Julie Guerrero and Joan Scurran
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

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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

• Change over time
  – patterns and trends
  – accumulations

• Feedback
  – interdependencies
  – reinforcing and balancing relationships

• Leverage
  – structure generates behavior
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Systems Concepts

- Change over time
  - patterns and trends
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Reinforcing Causal Loop Diagram

Balancing Causal Loop Diagram: “Predator-prey”
The Story of Mrs. Jones
5th grade student generated causal loop diagrams
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

- Amt of transportation → Amt of land settled
- Need for transportation → Population
- People's readiness to become a state → Amount of agriculture
- Congress' willingness to make Az. a state → Money
- Mining → Money
- Food needed → Money
- Water availability → Population
- Money → Congress' willingness to make Az. a state
- Amount of transportation → Need for transportation
- Amt of land settled → People's readiness to become a state

Stream Study

Animals in an Arizona mountain stream

What are the limits to this system?

- Adult insects
- Baby insects
- Eggs
- Reproduction

Graph:

- High
- Low
- January
- June
- December
- # of animals
Kindergarten example

Systems Concepts we practiced

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

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

4th grade student generated stock/flow map
15th grade student generated stock/flow map

- **Protected area**
- **Tourists buying giraffe items**
- **Protection programs**
- **Direct death**
- **Natural caused dying**
- **Predators**
- **Hunters**
- **Giraffe pop**
- **Being born**
- **Being eaten**
- **Acacia trees or other food**
- **Urban growth**
- **Moving away**
- **Space and habitat**
- **Cutting down fraction**
- **Moving fraction**
- **Leaving fraction**
- **Being born in captivity**
- **Climatic changes**
- **Tourists being interested in giraffes**
- **Being born in captivity**
- **Zoos**
- **Eating fraction**
- **Being eaten fraction**
3rd grade Tucson Lesson

**Title:** Tucson

**What is seen?**
- Indians lived in the area.
- Chuck Shin Erickson lived in the area.
- 1729: Eusebio Kino establishes a mission.
- Spanish rule is superseded by Mexico.

**What events happened?**
- 1854: US buys territory from Mexico in the Gadsden Purchase.
- 1867-77: Tucson is the territorial capital of Arizona.
- 1880: the arrival of the Southern Pacific Railroad.

**Patterns of Behavior**
- What trends have been happening?
- What has influenced the patterns?
  - e.g. geographical & natural structures, man made structures, political structures such as rules, laws, & decisions.

**Underlying Structures**
- What are the relationships among the parts?
  (Discussion during the debrief)

**Mental Models**
- What assumptions, beliefs, and values do people hold about the system?
  - Relate that Tucson is a good place to find a job.
  - Tucson is a good place to retire.
  - Tucson is known for its dry, sunny climate and unique dessert.

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**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

What is seen

1860 Abraham Lincoln elected pres. S. C. secedes . Later Missi, Flor, Ala, Geor, Louis, Tex
1861 Battle at Fort Sumter
1865 Sherman's march to the sea. War ends. Lee surrenders to Grant
1854 Kansas Nebraska Act. "Bleeding Kansas" 3 states
1857 Dred Scott Decision
1860 M. L. King Fight for equal rights. No more segregation

What is generally unseen

1820 Missouri Compromise
1850 Compromise of 1850
1840s Missouri Compromise
1860 Compromise of 1850
1850 Missouri Compromise
1850s Slavery, industry developing, agriculture, important, tariffs, states rights, cotton farming
1860s Secession of Independence

Events

Patterns of Behavior

Learning

Amount of slavery in the Union
Amount of slavery in the Confederacy

high

low

med

Add slave state/free state still goes up
underground railroad

Missouri Compromise

Slavery's banned north of 36° 30’ line of latitude except in Missouri Maine free state. Number of states stays same to stay equal freestate

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
People in North helping slaves run away to Mexico, Canada, "Conductors"-freed slaves, white church leaders, Quakers, etc. Harriet Tubman-
freed slave

President Lincoln elected

Abraham Lincoln elected. 7 states

Cotton gin

Good jobs in factories, population increasing. More cotton, faster production, more money

1865 Dred Scott Decision

Enraged about slaves not "equal" Unhappy about slavery in territories. Not happy about no slaves in territories. Should feel bad about slavery because slaves aren't legally "men"

Dred Scott Decision

"Conductors"-freed slaves, white church leaders, Quakers, etc. Harriet Tubman-a freed slave

President Lincoln elected

Abraham Lincoln elected. 7 states

Cotton gin

More cotton, faster production, more money

North

South

Angry, determined to help slaves

Feeling good, they get their slaves back

More slaves, more money and cotton for more money...

Dred Scott Decision

Enraged about slaves not "equal"

South happy that slaves aren't considered equal

But not happy about slavery in territories. Shouldn't feel bad about slavery because slaves aren't legally "men"

Commodities

Cotton gin

Good jobs in factories, population increasing. More cotton, faster production, more money

Kansas-Nebraska Act

All this bloody violence not great. Go John Brown

We cant let them take slavery away.

4th grade

Use of Electricity

Over Time

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

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.
Electricity

Use of Electricity

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.

Adapted by
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Events

- Individual things are being invented
- Infrastructure is built

Patterns of Behavior

Need for infrastructure
Creating/Building of infrastructure

Underlying Structures

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

• outlets
• wires
• poles
• power plants

Standardization of current
Disks
etc.

4th grade

Use of Electricity

Over Time

time

The use of electricity
We believe we need electrical inventions for convenience, safety, communication, entertainment, comfort, etc.

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

Patterns of Behavior
What are the relationships among the parts?

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

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

Relationships among the parts

Perceived need for invention

New uses/ New ideas

Invention

Use of invention

Creating/Building of infrastructure

Need for infrastructure

Standardization of current

Power plants

Poles

Wires

Outlets

etc.

Relationships among the parts
Events

Patterns of Behavior

Underlying Structures

Mental Models

Cars are indispensable/ People are "auto dependent".

- cars
- infrastructure, eg. roads, signs, lights etc.
- industries, eg. fuel, car manufacturing, sales, insurance etc.
- laws, licensing, taxes, money supporting infrastructure, suburbs

Pedestrian Paradise

5th grade class generated iceberg

What is
seen

What is
generally
unseen