LIVING STORIES ABOUT LIVING SYSTEMS

Connected Wisdom

TEACHER'S GUIDE

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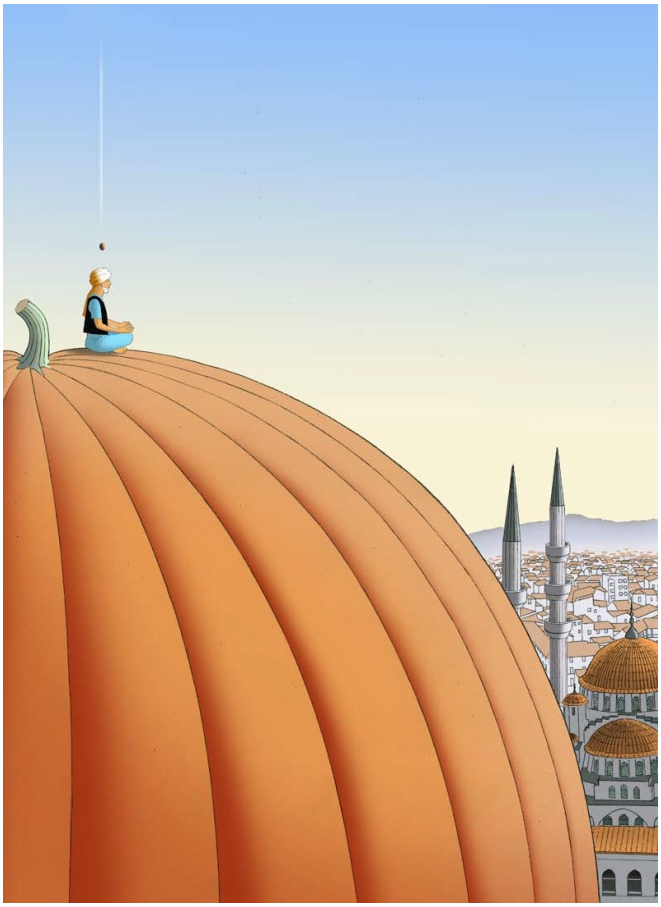
Introduction

The *Connected Wisdom* Teacher's Guide is designed to guide educators through lesson plans that will explain living systems principles for their students. The guide was created with students aged 10-18 in mind, but the lessons can be adapted for younger students.



Chapter 1: Interdependence

Before completing the following activity, read "Gecko's Complaint" from Chapter 1 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

How often do we find ourselves annoyed by things others do or frustrated by events when we don't understand the reason they occur? We may find that the source of our problems becomes clear—and may even go away—when we shift our focus from protecting our independence to understanding our interdependence. This is the lesson learned in the story "Gecko's Complaint."

Objectives

- To develop an understanding that living systems are made up of interconnected relationships, in which each partner affects and often needs the other.

- To explore this essential question: why do unseen interdependencies often produce surprising behaviors?

Literature and writing standards

- Determine a theme or central idea of a text and how that theme is conveyed through particular details.

- Find examples of real-world applications of the text's theme and ideas. Use text from other sources to inspire original writing.

Classroom management

The first part of this activity is done best as a large group, and then as you start to play the Hidden Connections game, in smaller groups of three to four students.

Materials

- Pencil or pen
- Paper
- Dry uncooked noodles (in a box or bowl)
- A ball of colorful yarn or string

Student activities

I. Group discussion and writing

"A system," as author and anthropologist Mary Catherine Bateson suggests, "has many parts of which are invisible to the naked eye." To foster the ability to think about systems, we need to create opportunities for children to discover the interdependencies among the land, animals, plants and people. This activity can be used directly following the reading of the story to encourage students to reflect on the story from a systems perspective.

1. Living systems are made up of myriad interconnections and interdependencies. Often when we try to create change in such systems, the key to making the change lies far away from the problem. Ask students to write a paragraph about other situations where the key to making a change may be far away (in time or space) from the problem.

2. Think of example of interdependence, in nature, in your life, perhaps on the global stage. What challenges does interdependence create? Now flip it, and consider: what opportunities does interdependence create?

3. Think of situations involving degrees of interdependence. Is this interdependence represented visually (typically it is not)?

II. Hidden Connections game

Hidden Connections is a simple activity that can be done to foster thinking about interdependence. In this game, students imagine the hidden connections related to everyday objects.

1. Explain to students how to make noodles. You put water in your pot, add a little salt and heat the water until it boils. Then you put the dry noodles and then cook for 8–10 minutes. Just five simple steps, right?

2. Ask the students how many interconnections lead to this bowl of noodles.

3. Students should write down all the possible connections on their own piece of paper.

   If the noodles are made in Italy and you live in Malaysia, there could be a hundred people, resources, and elements involved in bringing that bowl of noodles to your table. Here are just a few of the connections; you can

provide images of these connections if you so wish by cutting them out from old magazines or newspapers:

- Farmers in Italy who grow the wheat and raise the chickens for eggs.
- Airplanes to fly the noodles to destinations around the world.
- Truck drivers in Italy and U.S. to transport the noodles to the markets where they are sold.
- Markets where the noodles are sold.
- Parents or caregiver, or student shopping for the noodles.

4. Some people make their own noodles. Ask the students how many connections and interconnections can you find that lead to homemade noodles?

5. Ask the students to draw a large circle on a piece of paper. Have them place all of the connections on their list around the circle. Then, have students draw line between the elements on the list that connect to each other. For example, farmer connects to harvesting wheat. Then what does wheat connect to? And so on. The finished result should be a complex web of interconnections.

III. Create a "living web" based on "Gecko's Complaint"

1. Assign different students to represent each character.

2. Ask the person representing Gecko to hold a ball of string or yarn. Now have the group retell the story, this time passing a ball of yarn or string to the person who represents that character. To begin, Gecko should hold onto the end of the string and pass the ball to the person representing Chief.

3. The group continues identifying as many connections as possible while the "web" grows in complexity. Once the group has sufficiently captures all of the interconnections in the story, have them place the web, intact, on the floor.

4. Ask the group and the rest of the class to step back and look at the "web" that has been created by following the interconnections in the story.

5. Ask the students to write down their answers to the following questions:

    a. What if the Chief had simply jumped to blame Firefly without understanding all of the interconnections in the story?

b. How can the habit of tracing interconnections help us to make better decisions?

Take it a step further

Extensions of this activity include creating influence diagrams using over-sized post-it notes, drawing connection diagrams, making mind maps and using software such as Inspiration.

This activity can be made developmentally appropriate for older children by picking two seemingly unrelated people or objects and searching out possible interconnections. For instance, are there connections between your tuna fish sandwich, the mayor of your city, and the sneakers in your closet?

Chapter 2: Systems Integrity

Before completing the following activity, read "The Parts of the House Argue" from Chapter 2 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

There are many essential elements—parts and processes—that make up a system and give it integrity, or wholeness. We know this by looking at what happens when some of those parts are taken away, for example if a house loses its roof or its walls? In "The Parts of the House Argue" the parts finally realize that none is important without the other, and they know they, and the house as a whole, cannot function without one another. We also can become blind to the contribution of all the elements that give integrity to the systems around us.

Objectives

- To develop an understanding that a living system is whole or it has integrity when all the parts and processes essential to its ability to function are present. For example, in living systems, it matters how the parts and processes are arranged. That is why you don't get two cows if you cut a cow in half.
- To explore when the whole is no longer a whole if a part is removed or shifted.

Literature and science standards

- Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.
- Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
- Develop a model based on evidence to show the relationships between systems or parts of a system.

- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Materials

- Pencil
- Paper
- Transparent bucket or bin
- Building blocks, popsicle sticks, Legos, or any other objects than can be used to build a tall structure.

Student activity

What do we know about living systems?

1. In the front of the room, place a transparent bucket or bin of some kind of building blocks. You can use Legos (if they are available), wooden blocks, popsicle sticks, or any combination of objects students can build with. Ask a volunteer from the class to stand next to the bucket.

2. Point to the volunteer and the bucket of objects. Ask the other students the following questions.

    a. Which one of these is a system?
    b. What's the difference between the two?
    c. If you take a block out of the bucket, does it make a difference? Does it change how the bucket of blocks works?
    d. What would happen if we removed the heart from _____ (fill in name of volunteer)? Would the heart work on its own?

    Systems involve two or more parts functioning within some boundary. If we look at the blocks in the bucket, there is no particular boundary. So if we take away a block, it does not change the functioning of the bucket or the other blocks. In a system such as the human body, if you take away one part, for example, the heart, the rest of the system will not function. We can think of our families, our schools, or our national economy as a system

3. Have groups of students build structures as tall as possible with the blocks.

    a. Once the groups are finished, have the students walk around the room and look at all the different buildings. Each group should evaluate the structure of the other buildings. They should take notes on what they think makes the designs successful and what may cause a building to fall easily.
    b. When the students return to their groups, ask them to experiment by removing key pieces of their own building. What happens?

   c. Is there a way to make their buildings stronger by adding pieces to the system? Students can reevaluate and strengthen their original designs if there is time.

4. Return to your volunteer. Ask the students to explain the difference between the buildings and _____ (volunteer's name). The students will brainstorm a list. You may add the following: a building or a mechanical system (like a car or vacuum cleaner) is built in a certain way, and stays that way until someone replaces a part. On the other hand, living systems grow and change over time.

5. Ask the students the following questions.

   a. How is your personal life a living system?
   b. How could you apply this idea of strengthening a system, like we did with the buildings, in your own life?
   c. What parts of your school or home life could use strengthening?
   d. How could this be accomplished and what might the outcome be?

Take it a step further

Ask students to draw the different parts of the house and show in a simple drawing how the parts interrelate to form a "whole."

It is easy to "not see" the set of interrelationships among elements that give integrity to the living systems around us. One example is the removal from an ecosystem of an animal that is considered a pest, for example the near-eradication of wolves from North America. As ecologists discovered, the wolves were necessary predators, and have been reintroduced. As keen observers of nature know, when all the parts and processes essential to a system's ability to function are present, it thrives.

Think about an environmental and/or social system of interest to you. What are the essential elements and processes to that system? Have students draw a picture or write a paragraph about what will happen (or has happened) to the whole or integrity of that system if a part or a process is removed.

Have students share drawings and responses with the group.

Classroom Activity

Chapter 3: Biodiversity

Before completing the following activity, read "Kanu Above and Kanu Below," from Chapter 3 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

In this tale, the sticky-web-building spider, the food-stealing rat, the biting fly, and the hole-digging anteater are considered a nuisance. The wise chief Kanu Below helps the villagers to see that it is the very diversity of these "troublemakers" that makes it possible for them to save his daughter. In much the same way, human communities, like ecological communities, are healthier, more resilient, and more flexible when they have greater diversity.

Objectives

- To explore the role of biodiversity in ecosystems.
- To determine how one missing part of a system can affect the balance of biodiversity in an ecosystem.

Literature and science standards

- Find examples of real world applications of the text's theme and ideas.
- Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural or designed systems. (LS2-1)
- Stability and change: Small changes in one part of a system might cause large changes in another part. (LS2-4)
- Ecosystems: Changes to physical or biological components of an ecosystem affect populations. (LS2-4)

Classroom management

Students should work in groups of three or four for this activity.

Materials

For each group:

- One copy of the Lake Michigan Food Web found on pages 14 and 15
- Pencils or pens
- Paper or notebooks

Student activity

1. Ask each group to look at the Lake Michigan Food Web. Give each group a few minutes to look at the different types of organisms that are represented in this web. The biodiversity of this aquatic system is extensive, and not all the species in the lake could be represented on this graphic. For example, Lake Michigan has 134 species of fish but only 16 are shown on the chart.

2. After students have familiarized themselves with the food web, go around the room with a marker and place an X over the Zebra/Quagga mussels* on the left hand side. Tell students that this represents species going extinct in this ecosystem.

3. Ask each group to discuss the following questions:

    a. What could have caused the Zebra mussels to go extinct?
    b. What are the consequences (positive or negative) on the ecosystem if the Zebra mussel is no longer present? *The Round Goby would rely entirely their other food source on the chart, the Chironomids, which could cause a lack of resources and increased competition among the Round Goby.*
    c. How could this problem be resolved? *Answers may include reintroducing the species from another aquatic source or finding a way to increase the supply of Chironomids.*

4. After students have discussed and shared their thoughts reverse the situation. Instead of the Zebra mussels becoming extinct, all of the Round Goby fish and the Lake Whitefish disappear from over-fishing. What happens to the Zebra mussels? What could the harm or benefit be to the biodiversity and stability of the ecosystem without these fish?

Take it a step further

Instead of using the food web of Lake Michigan, search for food webs that represent your local climate.

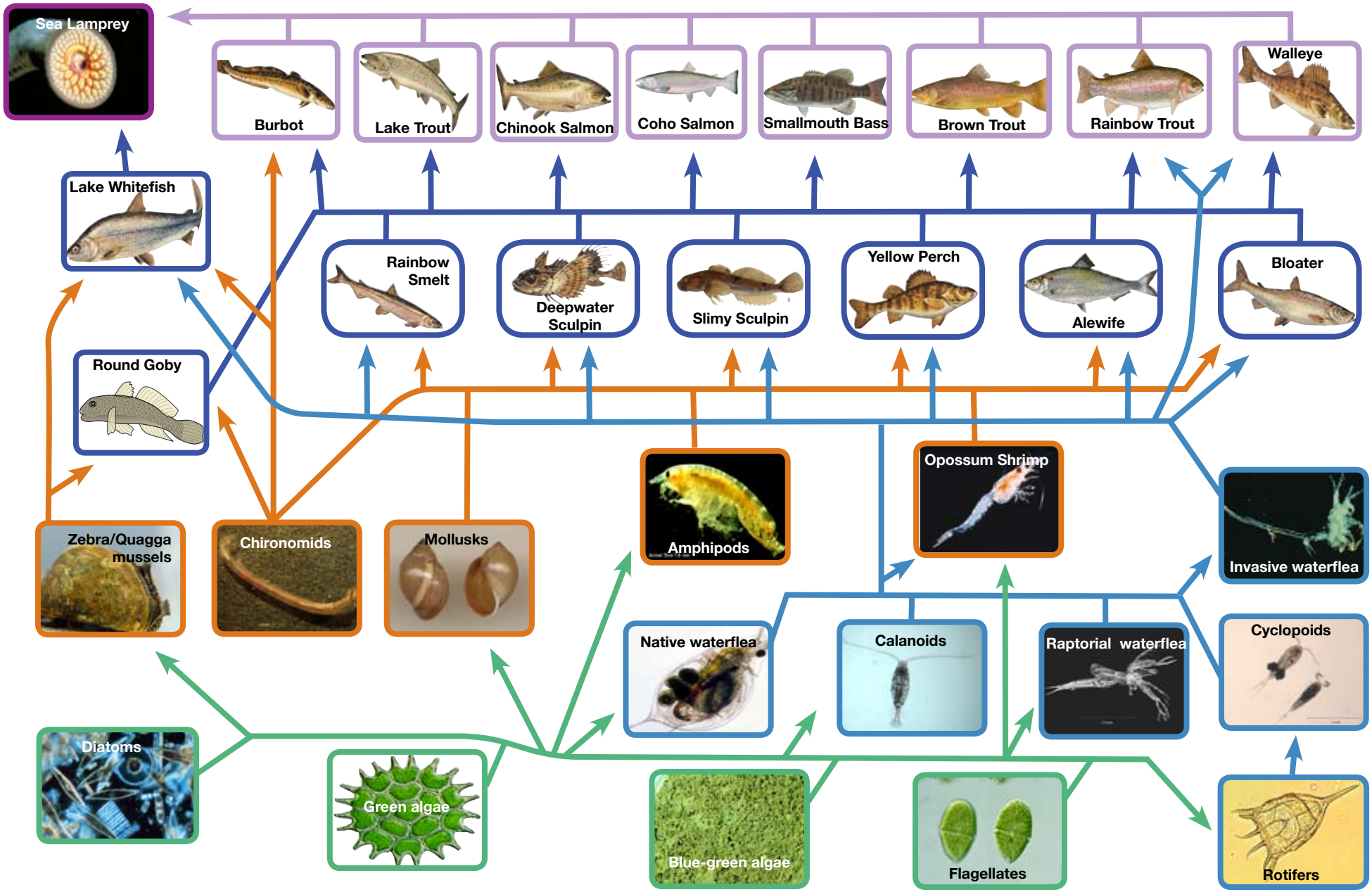
Have students conduct a biodiversity survey around their school and homes. A biodiversity survey can be as simple as students listing all species of life they see in one day, one week, or one month. The length of the project is up to you. It is important that students don't just see the big items, but that they take the time

to find the small and microscopic species. These species play an important role in the biodiversity of the local ecosystem. If time allows, and you have the equipment, have students study local water and soil samples under a microscope to get the full picture. After students have gathered the information, make a large food web with the information collected from all of the students (make sure humans are included on the web as well). This is a great way to show the biodiversity in your local community.

Students can explore the biodiversity of the species found on Earth by playing the Biodiversity Game from National Geographic. This game challenges students to pinpoint the number of species that have been identified in each major category of life.

**Note: Zebra mussels are an invasive species in the Lake Michigan food web. The species was introduced unintentionally in the 1980s, in the ballast water tanks of ships that traveled from Europe. Since then, Zebra mussels (and Quagga mussels, a later invader) have driven out native species of mussel and have had a detrimental effect on native aquatic life. To read more on the Zebra mussels visit the NOAA Web site.*

Lake Michigan Food Web



Foodweb based on "Impact of exotic invertebrate invaders on food web structure and function in the Great Lakes: A network analysis approach" by Mason, Krause, and Ulanowicz, 2002 - Modifications for Lake Michigan, 2009.

NOAA, Great Lakes Environmental Research Laboratory, 4840 S. State Road, Ann Arbor, MI
734-741-2235 - www.glerl.noaa.gov

Lake Michigan Food Web

Sea Lamprey

	**Sea lamprey** (*Petromyzon marinus*). An aggressive, non-native parasite that fastens onto its prey and rasps out a hole with its rough tongue.

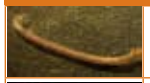
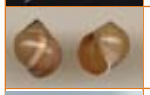
Piscivores (Fish Eaters)

	**Chinook salmon** *(Oncorhynchus tshawytscha).* Pacific salmon species stocked as a trophy fish and to control alewife.
	**Coho salmon** *(Oncorhynchus kisutch).* A Pacific species imported and stocked since 1966. Reproduce in many streams, but its population sustained in hatcheries.
	**Rainbow trout or Steelhead** (*Oncorhynchus mykiss*). A lake strain of non-native rainbow trout, rarely found deeper than 35 feet. Supplemented by stocking.
	**Smallmouth bass** *(Micropterus dolomieu).* Native coolwater species. Intolerant of pollution so is a good indicator of a healthy environment.
	**Brown trout** *(Salmo trutta*). A European species introduced in the late 1880's. Mostly does well in slightly degraded habitats.
	**Lake trout** *(Salvelinus namaycush*). Nearly eliminated by sea lampreys during the 1950s and 1960s. Stocking and lamprey control are resulting in its resurgence.
	**Walleye** *(Stizostedion vitreum*). Carnivorous night feeders, eating fishes such as yellow perch and freshwater drum, insects, crayfish, snails, and mudpuppies.
	**Burbot** *(Lota lota*). Elongated, cylindrical, freshwater codfish.

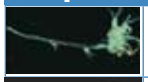
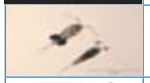
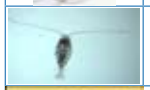
Forage Fish

	**Lake whitefish** (*Coregonus clupeaformis*). Native found in cold waters. Bottom feeder—diets have shifted to include zebra and quagga mussels.
	**Yellow perch** (*Perca flavescens*). Native that schools near shore, usually at depths less than 30 feet.
	**Bloater** (*Coregonus hoyi*). Native deepwater chub feeding on zooplankton and other organisms near the lake bottom. Harvested commercially for smoked fish.
	**Deepwater sculpin** (*Myoxocephalus quadricornis thompsonii*). A native glacial relic that lives at the bottom of cold, deep water feeding on aquatic invertebrates.
	**Slimy sculpin** (*Cottus cognatus*). Native, nocturnal inhabitant of nearshore areas where it primarily eats invertebrates.
	**Rainbow Smelt** (*Osmerus mordax*). Found in both coastal and offshore habitats. Light-sensitive, so prefer deeper, cooler waters during the warmer seasons.
	**Alewife** (*Alosa pseudoharengus*). Atlantic species that invaded Lake Michigan in 1949 via the Welland canal.
	**Round goby** (*Neogobius melanostomus*). Invasive, introduced into the Great Lakes via freighter ballast. Feeds on bivalves, including zebra mussels, crustaceans, insects, and small fishes.

Macroinvertebrates

	**Chironomids/Oligochaetes**. Larval insects and worms that live on the lake bottom. Feed on detritus. Species present are a good indicator of water quality.
	**Amphipods** *(Diporeia)*. The most common species of amphipod found in fish diets that began declining in the late 1990's.
	**Opossum shrimp** *(Mysis relicta)*. An omnivore that feeds on algae and small cladocerans. Migrates into the water column at night.
	**Mollusks**. A mixture of native and non-native species of snails and clams are eaten by lake whitefish and other bottom feeding fish.
	**Zebra and quagga mussels** *(Dreissena polymorpha* and *Dreissena bugensis)*. Established in Lake Michigan in 1989 (zebra); 1997 (quagga). Filter-feeders that remove huge quantities of plankton.

Zooplankton (Microscopic animals found in the water column)

	**Invasive Spiny waterfleas** *(Bythotrephes longimanus)*. Visual raptorial predator that can depress native waterflea populations.
	**Native Raptorial waterfleas** *(Leptodora kindtii)*. Slow moving and patchy distribution of small swarms at relatively low numbers.
	**Cyclopoid copepods** *(e.g., Cyclops bicuspidatus)*. Carnivorous copepods that feed on rotifers and other microzooplankton.
	**Native waterfleas** *(e.g., Daphnia galeata)*. Filter-feeding waterfleas that can be important for controlling phytoplankton.
	**Calanoid copepods** *(e.g., Diaptomus* spp.*)*. Omnivores that feed on both phytoplankton and microzooplankton.
	**Rotifers**. A diverse group of microzooplankton that, depending on species, feed on phytoplankton, detritus, or other microzooplankton.

Phytoplankton (Algae found in the water column)

	**Blue-green algae** (aka Cyanobacteria). Often inedible and frequently toxic; blooms in late summer and can look like spilled paint on the water surface.
	**Green algae**. Microscopic (single-celled) plants that form the main support of the summer food web. Also includes large nuisance species such as *Cladophora*.
	**Diatoms**. Cold-loving microscopic (single celled) plants encased in silica shells that support the first wave of production in the spring.
	**Flagellates**. Motile, single-celled plants or animals frequently found in high numbers. Most eat bacteria and so may help funnel bacterial products back into the food chain.

134 species of fish, including 17 non-natives, make their homes in the waters of Lake Michigan. Eight species of native fish have been extirpated from Lake Michigan. This food web includes only the dominant species.

Chapter 4: Cooperation and Partnership

Before completing the following activity, read the story "Stone Soup," from Chapter 4 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

The story of "Stone Soup" is as much about cooperation as it is about scarcity. When things become scarce for the villagers, they find themselves acting miserly, thinking only in terms of their own survival. With the help of a humble but clever traveler, they find that renewed strength, and a delicious soup, can come from cooperation, partnership, and generosity. So it is in nature. While there is a role for competition in the evolution of different species, the survival of every life form, from cells on up, depends on cooperation and partnership.

Objectives

- To develop an understanding that in living systems, species exchange energy and resources through a continual process of cooperation and partnership.
- To explore the potential role of cooperation and partnership in students' everyday lives.
- For students to see how their own assumptions about competition and cooperation directly affect the actions they take.
- To learn about physical cooperation through any number of motor skill activities, such as a three-legged race, two persons applauding—one using a left hand and the other using a right hand.

Literature and science standards

- Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.
- Outline and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- Analyze how and why individuals, events, or ideas develop and interact over the course of a text.

Materials

- Paper or student journals
- Pens or pencils for each student

Student activities

I. Reflective questions and writing

After students have read the story, ask:

1. What other stories do you know in which cooperation and partnership prevails over competition and isolation?
2. How does cooperation and partnership play a role in creating sustainable and just world for all?

II. Thumb game

This game is adapted from *The Systems Thinking Playbook: Exercises to Stretch and Build Learning and Systems Thinking Capabilities* (Volumes 1-3) By Linda Booth Sweeney and Dennis Meadows (1995/2010), Chelsea Green Publishers.

1. An even number of students is needed to participate in this game. Typically students sit in chairs although this game can be done standing up as well. If there is an odd number, the teacher may wish to participate. The whole activity can take between 5 and 15 minutes.

2. Ask students to find a partner, preferably by turning to the person sitting or standing next to them.

3. Once everyone is paired, ask the group if they have ever thumb wrestled before. Demonstrate thumb wrestling for those who aren't familiar with the game.

4. Explain that in regular thumb wrestling the object is to pin your opponent's thumb with your thumb, but in this version the thumb wrestling pairs want to pin each other's thumbs as often as possible in one minute, with each pin counting as one point. Explain that the goal is to collect as many points as you can in one minute.

Note: Be careful not to set the partners up explicitly as competitors. This is a friendly exercise.

5. Have the pairs grasp fingers as shown in the following photo:

6. Before beginning, ask each pair to warm up by tapping their thumbs back and forth three or four times. When the teachers says go, the pairs should begin the thumb game.

7. After one minute, stop the game. There should be a lot of laughter. That is good. Have fun with it.

8. After the game is over ask the partners how many points they earned. You will hear numbers between one and five, with the some pairs who manages to achieve 20 or 30 points. If you have a pair with a high score, ask how they did it. The answer will most likely be that they cooperated, one person allowing his or her thumb to be pinned by the other multiple times, and then switching. Using this method, the partners have a much better chance of scoring more points.

9. Using the following reflective questions, encourage the students to put into practice the principles of living systems.

    a. What were your assumptions about the thumb game? *Typical answers: one person wins and one person loses. Or, if you're competing with the larger group, you may both lose. What made us make those assumptions?*
    b. How can we shift our focus to see various forms of cooperation and partnership? *For example, instead of looking at each other as two adversarial thumb wrestlers, how can we shift our focus to another, higher form of relationship, i.e., collaboration?*

Chapter 5: Rightness of Size

Before completing the following activity, read the story "The Tale of the Pumpkin Vines & the Walnut Tree" from Chapter 5 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

For centuries the folklore of Nasreddin Hodja has entertained the Turkish people. Here, the Hodja learns about the rightness to the sizes in nature. Walnuts the size of pumpkins? Pumpkins the size of walnuts? In nature, growth is controlled by a species and its environment. The thickness of a palm tree doesn't increase as the tree grows taller. If it grows more than its normal height, it topples over. Along with the Hodja, we can learn to see if the size of something serves its purpose, or if it serves some other purpose, like status, profit, or ego.

Objective

- To explore that everything in nature has a right size and the implications if that size was to change.

Literature and writing standards

- Determine a theme or central idea of a text and how that theme is conveyed through particular details.
- Find examples of real world applications of the text's theme and ideas.
- Use inspirational text to create original writing.

Classroom management

Students can complete this activity individually or in a small group of three or four students. Supplies should be easily available by all students. You may want to create one supply area or pass out the supplies to each student or group.

Materials

- Old magazines or newspapers
- Scissors
- Glue
- Large blank paper
- Lined paper, a notebook, or a computer with a word processing program

Student activity

1. Have the students look through old, unneeded magazines or newspapers for pictures of objects found in nature. These pictures can be plants, animals, insects, landforms, or anything else that occurs naturally in our environment. Have them cut out seven to ten pictures of different sizes. This activity will work best if they have a mixture of small and large pictures. The students should cut these pictures close to the edge of the objects they want to focus on.

2. Next, have the students glue these pictures onto a blank sheet of paper to create a scene. This scene does not need to be realistic (for example, they can have a giraffe with a palm tree). Students can finish the scene by adding their own hand-drawn details if they have time.

3. For an optional activity. ask the students to find photos of everyday objects—bicycles, soda bottles, buildings—and add two or three of those pictures to their montage.

4. Have each student take a few minutes to look at his or her completed picture. Ask the following questions (depending on the age of the students, they can discuss these questions in small groups or as part of whole class discussion).

    a. Do you notice anything that looks strange to you?
    b. Are all the pictures that you chose to scale? When we say "to scale" we are referring to an object's accurate size when viewed next to another object. For example, do you have a dog that is bigger than a tree or an ant that is the size of a lake?
    c. How do we know if the size of something is serving its purpose?
    d. When is bigger better? Is smaller beautiful?
    e. How was the idea of "rightness of size" important to the Hojda in the story?
    f. What did Hojda come to realize about the small size of the walnut?
    g. What in your picture are you happy is found small, like the walnut, in nature?

5. Tell the students that their challenge is now to write their own folktale or story that uses these pictures to allude to "rightness of size," just like the story found in Chapter 5 of *Connected Wisdom*. Their stories can be as simple or complex as you would like for them to make it. Perhaps a student tells about a mosquito the size of an elephant, or about lion the size of a mouse. Here are some simple guidelines for students telling their own stories.

    a. Set the scene. Where does your story take place?

   b. Introduce your characters.
   c. Is there a sequence of events?
   d. Is there some sort of conflict?
   e. What is the resolution?
   f. Now, tell your story!

6. When everyone is finished, ask some volunteers to share their stories with the class. Exchange perspectives and ideas on what would go wrong on the Earth if there was no rightness of size and items could be as large or small as we wanted.

Take it a step further

Ask students to write a blog on www.planetseed.com and share your picture and story with our community. You will need to create or have a www.planetseed.com account in order to do this.

Create a gallery of stories in your school to share with classmates and other teachers.

Create original artwork to accompany your story and replace the magazine and newspaper clippings.

Chapter 6: The Commons

Before completing the following activity, read "Too Much Sky" from Chapter 6 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

In the Bini Nigerian folktale "Too Much Sky," a first people discovers that even the sky is a precious and limited resource. The sky gives us oxygen to breathe, protects us from ultraviolet rays, and regulates the Earth's temperature, and often we do not protect it, because we do not see it as limited. When we see that the sky is a commons, we understand that we must all take care of it. If an activity or resource is open to all, then it is likely to be a commons. We are all free to visit a public park, walk on a city sidewalk, or breathe the air. Some commons, such as the sun, music, and language, are unlimited. Others, such as fisheries, energy, and schools, are limited or finite. They can be used up or overrun.

Objectives

- To identify in students' school and/or communities those shared resources—such as air, water, land, highways, fisheries, energy, or minerals—on which they depend and for which they share responsibility.
- To explore the difference between finite and infinite "common" resource and consider the students' role in caring for those commons.

Literature and science standards

- Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (ESSS3)

Classroom management

Students should work in pairs for this activity.

Materials

- Map of your community, with enough copies for two students per map. If you cannot obtain a map, you can sketch one for use in this activity.
- Pencil or pen
- Paper
- Colored pencils, markers or crayons

Student activity

For this activity students will identify the commons in their community, and think about the best ways to protect them for all to use.

1. Have the students find partners, and distribute a map to each pair.

2. Ask the students to look at their community map and color in the common spaces and resources.

3. When the students have completed their maps, start a discussion about your community's commons. Which commons are limited? Which are unlimited? Encourage students to think about ways to protect their commons.

   Often the answers to these questions lie in everyone following certain rules to care for the commons and managing the commons for the long-term benefit of all.

4. Give the class a commons quiz:

   a. Would you rather have cleaner air or more cars on the road?
   b. More parks and open fields or more shopping markets?
   c. Would you want more neighbors willing to watch your house when you go away or more locks on your doors?

Take it a step further

Take the students on a commons tour of their school. Walk the school grounds and look in classrooms, the administrative offices, etc. Upon returning to the classroom ask the students to pair up and draw a map of their school, coloring in the commons areas just like before. Then answer the following questions:

a. Who and what did you see that might be considered part of the commons? Ask the students to write down their ideas. For instance, air is available to all but water may or may not be made available.

b. How about history (of the town, the school, the country), language, music, culture (art, dress)? Are these commons?
c. Are there elements of the commons that you don't see at school?
d. In what ways do you as students benefit from these commons and in what ways can you care for or protect these commons?

Chapter 7: Living Cycles

Before completing the following activity, read Chapter 7 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

Cycles are those circular processes that repeat over and over, frequently returning to where they began. Living cycles sustain life, circulate resources, and provide opportunities for renewal. Some examples of cycles we are all familiar with include the water, carbon, and oxygen cycles, and there are many more. In the Sufi story "The Tale of the Sands," the stream learns to become a part of the natural rhythm of the water cycle.

Objectives

- To understand the nature of living cycles.
- To explore how cycles influence our everyday lives.
- To consider the benefits of working with, rather than disrupting, living cycles.

Science standards

- Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, or atmosphere interact. (5-ESS2-1)

Classroom management

Start this activity as a large group first, and then, as you conduct the water cycle activity, work in smaller groups of three to four students.

Materials

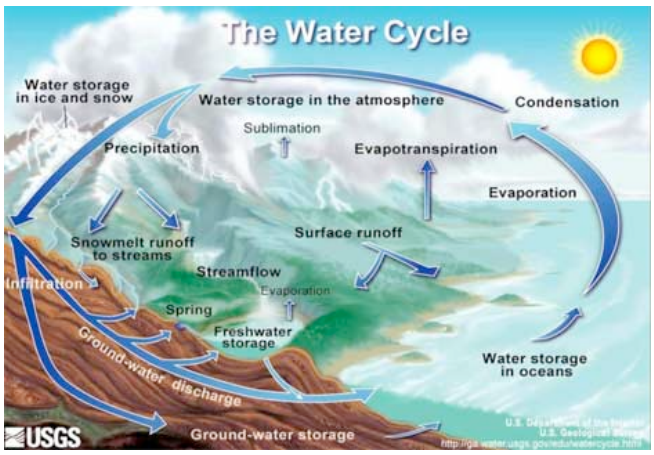
- Pencil
- Paper
- A small cup, preferably a fairly heavy ceramic one
- A glass bowl that is larger than the cup
- Plastic wrap
- A small rock or other weight
- Water

Student activities

I. Group discussion and writing

1. Encourage students to identify cycles in nature and consider the purpose of those cycles. The students can then explore ways that they may influence or be influenced by those cycles.

   You can use the water cycle as an example. Water flows from the smallest stream to the largest lakes, finding its way eventually to the ocean. The water evaporates and returns to the atmosphere as a vapor and then comes again to the land as rain, snow, and hail. The water is either absorbed into the ground or runs off into streams, rivers, and lakes.



2. How do we often unknowingly disrupt natural cycles? Show students pictures of the water cycle and ask them to consider where humans may most influence or disrupt this cycle. For example, when we pave streets and parking lots, we interrupt the water cycle by lessening the amount of water absorbed into the soil and increasing the amount of water diverted into storm sewers.

3. What are some other natural cycles that can be disrupted? The sleep cycle is one example. When we reach for a cup of coffee in the afternoon because we feel tired, we ignore the body's signal to wind down and prepare for the rest part of the sleep cycle. By meddling with our sleep cycle, we become more tired, no matter how much coffee we drink.

4. How can we work with natural cycles? The first step is to recognize and respect them. It could be is as simple as building more parks with unpaved areas in our cities, or sleeping when we feel tired.

II. Recreating the water cycle.

In this activity, students create their own small-scale replica of the Earth's water cycle.

1. Place the small ceramic cup in the middle of the glass bowl. Fill the bowl with about 2 cm (0.79 in) of water. Be careful not to fill the small container inside.

2. Cover the bowl with plastic wrap, and secure the plastic wrap around the rim of the bowl.

3. Put a small rock or weight on top of the plastic wrap in the center. The rock causes the plastic wrap to stretch a bit so that it is lower in the center—just above the cup—than at the sides. This diagram shows a cutaway view from the side.

4. Place the bowl in sunlight. Near a window is an ideal location.

5. After a while you will see droplets of water start to form on the underside of the plastic wrap. As the water droplets became larger, they began to flow down the inner surface of the plastic wrap toward the center. There they meet other droplets coming from other directions. As the droplets meet and join, they become heavier and drop into the cup below.

   For detailed instructions on how to set up this activity, please view the Drinking Water from the Sea activity from PlanetSEED.com.

   While students develop their working models of the water cycle, ask them to think about and report on these questions:

   a. How long does it take for water to evaporate and condense on the plastic wrap?
   b. Where does the water go after it condenses on the plastic wrap?

Take it a step further

There are many high-quality cycle-related animations and activities on the PlanetSEED Web site.

- Water cycle: http://www.planetseed.com/forum/working-water-cycle-pre-assessment and Drinking Water from the Sea

- Carbon cycle animation: http://www.planetseed.com/relatedarticle/carbon-cycle

- Infection cycle: http://www.planetseed.com/relatedarticle/infection-cycle
- Solar cycles: Sun and Earth and Temperature Change
- Nutrient cycle: Water Source: Watershed Investigations
- Sleep cycle: Adolescent Sleep Deficits Invite Innovative Research: The Study of Circadian Phase Preference Delay

Chapter 8: Waste = Food

Before completing the following activity, read "The Food of Paradise" from Chapter 8 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

Yunus was a Syrian who died in 1670. It is said he was an innovator with extraordinary healing powers. In this adaptation of a Sufi tale (originally told by Sufi author Halqavi), Yunus sets out to discover the divine source of human sustenance. He discovers a simple principle that guides all living systems: one inhabitant's waste can become another's food. In this activity set, students discover ways in which the principle of "waste=food" applies to their everyday lives.

Objectives

- To develop an understanding that waste from one system can become food for another.
- To explore how nature continuously circulates materials in closed loops of production, use, and recycling and how that principle may apply to our everyday lives.

Literature and science standards

- Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- Develop a model to describe the cycling of matter and flow of energy among living and non-living parts of an ecosystem. (LS2-3)

Classroom management

This activity can be conducted as a large group or in smaller groups of three or four students.

Materials

- Soil from a garden or a local park

- Magnifying glasses, enough for each student or each group of students
- Empty milk cartons or small, resealable bags (one per student, or one per each group)
- Scissors
- Tape
- Glue
- Construction paper
- Notebooks or journals for each student or group
- String
- Greens—old lettuce leaves, apple peels or other kitchen leftovers
- Browns—shredded newspaper or brown paper, such as pieces of a brown paper bag

Note: Have the students bring in the greens and browns from home the day of the activity.

Student activity

This activity will explore how waste is turned into food in the garden.

1. Put a few handfuls of dirt on a table. Invite students to touch it and inspect it with a magnifying glass.

2. Ask students the following questions.

    a. What do you feel and see in the soil? (Most soil will have bits of leaves, branches, or rocks, as well as decaying plants and animals.)
    b. What is alive in the soil and what is not?
    c. Does anyone know how the soil uses certain waste as food and turns that waste into more soil?

3. Discuss the concept of decomposition.

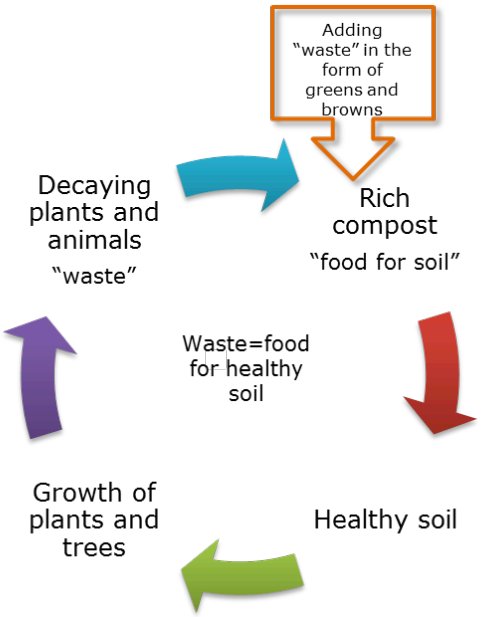
4. Have the students create a compost container by cutting off the top of a milk carton or by using a small plastic bag. The class may either make one large container or smaller containers to be used by student groups.

5. For each compost container, mix the greens, the browns, and a handful of dirt. This will create healthy soil over time.

6. Have students mix and observe their compost bins over a month. Record any changes in a notebook or journal.

7. After one month, discuss your observations. How has the soil changed? What happened to the browns and greens wastes?

8. As part of the discussion of how waste from one organism can be food for another, show the causal loop diagram on the next page. This diagram reinforces the idea that *waste becoming food becoming waste becoming food* is a healthy and practical cycle in nature, one we can learn to support. It is best to draw this diagram one variable at a time as you discuss it with students.



9. After one month, add the newly composted soil to your school's garden or a garden at a local park (with permission).

Take it a step further

If you have time, take the class on a walk around the school looking for other waste materials that will "feed" the compost pile. Items should be natural and should not contain any animal products or waste. Please visit Composting At Home for more information.

Ask students to think about opportunities for waste to become "food" at home. One obvious answer will be home compost. But other objects from the home can be recycled. There are programs to turn old sneakers into playground surfaces, and plastic bottles into polyester fleece for jackets or composite lumber for building.

Chapter 9: Balancing Feedback

Before completing the following activity, read "Gluskabe Traps the Animals" from Chapter 9 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

Balancing feedback consists of circular processes that create stability by counteracting or lessening change. In this tale, young Gluskabe, a mythical hero of northeastern North American natives, learns about the consequences of interrupting nature's dynamic balance. Taking too many game animals means there will be fewer animals to regenerate their numbers, which results in fewer animals for all the hunters for years to come. Like Gluskabe, we can be wise and learn to understand the balancing feedback processes all around us.

Objectives

- To explore an underlying pattern in living systems that seeks stability by lessening change or counteracting change.
- To explore the question: what set of interrelationships enable a particular system to achieve a state of balance?

Literature and science standards

- Draw inferences from text; determine the theme of a story from details in the text. Analyze how characters change throughout the text.
- Cause and effect relationships may be used to predict phenomena in natural or design systems. (MS-LS2-1)

Classroom management

Students should complete this activity in pairs.

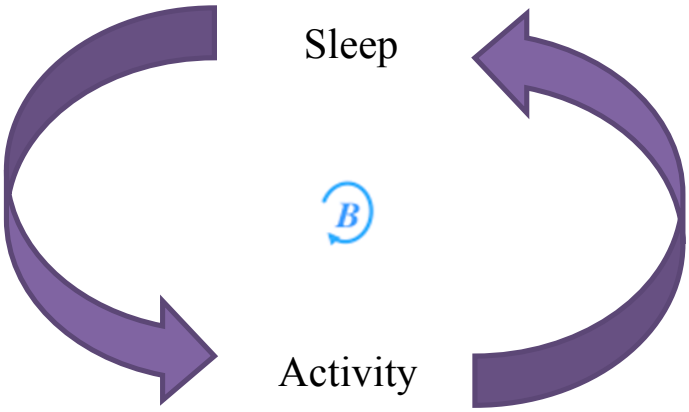
Materials

- Blocks of wood approximately 10 cm x 10 cm x 30 cm (4 in x 4 in x 12 in), enough for the entire class or for pairs of students

Student activity

This activity is designed to help students learn to identify balancing feedback and then to find examples of balancing feedback in their own lives. Ask your students where in their lives do they see an increase and then a decrease of something followed by an increase,

and so on? A good example is the balancing feedback loop created by sleep and activity. Have your students draw a simple line graph that represents the amount of sleepiness they experience in a day. It will likely go down in the morning, then up during midday, then down after they go to bed.



1. Place the blocks of wood on the floor. Pair off the students, and ask one of the students stand on one foot on a block; each block is just a few inches larger than the student's foot. Note that if you cannot obtain blocks of the necessary size, this activity can be conducted standing on the floor.
2. Have the students continue standing on the blocks for 5 minutes, and ask the other partner to observe what the balancing student does to continue standing on the block. What do the balancing students do to stay on the block? Do they switch feet? Put both feet down?

The balancing students stay balanced by making adjustments. As they tire from standing on one foot, they put their other foot down to help balance or to switch feet all together. Once the original foot has rested, they will be able to balance on it once again. Nature is constantly making these adjustments. That process is called balancing feedback.

By its very nature, balancing feedback seeks to create stability by dampening or negating change. When we work to achieve balance standing on a block, we are part of a balancing feedback loop that seeks to close the gap between desired state of balance and the actual state.

Take it a step further

To take the balancing exercise further, ask students to close one eye, and possibly both, while they balance! If there is any concern about students falling off the block, this exercise can be done standing on the floor.

Play the Predator Prey Game http://www.exploringnature.org/graphics/foodwebs/pred-prey%20game.pdf

Chapter 10: Reinforcing Feedback

Before completing the following activity, read the story "Hercules and Pallas," from Chapter 10 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

Have you ever heard someone say, "We're on a roll!" when successes seem to build on themselves, or "We're spiraling out of control!" when problems continue to pile up? When people use these kinds of phrases, they tend to be describing reinforcing feedback, a circular process in which a change builds on itself over time. In the folk tale "Hercules and Pallas" Hercules and Strife are trapped in a closed loop of cause and effect, called a reinforcing feedback loop. The greater Hercules' aggression, the larger Strife grows, and the larger Strife grows, the greater Hercules' aggression. It is only when Hercules realizes, with the help of Pallas, he must not respond, that the spiral is broken. Reinforcing feedback is one of the ways living systems change.

Objectives

- To explore reinforcing feedback, an underlying pattern in living systems that amplifies change, acting as engines of growth or decline.
- To explore the question: how can a set of interrelationships cause a living system to grow or decline?

Literature standards

- Read fables, folktales, and myths from diverse cultures.
- Describe characters in a story and explain how their actions contribute to the sequence of events.
- Make connections between fables, folktales, and myths and relevant everyday situations.

Classroom management

Students can complete this activity individually or in pairs.

Materials

- One printed copy of a photo
- Paper
- Pen or pencil

Student activity

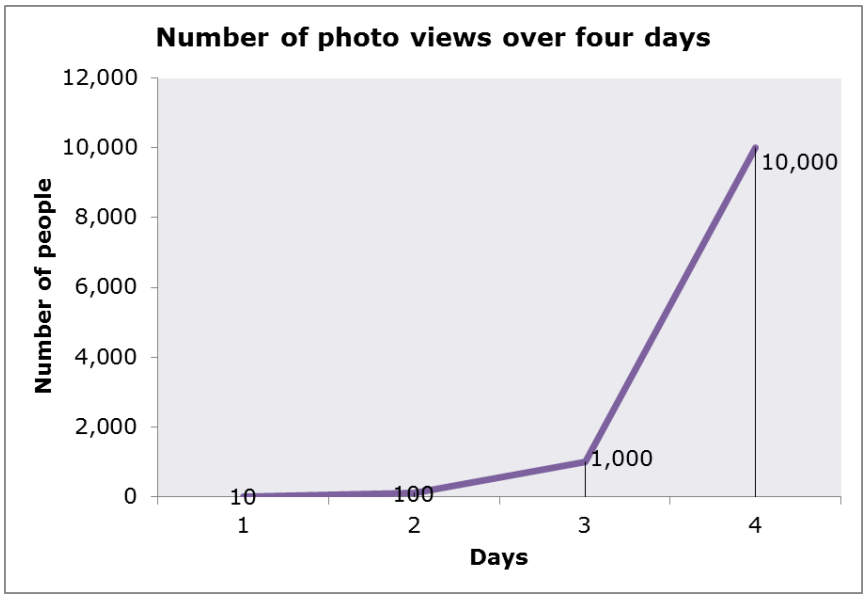
This activity explores reinforcing feedback, a common pattern of change in living systems, using social media and how information spreads as an example. Over the past few years the term "go viral" has taken on a new meaning. It no longer refers to sickness, but to a picture, video, or comment over the Internet that has taken on a life of its own. This activity explores the potential power of posting information on social media, how that information can spread, and its relationship to the "Hercules and Pallas" story.

1. Select a photo to share with the students. The photo should be something the students will think is funny, interesting, or unusual. Tell them you wanted to share this photo with them because you found it interesting and thought they would too. Talk to them about how sharing a photo in person reaches only them. They have no way to share this photo with friends or people at home if you have the only physical copy of it.

2. Ask students to list 10 people they know and interact with regularly. Discuss what might happen if they were to share this photo with those 10 people. Ask if they think any of the 10 people would think the photo was interesting and would want to pass it on? Would this be possible to do if you only had the physical copy of the photo? What would be an easier way to share it?

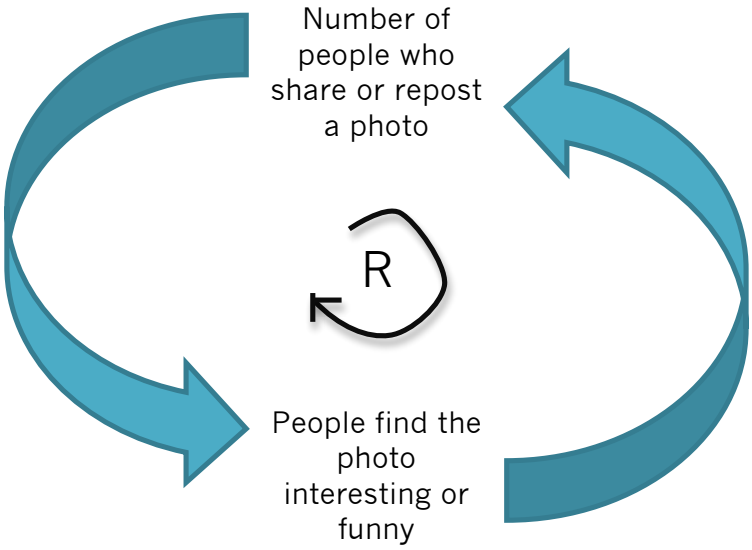
3. Students will probably agree that sharing the photo on the Internet, through e-mail, Twitter, Facebook, or other social media outlets would be much simpler. If they shared this photo on day 1, 10 people would view it. What would happen if on day 2, each of those 10 people shared the photo with 10 people they knew?

4. Ask the students to continue the pattern of people sharing with 10 more people for four days. At the end of four days, how many people would have seen the photo? Have students create a data set and chart that represents the amount of views the picture would have over four days. Here is our example:



Day	Number of people
1	10
2	100
3	1,000
4	10,000

5. Take this idea further by having students continue to add up the potential exposure the picture would receive if people continued to share it. In the story, Hercules tried to fight the monster he encountered. For every blow from Hercules, the monster tripled in size. So while the monster started out small, it grew in size exponentially with each blow. The same idea can happen in social media. For each person who shares a photo or video, the audience grows exponentially because every friend of that person has the potential to share it as well. Challenge students to create a feedback loop that represents the system that is occurring.



6. Discuss with the students the positive and negative repercussions of media going viral. What are the important safety considerations? Do the benefits of social media outweigh any negative effects?

Take it a step further

Ask students to share (appropriate) examples they have seen of media going viral.

Challenge students to create an appropriate video or photo that could possibly go viral. What social media outlets should they use to promote it? Have them develop a plan to aid in the success of the video or photo. If you want, allow them to follow through with the plan.

Chapter 11: Nonlinearity

Before completing the following activity, read the tale "A Kingdom Lost for a Drop of Honey" from Chapter 11 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

Nonlinearity may sound like a fancy modern term, yet it is an ancient truth that we see expressed in various cultures and languages around the world. The Chinese capture nonlinearity in this simple proverb: "An ant may well destroy a whole dam." The Arabic proverb "the straw that broke the camel's back" and the French proverb "little brooks make great rivers" also illustrate the idea of disproportionate effect. In this tale the king overrides his chief adviser's intuition about the power of nonlinear phenomena. After all, what consequence could a single drop of honey have? He finds out that even the tiniest act can have enormous consequences, particularly when myriad interconnections and reinforcing loops of cause and effect are involved.

Objective

- To explore a type of behavior in which the effect or outcome is disproportionate to the cause or originating event.

Literature, writing, and science standards

- Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.
- Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
- Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural or designed systems.(LS2-1)
- Stability and change: Small changes in one part of a system might cause large changes in another part.(LS2-4)

Classroom management

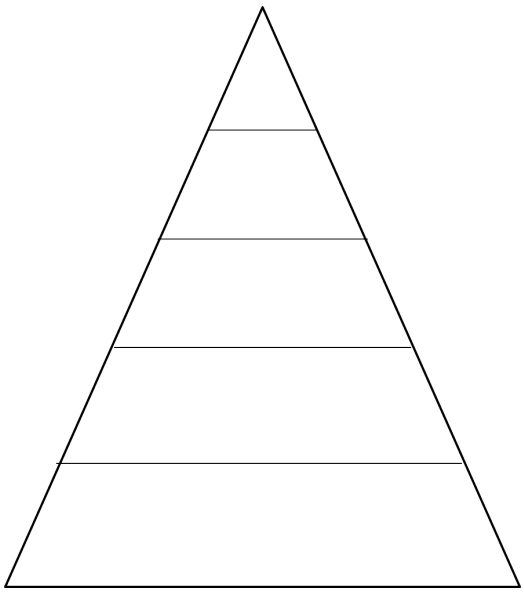
Students can complete this activity in groups of two to four.

Materials

- One large sheet of paper per group
- One ruler or meter stick per group
- Pens or pencils

Student activity

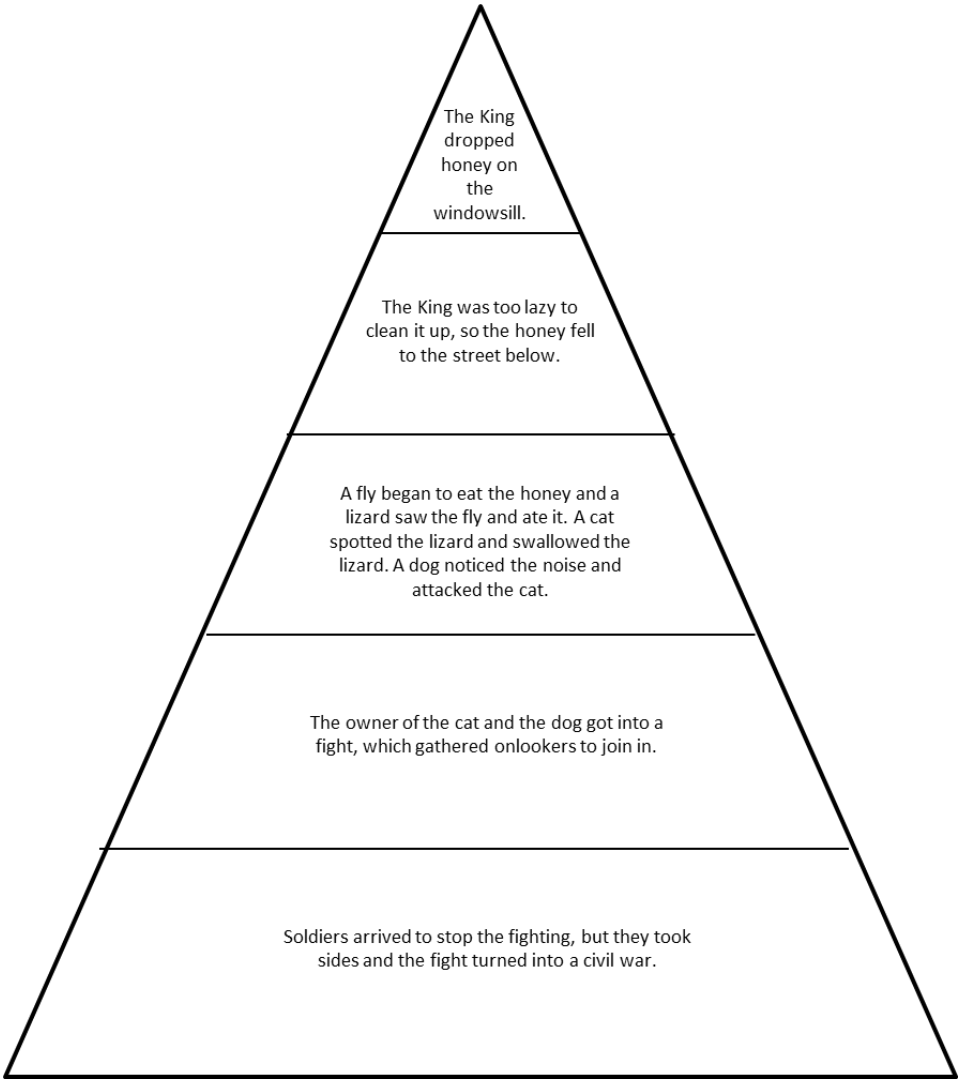
1. Have the students draw a large triangle that takes up the majority of the large sheet of paper. Students should then evenly divide the triangle into five equal horizontal parts, as in the diagram.



2. Remind students of the story "A Kingdom Lost for a Drop of Honey," when one drop of honey leads to a civil war and the destruction of the palace.

3. Each student group will then brainstorm a simple action that could end with an event that is disproportionate to the initiating action, similar to the events the story. You may want to encourage students to pick an action that could have a large social impact, such as leaving a faucet running or recycling. You may also choose to have your students create a folktale-type story. Make sure that your students understand that it is important to reinforce the extreme difference between the beginning action and the result.

4. The groups will create five events to tell their disproportionate chain reaction. They will transfer these stories to the five sections of the triangle on the large sheet of paper. The beginning action goes in the smallest section of the triangle, with the remaining events going in subsequent sections. See the example created here for "A Kingdom Lost for a Drop of Honey." When the groups are finished they should have a chain of events, starting with a small action at the top and ending with one that is disproportionate at the bottom.



5. Ask the groups to brainstorm why the triangle shape was used for this activity. Students should be able to make the connection between the sizes of the spaces getting larger with events escalating in a nonsensical manner. Ask them to think about other shapes that would be suitable for this type of story, for instance, a spiral.

6. Have the groups to share their cascade of events with the class. Allow other groups to question and challenge the cascade of events the groups present.

    a. Do the other students agree that the first action can lead to the final event?
    b. What are other possible outcomes of the first action?
    c. Can the other groups take the same beginning idea and come up with a different disproportional outcome?

7. After the groups have presented their triangles, allow the class time to brainstorm other small actions in their community that could have a larger or disproportional affect in a positive way. For example, the introduction for Chapter 11 explains how fixing broken windows improved the community's sense of security. This caused the rate of crime to go down because people felt safer on the streets. What small action could lead to a major change? Referring to the broken windows story provides a terrific opportunity to ask students how, in a chain of events, there might actually not be a straight line from the initial action the "final event" but how there might actually be a link from the "final event" back the initial event. In the broken windows example, fixing the broken windows ultimately led to a safe community, which led back to fewer broken windows over time. This is a reinforcing loop (see Chapter 10). It is important to always encourage students to think beyond straight lines of cause-and-effect, to closed loops of cause-and-effect that go around and around.

Take it a step further

Have students create an action plan to implement small, positive changes in the community that could have a larger impact on a local or global scale. Students can use these plans to form afterschool clubs and hold community meetings to gain support. Help students by providing mentoring and support for their ideas.

One example of a community project that started small and has grown disproportionate to its beginnings is Alex's Lemonade Stand. This project was started by a four-year-old cancer patient, Alex, who began raising money for cancer research by opening a lemonade stand in her front yard in 2000. Today, it is a national foundation that has raised over 60 million US dollars and has funded over 300 cancer research projects.

Chapter 12: Earth Time

Before completing the following activity, read the story "The Rice Puller of Chaohwa" from Chapter 12 of *Connected Wisdom* to the class, or have students read it in small groups of three or four.

Introduction

Most of us can't imagine pulling on rice stalks to make them grow faster. Yet we might expect to take a few guitar lessons and play like a rock star, or expect a group to work as a team after just a few days, or want efforts to reduce carbon emissions to have an effect immediately. We can learn from Earth's time, and Liu's experience, to take a longer view, to slow down, and to understand that sometimes the results of our actions lay in the distant future.

Objective

- To explore that there is a right amount of time for actions to take place in nature and that human interference can damage this process.

Literature, writing, and science standards

- Analyze a particular point of view or cultural experience reflected in a work of literature from outside the United States, drawing on a wide reading of world literature.
- Draw evidence from literary or informational texts to support analysis. Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
- Developing a model to explain Earth processes to show relationships among variables between systems and their components in the natural and designed world.
- Systems and system models, which can be described in terms of its components and their interactions.

Classroom management

Students can work independently or in pairs for this activity.

Materials

- Seeds that grow quickly, such as radish seeds or lima beans
- Soil
- Small plastic cups
- Water

Student activity

1. After reading the story, have each student fill a small plastic cup with soil and plant a seed from a fast-sprouting plant. Add a small amount of water to the cup and place the cups in a window or outside where they will receive sunlight.

2. Have your students check on their seeds each day. Discuss ways that can make the seed grow faster. For example, some students may think it is a good idea to add extra water, soil, or fertilizer. Ask them what the consequences would be if you added too much of those substances. You can test some of the students' suggestions and observe the results of over-watering them, giving them more soil, or even fertilizing helps them. Make sure you mark which seeds were given these extra items. Just as in the story, sometimes the best intentions to help speed up a process can lead to consequences that were not thought out.

3. After a few weeks the seeds should sprout. If you followed the students' suggestions, have students write down observations of differences between the groups of seeds. Take this time to revisit the story and make the connection between waiting for the seeds to sprout and having patience for nature to take its time.

Take it a step further

If you don't have the time or space to grow seeds, here are some other activities you can do.

The Untangle Game

1. Divide the students into groups of six to eight.

2. Have the students form a circle facing one another.

3. Instruct each student to grab the right hand of the person across from (not next to) him or her.

4. Then, join left hands with a different person.

5. Finally, try to untangle, without anyone letting go.

6. What happens if you just pull or you just tug? Does the group get untangled?

The Unripened Fruit

1. Purchase fruit that is not yet ripe and bring it to school.

2. Cut the fruit up into small pieces and share the fruit with the students without telling them it isn't ripe (make sure there are no allergies to the fruit you choose).

3. Watch students' reactions as they eat the fruit. If the students complain about the taste, tell them it is all the store had and you wanted to make sure they had a snack in class today.

4. After students have had a taste of the fruit, either read the story as a whole class or in small groups of students.

5. Ask your students the following questions.

   a. Why did the farmer want to pull on the rice?
   b. What are some other examples of impatience with the speed of nature result in a bad outcome? (*Answers should refer back to the unripe fruit they tasted*)
   c. Are there times where you have been inpatient waiting on something you really wanted?

   These questions can either be answered verbally or students can write the answers in their journals.

Additional Resources

PlanetSEED.com Resources

Meet the author of *Connected Wisdom*, Linda Booth Sweeney

Join us in the PlanetSEED Living Systems Forum for more links to new and articles about *Connected Wisdom.*

Visit Linda Booth Sweeny's Web site

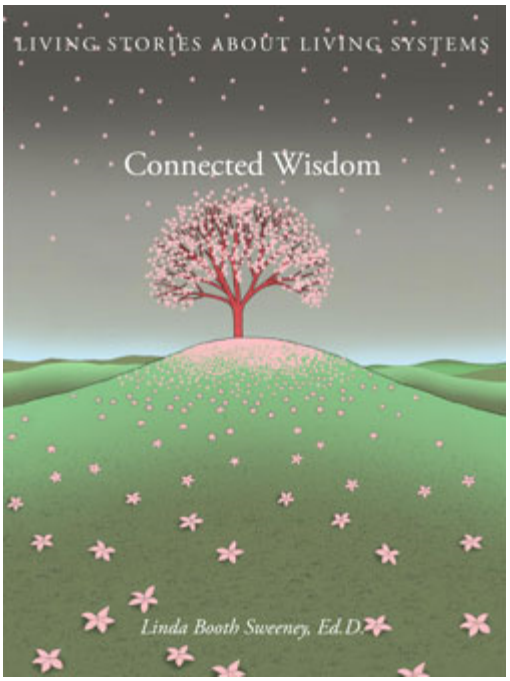
Systems thinking video library

What is Systems Thinking?

Connected Wisdom and Global Issues

Principles of Systems Thinking

Ordering Connected Wisdom



Preview before you order

Introduction

Chapter 5: Rightness of Size

Print book

Amazon

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ebook

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Audio book

SEED collaborated with Linda Booth Sweeny and storyteller Courtney Campbell to record all 12 folktales, with adapted explanations of the related systems thinking. The CD is available in English only.

SEEDSTORE

Amazon

Listen to a preview of Chapter 11: A Kingdom Lost for a Drop of Honey

Additional systems thinking resources

The Creative Learning Exchange
The organization's mission is to develop systems citizens through active, learner-centered K-12 education. This site provides the educational community with a library of materials, a newsletter, K-12 listserve, and a biennial conference.

The Waters Foundation's Systems Thinking in Schools
Project provides training and resource materials to K-12 teachers and administrators around the world. Don't miss their new web-based tutorial.

The International Society for the Systems Sciences (ISSS)
Among the first and oldest organizations devoted to interdisciplinary inquiry into the nature of complex systems.

The EcoTipping Points Project
Examples of how the principles of living systems are being applied to ecosystems and human societies.

Center for Ecoliteracy
Providing information, inspiration, and support to educators, parents, and other members of the school community who are helping young people gain the knowledge, skills, and values essential to sustainable living.

The System Dynamics Society
See you system dynamics and systems thinking are being developed and used by researchers, educators, consultants and practitioners around the world.

The Cloud Institute
Organization ensures the viability of sustainable communities by leveraging changes in K-12 school systems to prepare young people for the shift toward a sustainable future.