LESSONS FROM *THE LORAX*
USING GRAPHS TO STUDY CHANGE
by Rob Quaden and Alan Ticotsky

*T*he Lorax, by Dr. Seuss, is a classic children's book that appeals to all ages. Told in a fanciful style, the story relates how an ambitious businessman named the Once-ler exploits all the resources of a small country. Despite the warnings of a character named the Lorax, all the truffula trees are cut down and made into fast-selling products called thneeds. At the end of the story, the Once-ler regrets his actions, but is it too late?

With a new movie version having debuted in March, 2012, many students will be revisiting *The Lorax*, or experiencing it for the first time. The rich lessons in the story can be made even more powerful by actively engaging readers in some basic graphing activities.

THEMES IN THE LORAX

Several important themes are central to *The Lorax*.

- Citizenship

- Environmental stewardship and the necessity for businesses to practice sustainable use of resources

- The necessity for businesses to practice sustainable use of resources

- Making room for both natural environments and economic development

The characters are portrayed broadly as black and white by a hero (the Lorax) and a villain (the Once-ler). That's important because it draws readers into the conflict. In reality there are more gray areas. Individual attributes drive Dr. Seuss's characters, influencing their decisions either to behave honorably and stand up for the environment, or to be selfish, driven by excessive greed. The story presents teachers with an opportunity to bring these and other important concepts into the classroom.

Many state and national standards, as well as local curriculum topics, can be addressed through *The Lorax*. In this lesson, students will

- Evaluate complex information and ideas

- Express logical arguments

- Understand systems

- Consider sustainability and environmental issues in relation to business growth

- Represent and interpret data graphically.

GRADE LEVEL: 2-6

LENGTH: 1 to 2 class periods (45 - 90 minutes) not including reading The Lorax

MATERIALS
One or more copies of The Lorax, by Dr. Seuss
Copies of graphing template
Paper
Colored pencils or markers
Display tools (chart paper, electronic projection devices, overhead projectors, white boards, ...)

HOW IT WORKS

In this lesson, students read *The Lorax* and draw graphs to illustrate the changes that happen over the course of the story. Using simply stated questions, readers grapple with the complex themes in the book and movie. Students will investigate how cycles compete for dominance, and think about how the needs of business and natural resources can collide.

The growth cycle of business dominates for a while. The Once-ler makes lots of money, uses it to expand his business and employ his relatives, and makes even more money. But growth cannot continue forever, and natural resources become depleted. Pollution plagues the country and the tree population declines until it is no longer possible to produce thneeds. The Lorax's voice of dissent is ignored until the treasures of the land are spoiled.

PROCEDURE

1. READING THE STORY

The teacher should decide the best method appropriate to his or her class—read aloud, shared reading, etc.

2. FINDING OUT **WHAT IS CHANGING**

• Ask students "WHAT IS CHANGING?" in the story. Give them some thinking time, then choose two or three volunteers to say one answer each. They will probably suggest elements such as "truffula trees," or "thneeds." Urge them to be specific, asking follow-up questions if necessary or saying "tell more about that element of the story."

> Most of the story lines in literature are based on changing elements over time that create conflict. Students should be able to see the points of conflict clearly in The Lorax.
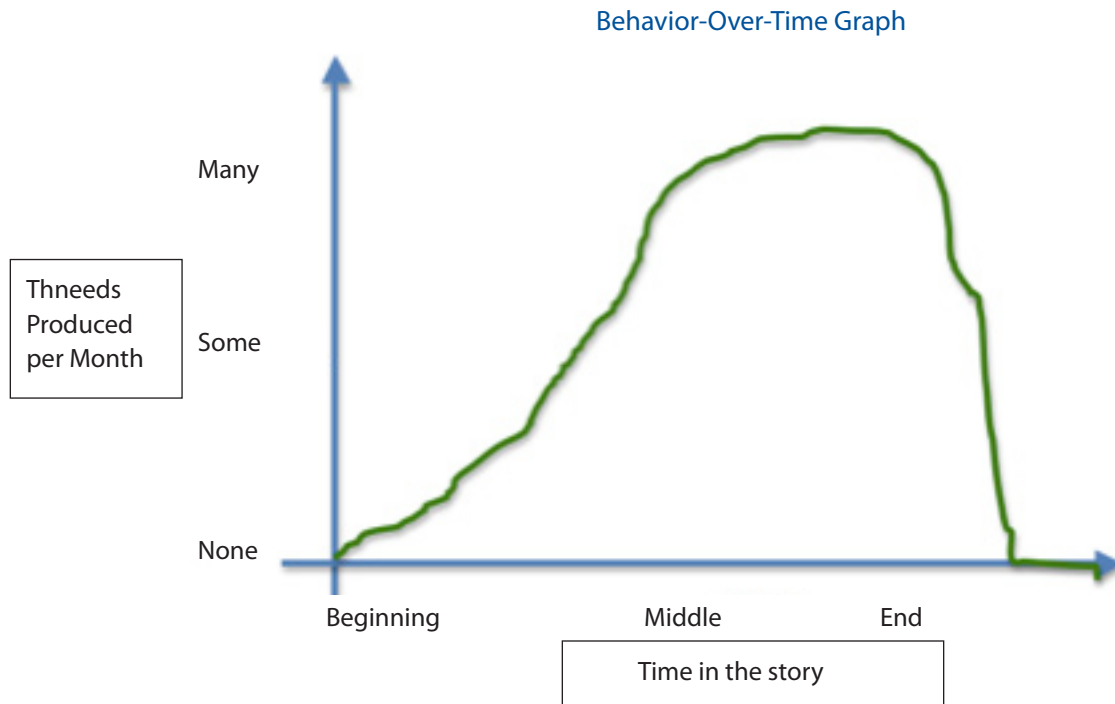
Example: If a student says "thneeds" changed during the story, do they mean "total thneeds produced," or "thneeds produced per month?" Using precise, descriptive language is an important skill to practice.

• Use the student suggestions to start a list on a display board or screen.

• Have students work in teams to generate their own lists of elements that change over time during *The Lorax*.

• Share the resulting lists in a whole class session, and be sure to emphasize that there isn't just one correct list of things that change, and they may think of more later. If a team hears a changing element listed by others that they didn't include, they may add it to their list.

• Ask each team to choose elements they consider the most important in the story. Instruct them to *edit their list to ten or fewer items.*

> Some teams may aggregate data—instead of listing individual populations, using a term like "animals" can include the Brown Bar-ba-loots, Swomee-Swans, and the Humming-Fish.

• Come to a class consensus about the most important elements.
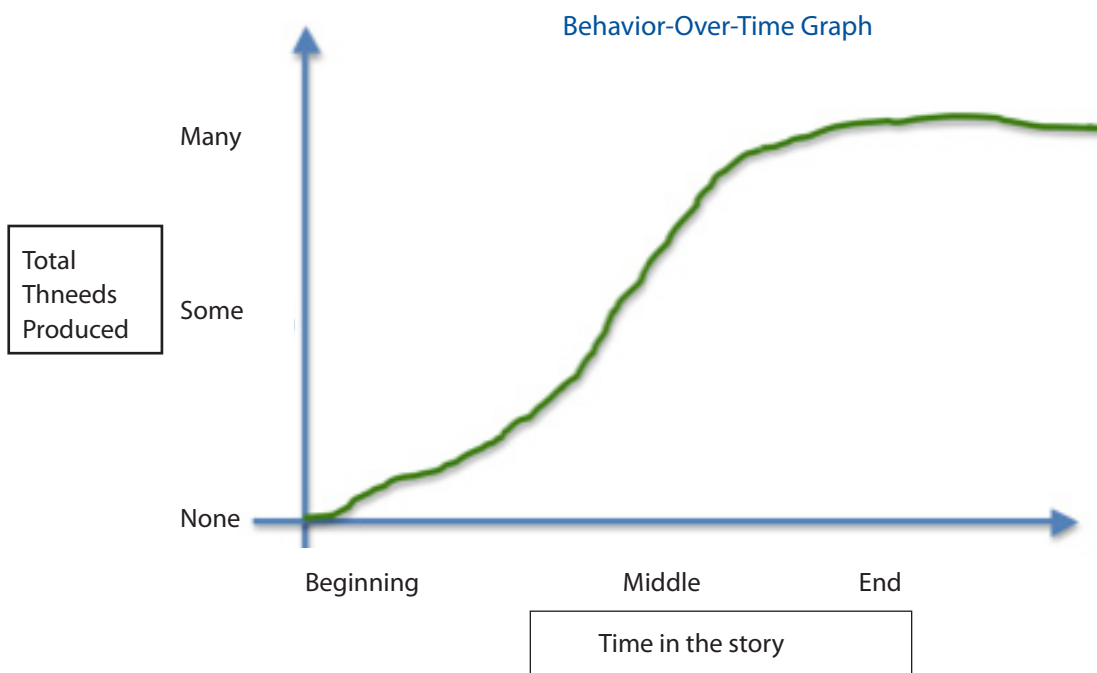
3. DESCRIBING **HOW THINGS ARE CHANGING**

• Tell students that they will graph the changing elements they have chosen in their list. The graphs they will draw are called *behavior-over-time graphs*, or *BOTGs* for short. BOTGs always follow certain rules:

   • BOTGs are always line graphs.

   • Time is measured along the horizontal x-axis.

   • The change in the variable is measured along the vertical y-axis.

   • The most important aspect of the line is its shape over time.

• Point out that Dr. Seuss doesn't provide "hard" data for variables that can be quantified, such as number of trees in the forest. When graphing, the scales for all of the story's elements will be descriptive in nature, e.g., 'many trees,' 'some trees,' 'no trees'. Most team lists will include one or more changing elements in the story that are hard to quantify, such as the Once-ler's greed or the Lorax's anger. These might be thought of as "soft" variables, but they can be graphed using a scale, such as 0 - 10, or with words ('not greedy at all,' 'sort of greedy,' 'very greedy').

• The graphs they will draw about *The Lorax* will trace the overall change, rather than precisely measured incremental differences. Students will sketch a line to represent their mental model of what happened to each element.

- Here are two sample graphs about thneeds. Remember that the graphs represent HOW that element changed over time.

Behavior-Over-Time Graph

Thneeds Produced per Month

Many

Some

None

Beginning   Middle   End

Time in the story

"Thneeds Produced per Month" starts as a low, flat line that grows quickly to a high level and eventually crashes down to zero.

Behavior-Over-Time Graph

Total Thneeds Produced

Many

Some

None

Beginning   Middle   End

Time in the story

"Total Thneeds Produced" also starts low and climbs rapidly, but then it flattens out at its peak.

Notice how a small change in language creates a big difference in meaning.

- Hand out templates and ask students to graph each of the elements chosen by the class, working collectively in their teams.

- Then instruct them to add a written description under each graph telling about the change that happened over the course of the story. Their writing should report on the direction of change rather than explain the reasons behind it.

Using the template provided at the end of the lesson plan for graphing will make all the graphs approximately equal in size. This will be important later in the activity. Be sure students title their graphs, clearly identifying the changing element.

Behavior-Over-Time Graphs

A behavior-over-time graph (BOTG) is a simple line graph that shows a pattern of change over time—it shows how something increases and decreases as time passes.

The horizontal axis on the graph always represents time. It can be in any units that fit the behavior: seconds, days, years, etc.

The vertical axis represents the variable in question, a quantity that can increase or decrease with time—an accumulation. It can be either "hard" or "soft."

For example, hard variables might be degrees Centigrade in a lab experiment, points scored in a game, dollars in the bank, fish in the sea, or miles traveled.

Soft variables could be a person's happiness or courage, a team's morale, the cleanliness of a room, or the excitement of a story. The vertical axis is also labeled in units that fit the behavior. For the hard variables, the units are straightforward: degrees, number of points, number of dollars, etc. These units must be defined first. "Cleanliness of a room" is a simple example. In discussion, everyone could envision a spotlessly clean room; they could also imagine an extremely messy room. The scale on the graph could use descriptive labels and range from "Terribly messy" to "Perfectly clean," with "Medium clean" at the midpoint. Alternatively, the scale could be numerical from 0 to 10, with zero for filthy and ten for immaculate.

Students just need to be clear about what they mean when they label their axes. Soft variables are just as valid to graph as hard variables. Indeed, often they are more interesting, and even defining the scales can initiate a good discussion.

BOTGs focus on patterns of behavior, not on particular details. They look at how something is changing.

- Is it increasing, decreasing, or staying the same?
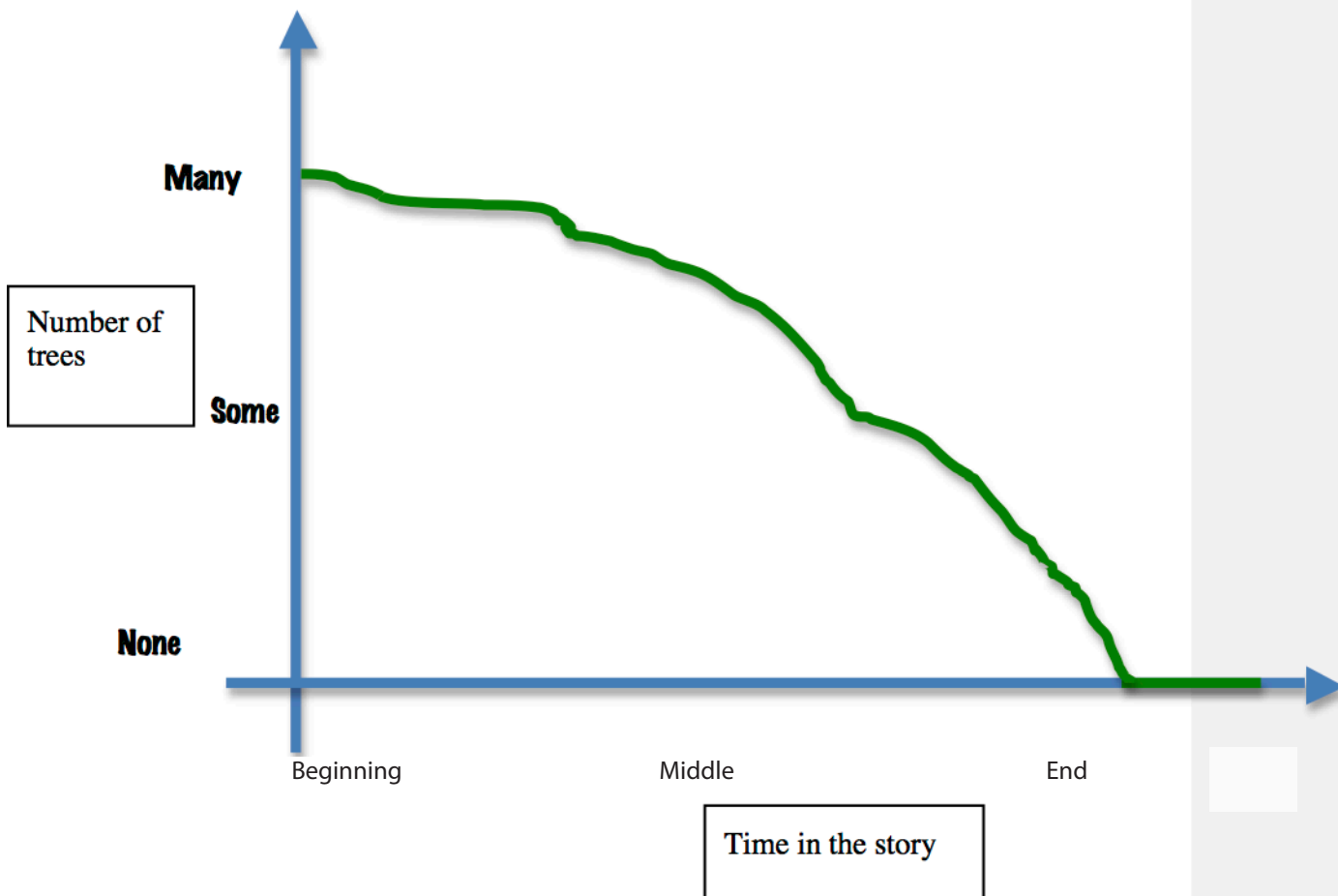- At what rate is it changing; how steep is the line?
- Does it fluctuate?

Once students can identify how something is changing, they can begin to ask why and make predictions about what will happen next.

SAMPLE GRAPH

NAME _____Student_____

GRAPH TITLE ___Truffula Trees in the Town_____

Behavior-Over-Time Graph

Many

Number of trees

Some

None

Beginning   Middle   End

Time in the story

Explanation of graph:
When the Once-ler first arrived, there were lots of trees. First he cut one down, then he called his relatives to work with him. He invented the Super-Axe-Hacker and could cut down lots of trees at once. His business grew and grew until all the trees were cut down.

The graph starts at 'many' and goes down faster and faster until it reaches 'none.' It stayed at 'none' because there were no trees left.

4. EXPLAINING **WHY THINGS ARE CHANGING**

• Ask each team of students to lay out their graphs so that they can see them all at the same time. Instruct each team to find one or more pairs of graphs in which the changing elements affected each other. For example, a graph of "thneeds produced" goes up, and a graph of "number of truffula trees" goes down. When "thneeds produced" went up, the "number of truffula trees" declined because the factory used more trees as it grew. Then, when the trees were gone, no more thneeds could be made.

• Have each team redraw the graphs of each pair they chose on a new graph template. Both lines will be on the same page, so have them use a different color for each line and, if necessary, for the units on the y-axis. The time along the x-axis should be the same scale they used in every graph.

• As before, ask students to write a brief explanations of their BOTGs, this time tracing the connection between the two variables.

SAMPLE GRAPH
Behavior-Over-Time Graph

Many

Total Thneeds Produced

Some

Number of trees

None

| Beginning | Middle | End |

Time in the story
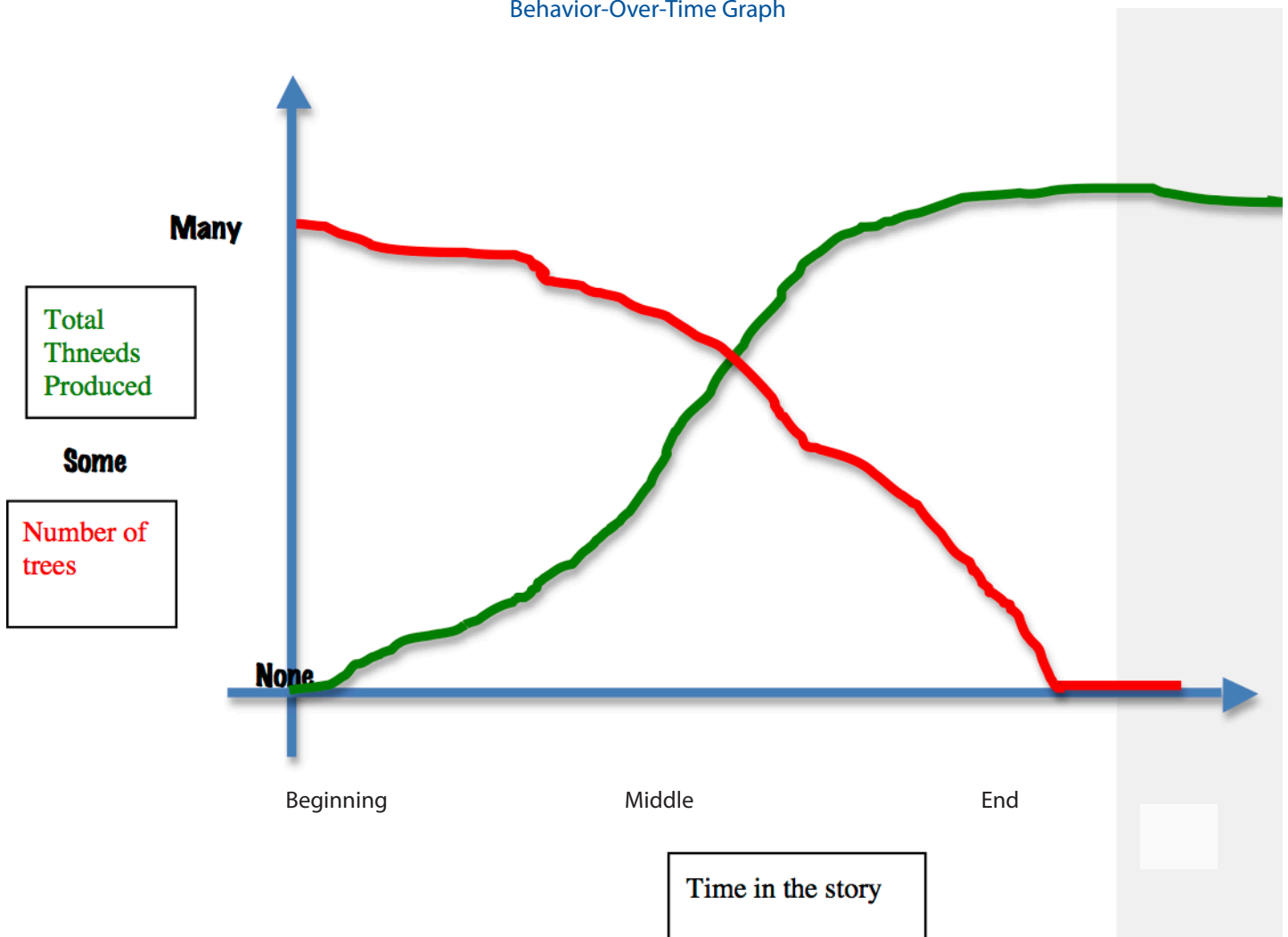
Explanation of graph:
When the Once-ler first arrived, there were lots of trees. He made one thneed from one tree, but before long he had a giant factory and was cutting down trees quickly. The number of thneeds made increased while the number of truffula trees decreased.

When the trees were all cut down, no more thneeds could be made so both lines became flat.

• Have teams share the graphs with two lines that they drew. What is the connection between the two lines? Is there a causal connection, where a change in one drives a change in the other? Students should be able to make many connections when explaining why they paired the variables they chose to put together on their two-line BOTGs.

• Post the graphs with their written explanations. Students will use these in the last step of the lesson plan.

5. NOW WHAT?

• Ask students to identify with their team the changing story elements they would like to reverse or avoid. Their job will be to propose a plan that would avoid a repeat of the tragedy of *The Lorax*.

• Referring to their two-line graphs, have them address the following questions:

   o How could we make things turn out differently?

   o Which line needs to change to accomplish your goal?

   o If we change one line, what will happen to the other?

• Students should write their conclusions and redraw graphs to illustrate how things could be managed differently in a town like the Lorax's. Give each team a large poster board or sheet of chart paper to present their plan.

• Get the whole class together to share each team's plan. Expect that students will have differing opinions about *The Lorax*, as they will about any complex issue.

6. BRINGING THE LESSON HOME

What do your students think?

• How could the tragedy of *The Lorax* have been avoided?

• What if we did use *The Lorax* as a cautionary tale warning us to change our behavior?

• Can we avoid stripping the world's resources and fouling our environment?

   Encourage students to ask questions as they complete and share their posters. Here are some guiding questions to use to encourage class conversation and discussion:

Q. Even though The Lorax is a fantasy, how is it similar to reality?

   The same changing story elements that drove *The Lorax* exist around us in the "real world." We need to become educated and aware citizens in order to avoid the same fate that befell the Lorax and the other characters in the story. The Lorax left only one word of warning—"UNLESS." The Once-ler had just one last truffula seed to contribute. What are we to do?

Q. Is it possible to develop natural resources and still protect the environment?

   Some students may suggest a moratorium on cutting trees or completely stopping the use of other natural resources. Other students will likely remind them that we need wood and other materials for providing what we consider necessities of daily life. But can they suggest ways to change? The graph of truffula trees could be turned around if new trees had been planted when the Once-ler harvested mature ones. Or laws could have been passed moderating the rate of harvesting. Students should have a stronger sense of what behaviors are conducive to a sustainable environment versus which are likely to lead to a situation like the one Dr. Seuss described.

When a BOTG tracks two variables, the amount of insight can increase dramatically. People are often taught to analyze situations using "cause and effect thinking." But situations are usually more complicated, and a deeper understanding can be reached by stretching that thinking. The "effect" almost always turns out to be a "cause" as well. And the "cause" is itself an "effect" of some element.

In the example graph on page 5, "Total Thneeds Produced" and "Number of Trees" affect each other as both cause and effect. As "Total Thneeds Produced" increased, it reduced the "Number of Trees." And, when the "Number of Trees" decreased, "Total Thneeds Produced" decreased, eventually to zero.

Q. Are business and environmental interests always competing?

Sustainability and balance require that elements in life be considered as connected, not competing. When we understand that our choices affect the future in complicated ways, that helps us plan for both the long and short term.

When the Once-ler states, "Business is business and business must grow," he represents the energy and progressive spirit that gives us so many wonderful innovations in our life. He also comes to realize the need for environmental protection when he later warns, "UNLESS someone like you cares a whole awful lot, nothing is going to get better. It's not." We need natural resources to live comfortably, but we cannot spoil our environment or we won't have the resources to use.

Q. How is it possible to affect change?

When students put two changing elements on one graph, it helps them see that causal connections are strong and can be traced. When they see a series of these BOTGs, it reinforces the idea that many elements in a story are connected. Changing one thing usually causes a lot of other changes.

But understanding and managing change is complicated. "Cause and effect" is not always predictable, and the effect is also a cause of other events. Finding the important place to change is almost never easy. Unexpected and unintended consequences happen, and time delays can postpone the desired outcome.

Stories and issues often hinge on conflicting opinions and goals. In *The Lorax*, dominance shifts from industrial production to environmental destruction. Profits, production, and ecological health are all connected. Students will see that the elements in the story change because of aspects they have in common. Wherever humans build, these conflicting elements will come into play. While there are no easy solutions, understanding how they are connected helps us understand the situation and make more informed decisions.

NAME _____

GRAPH TITLE _____

Behavior-Over-Time Graph

Beginning   Middle   End

TIME
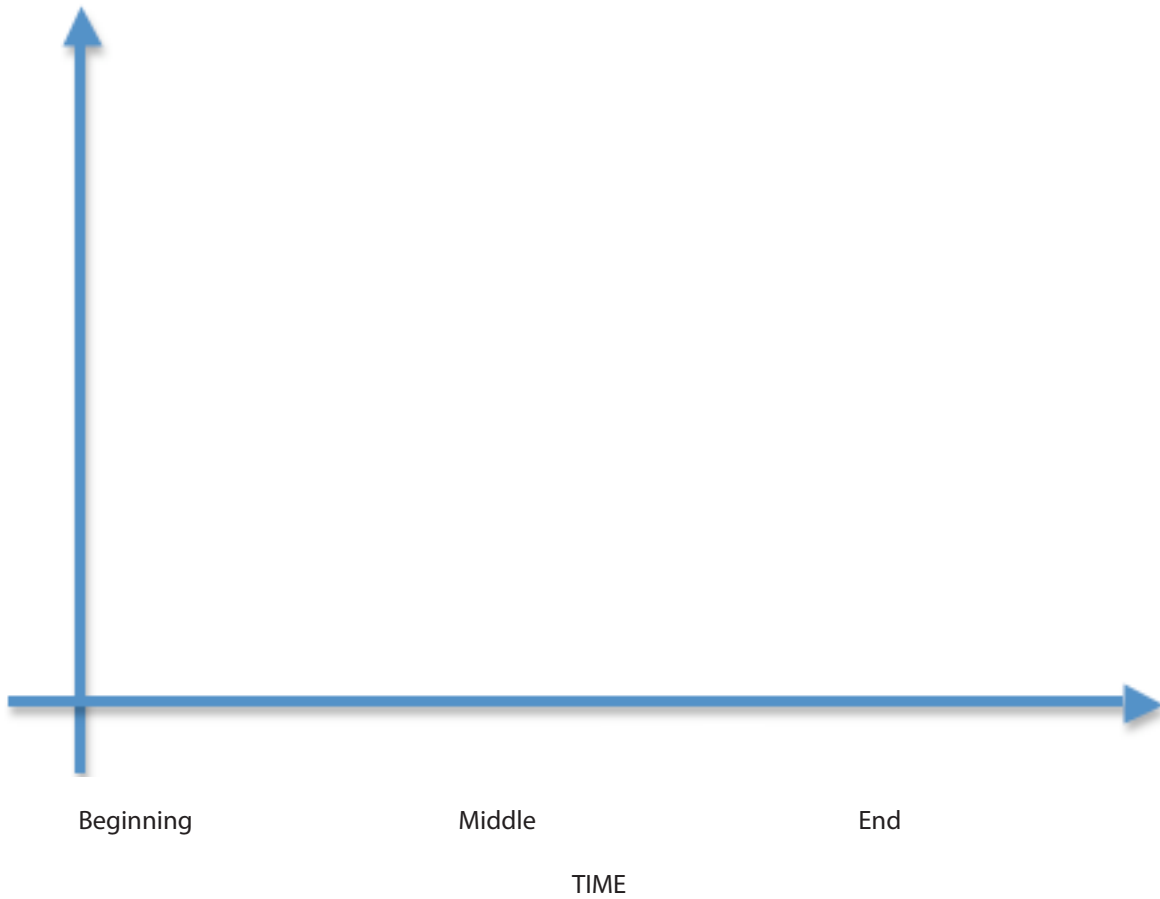
Explanation of graph

Connection to Characteristics of Complex Systems Project

Lesson Titles:
Lessons from *The Lorax*: Using Graphs to Study Change
Studying *The Lorax* with Feedback Loops

Overview:
These two lessons on Dr. Seuss's classic children's book, *The Lorax*, provide a rich opportunity to students to learn environmental stewardship and why businesses must practice sustainable use of resources.

**Related Characteristic(s) of Complex Systems:**
- Conflicts arise between short-term and long-term goals.
- Cause and effect are not closely related in time or space.

**Ideas and Examples for Connecting to the Characteristic:**
Individuals or groups may use resources to meet short-term goals at the expense of sustaining those resources over the long-term. In *The Lorax*, a business run by the Once-ler depletes the truffula trees to make products called thneeds.

Ask students questions such as, "What is the Once-ler likely to do if demand increases?" "What should the Once-ler do to ensure sustainability into the future?" "How many thneeds can be made when all the truffula trees are gone?" "What happens to the population without thneeds?"

An archetype, such as the Tragedy of the Commons, can illustrate how using a resource faster than it can regenerate leads to the loss of that resource. If the short-term goal is to harvest as much of the resource as possible, then the resource will decline (and possibly run out) in the long-term.

Figure: Example of Tragedy of the Commons
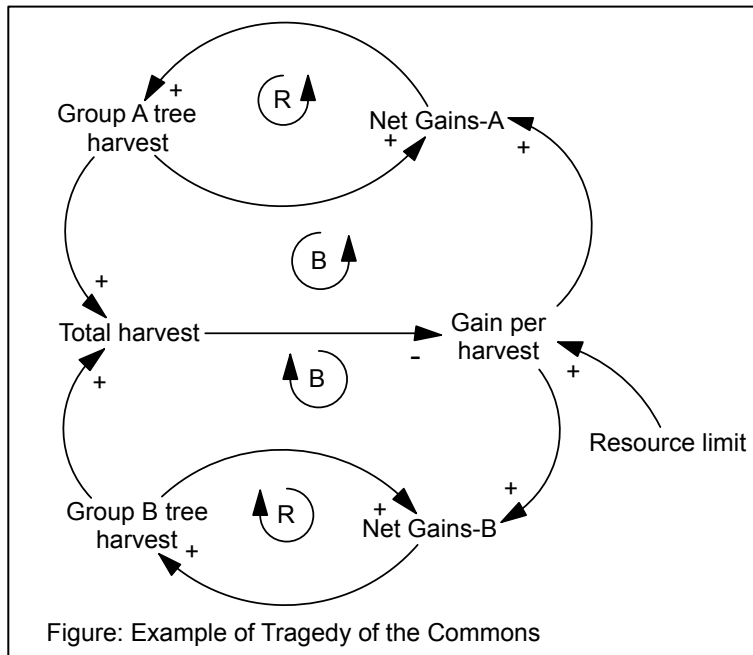
A stock/flow diagram shows how the system has long delays. Once the damage is recognized (the resource is depleted), the problem cannot be fixed immediately; regeneration of trees can take generations. When cause and effect are separated by time, it can be difficult to link the two together and see them as parts of a single system.

Figure: Stock/Flow diagram with time delays
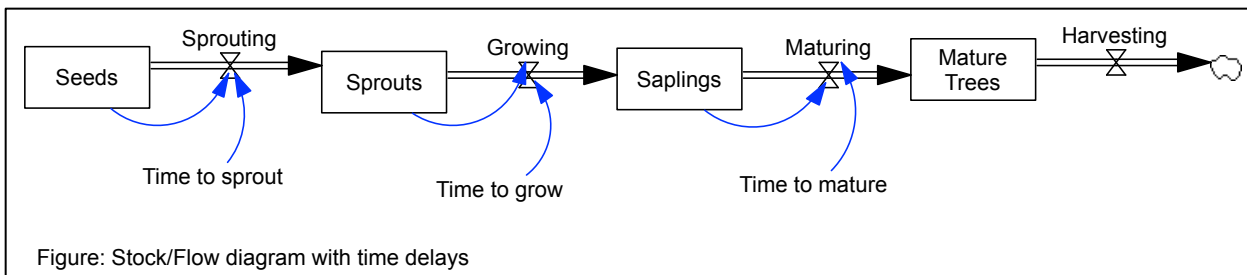
Resource(s)
Other ideas for teaching *The Lorax* in the classroom:
http://www.seussville.com/Educators/lorax_classroom/educatorlorax_plan.php

"Road Maps 4—A Guide to Learning System Dynamics"
http://clexchange.org/ftp/documents/Roadmaps/RM4/D-4504-7.pdf