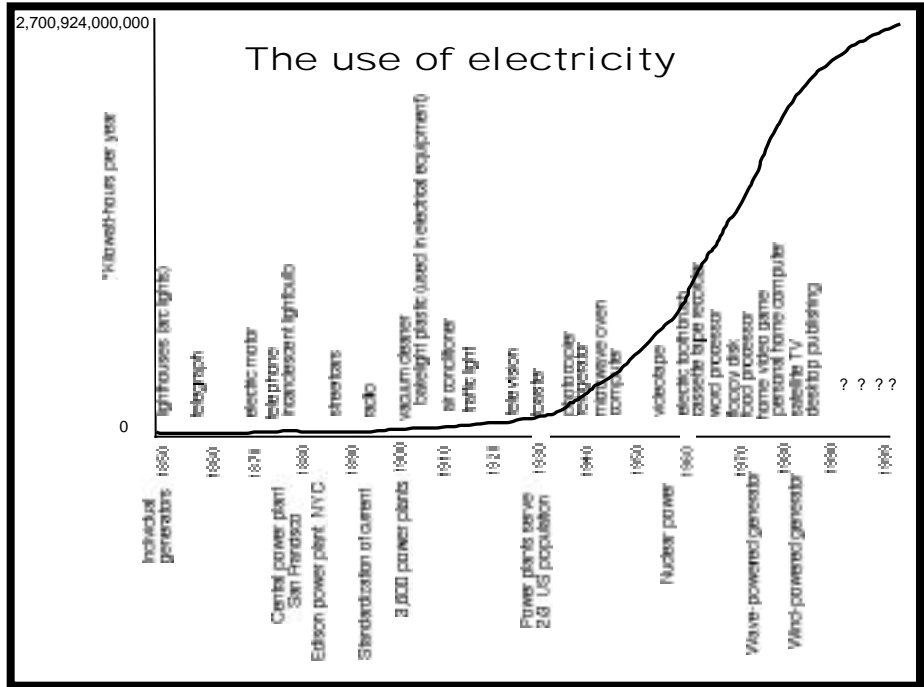


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**4th grade
Use of Electricity
Over Time**

- Events**
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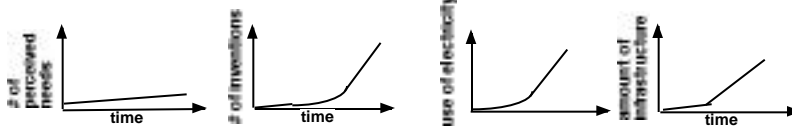
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4th grade Use of Electricity Over Time

- Events**
- Individual things are being invented
 - Infrastructure is built
 - Historical events

Patterns of Behavior

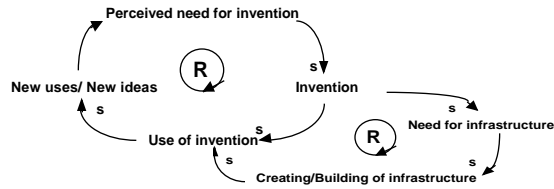


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Relationships among the parts

