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Do You Want Fries With That?
Learning about Connection Circles

by Rob Quaden and Alan Ticotsky, with Debra Lyneis

Introduction

Connection circles are thinking tools designed to help students understand complexity. Using connection circles as graphic organizers, students generate ideas about changing conditions within a system. They choose the elements they think are most important to the change and draw arrows to trace cause and effect relationships.

This lesson demonstrates how to use connection circles to understand a magazine article about the health risks associated with rising french fry consumption. Any story in which changes occur, fiction or nonfiction, can be analyzed with a connection circle.[1]

How It Works

The topics students study are complex and often difficult to understand. Seldom is an issue as simple as it appears on the surface. And, seldom will an issue present black and white choices – more often students are struggling with gray areas.

- Are the possible ecological dangers of pesticides worth the potential benefits of increased crop yields and lower disease rates?
- Is an aggressive foreign policy a deterrent to belligerent nations or will it create a more fertile atmosphere for war?
- In a novel, can we analyze the protagonist's actions from more than one viewpoint?

Connection circles help students delve into an issue and manage a number of different ideas at once.

Procedure

1. **Choose a story to read with students.** The piece may be a newspaper or magazine article, a book chapter, or a work of fiction. The more change over time that occurs in the story, the more effective the connection circle will be. For this lesson, we will examine the *Current Science* article, "Eyes on the Fries" by Rene Ebersole.[2]

2. **Create teams of four students each**. Although this structure is not necessary for the steps of the lesson, we have found that collaborative conversations improve student thinking. Ask students to read the article – independently, shared orally in groups, or aloud as a class.

3. **Simplify the article.** Although connection circles allow students to understand complex articles, vocabulary and content could still be beyond the readers' independent range. In addition, a piece of writing may include a level of detail that distracts students from the big ideas and themes. You can streamline the reading by organizing parts of the text for students.

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THIS ISSUE AT A GLANCE

Lowering the Barriers to Systems Thinking: Lessons from India

by Steve Kipp

Teachers who have used Systems Thinking have consistently reported that it is a powerful way to teach specific content and general thinking skills (see back issues of this newsletter at http://www.clexchange.org/ and the Waters Foundation Systems Thinking in Education website at http://www.watersfoundation.org/). But it has also been consistently reported that it can be difficult to help teachers recognize their own ability to use Systems Thinking. Many teachers' current mental models often block them from two key realizations: 1) Systems Thinking works; and 2) I am capable of teaching using Systems Thinking (Mons, 1997). Personal experience has shown that it is easier to demonstrate how well Systems Thinking (ST) works with students than it is to convince teachers that they themselves are capable of integrating ST into their palette of effective strategies. On a recent trip to train a school in India, I gained a few insights as to why teachers sometimes have a harder time seeing their own efficacy as ST practitioners than they do seeing the usefulness of the ST approach itself.

It came as a welcome challenge in June 2004 when Indian businessman Rajinder Raina invited me to India to train teachers at a school in a city called Pune, about 160 kilometers from Mumbai (Bombay). Rajinder had been using Systems Thinking (ST) tools to help him manage a factory using ideas from Peter Senge and the Society for Organizational Learning. He had located a school in Pune called the Rewachand Bhojwani Academy (RBA) that was open to exploring new ways to help kids think more clearly about their schoolwork and their own lives. The principal of RBA, Madhavi ("mahd-vee") Kapur, had founded RBA using ideas she gathered from a very diverse group of educational thinkers, from John Dewey to Maria Montessori to the Indian poet and social philosopher Rabindranath Tagore (see http://www.infed.org/thinkers/tagore.htm). Rajinder had come to a Waters Foundation training (where we met) in order to learn educational ST strategies and perhaps find a person to help him train the teachers at RBA. When he described the school it sounded like an environment where people could quickly adapt ST strategies. At the time I had no idea just how rapidly they would learn.

After the June training, Rajinder returned to Pune and did several short introductory sessions with a small group of teachers and students. He helped me to design a training program consisting of three days of workshops for most of the staff and two days of follow-up work with students in classrooms. (The training plan and results will be described in more detail in a subsequent CLE article.) After the 5 day training workshop/classroom sequence we did in November 2004, Rajinder has continued to provide local support, and I have provided remote support via email. There is a group of teachers at RBA who have taken off with it, designing (or adapting) and implementing their own lessons using ST strategies. So far, it seems to have been a success. Two critical reasons we were able to pull this off are that some aspects of Indian culture seem to be more naturally systemic than Western culture, and that these positive Indian cultural traits are especially emphasized at this particular school. Naturally systemic Indian cultural traits observed include 1) an open-mindedness that facilitated rich and rapid comprehension of the concept of mental models; 2) a deep and natural awareness of the interconnectedness of all things; 3) a refreshing blend of what

Lessons from India *continued on page 10*

EDITORIAL

Spring is gradually coming here in New England, after a winter with near record snowfalls. The snowdrops and crocuses are starting to come up through the snow. This year we celebrated the beginning of warmer weather by holding the annual DynamiQUE*ST* celebration on March 4. Read our report on DynamiQUE*ST* on page 13.

Next year at this time, we will be busy preparing for the biennial ST/DM conference, to be held in Marlboro, Massachusetts, June 24-26, 2006. Check out the website for the venue, appropriately called the Learning Center, at www.ahl-marlboro.com. We are pleased to have found a convenient and attractive location with very reasonable rates and a full range of ammenities. We hope to see many of you there in June 2006.

Have a productive and enjoyable spring.

Take care,
Lees Stuntz (*stuntzln@clexchange.org*)

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For example, in "Eyes on the Fries," the author explains the disadvantages of different classes of cooking oils. Although that section is clearly written and important to the thesis of the article, students may need help understanding the pros and cons of the oils. You can save time and avoid confusion with a table like the one in Figure 1.

Type of Oil	Advantages	Disadvantages
Beef tallow	Tasty	Increases LDL ("bad")cholesterol
Polyunsaturated vegetable oils	Lower LDL cholesterol	Cannot be reused
Hydrogenated polyunsaturated vegetable oils	Can be reused	Creates trans saturated fats which increase LDL cholesterol

Figure 1

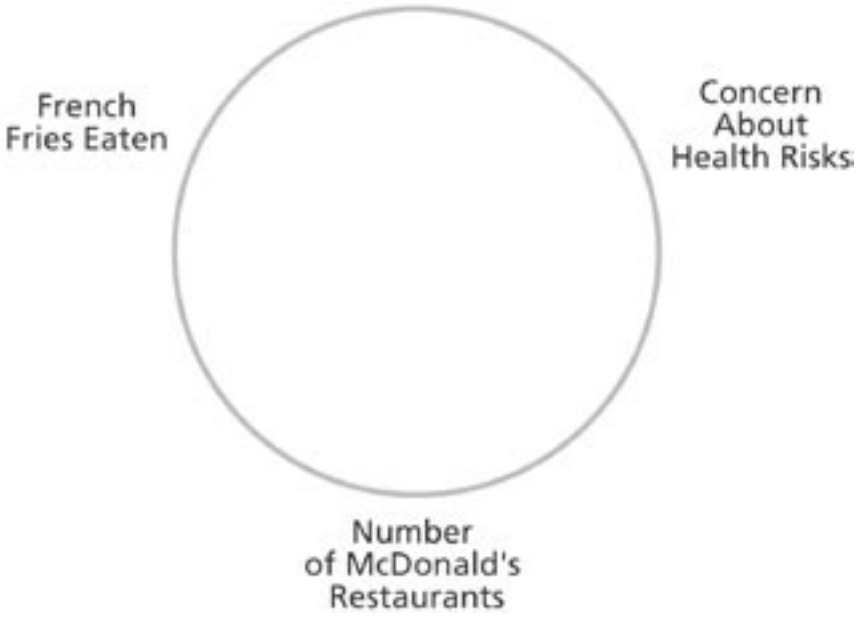
4. Give each student a copy of the Connection Circle Template and briefly explain the first step of the Connection Circle Rules, in the box in Figure 2. (The connection circle template is available in the book and online, and there is a larger copy of the rules to post in the classroom as a reference, as well.)

CONNECTION CIRCLE RULES

1. Choose elements of the story that satisfy ***all*** of these criteria:
   - They are important to the changes in the story.
   - They are nouns or noun phrases.
   - They increase or decrease in the story.
2. Write your elements around the circle. Include *no more than 5 to 10.*
3. Find elements that cause another element to increase or decrease.
   - Draw an arrow *from* the cause *to* the effect.
   - The causal connection must be direct.
4. Look for feedback loops.

Figure 2

5. As a class, brainstorm two or three elements, and ask students to write them around the outside of their connection circles. Draw a connection circle on the board or overhead to use as a class example. Below is the beginning of one connection circle for "Eyes on the Fries." **Student suggestions will vary.**



6. Allow students time to continue adding elements to their circles as they talk in teams. Encourage dialogue among student teams, but ask each student to draw an individual connection circle. Connection circles may vary within a team. The words around each circle do not have to be the same or in the same order.

As students refine their mental models, they are always free to change, add or erase elements around their connection circles. The thinking *process* is important – not just the product.

Precise language and clear thinking go hand in hand in using con-

***Fries** continued on page 4*

Do You Want Fries With That? continued from page 3

nection circles. **Precise language is important in naming elements**. Throughout the lesson, guide the discussion to insure that students are specific in their language. "French fries" figure prominently in the story, but that label is too vague. A more useful label to show the change in quantity might be "french fries sold" or "french fries eaten." Similarly, "McDonald's" is a major topic of the article, but what quantity about McDonald's might increase or decrease? Perhaps phrases such as "number of McDonald's restaurants" and "McDonald's profits" more accurately describe factors in the story that cause change to occur.

Also remind students that elements may be tangible, like "number of restaurants," or intangible and harder to quantify, like "concerns about health risks," or "desire to change the law." Often intangible elements are key to the changes in the story.

7. Start a class discussion by asking volunteers from each team to suggest elements for the sample class circle. Students may add or delete elements from their circles as they hear the ideas of others. Although the class may suggest and discuss many different elements, the final circles should have *no more than five to ten elements*. That way, students begin to clarify their language and their thinking about what is happening. The circle at right shows an example of one way to represent elements from "Eyes on the Fries."

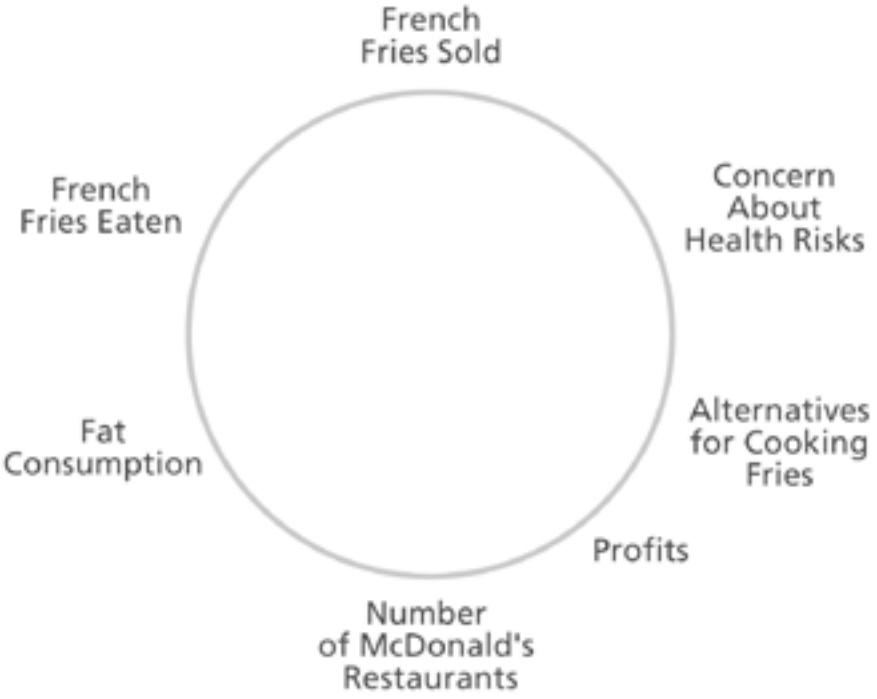
8. Ask a volunteer to describe a causal connection between two of the elements around the connection circle.

- Does an increase or decrease in one of the elements *cause* an increase or decrease in one of the others? For example, as the number of french fries eaten goes up, it *causes* the fat consumption to also go up.
- To represent this statement, draw an arrow *from* "Number of french fries eaten" *to* "Fat consumption." Be sure the arrowhead points to "Fat consumption" as shown below because that is the result or effect.

The Connection Circle as a Thinking Tool

The goal of using this tool isn't to find one specific connection circle that will correctly describe a given topic or article. Rather, the circle is designed to generate ideas and connections, and to clarify our thinking about complex ideas.

Connection circles help us brainstorm about what is changing and to trace webs of relationships within systems to understand those changes. The connection circle examples in this story demonstrate one way to interpret "Eyes on the Fries," but they are not the only way.



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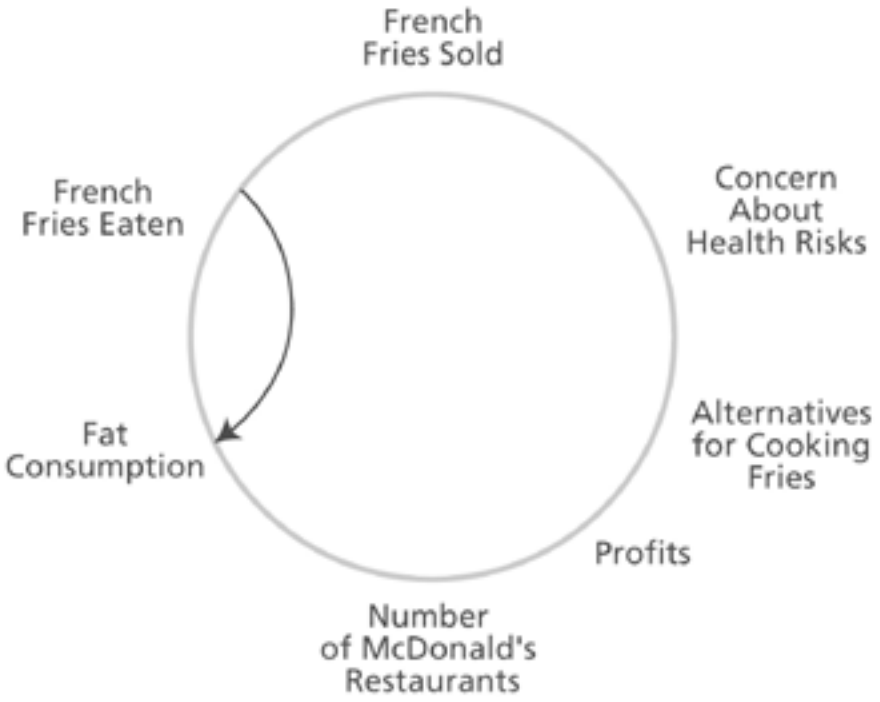
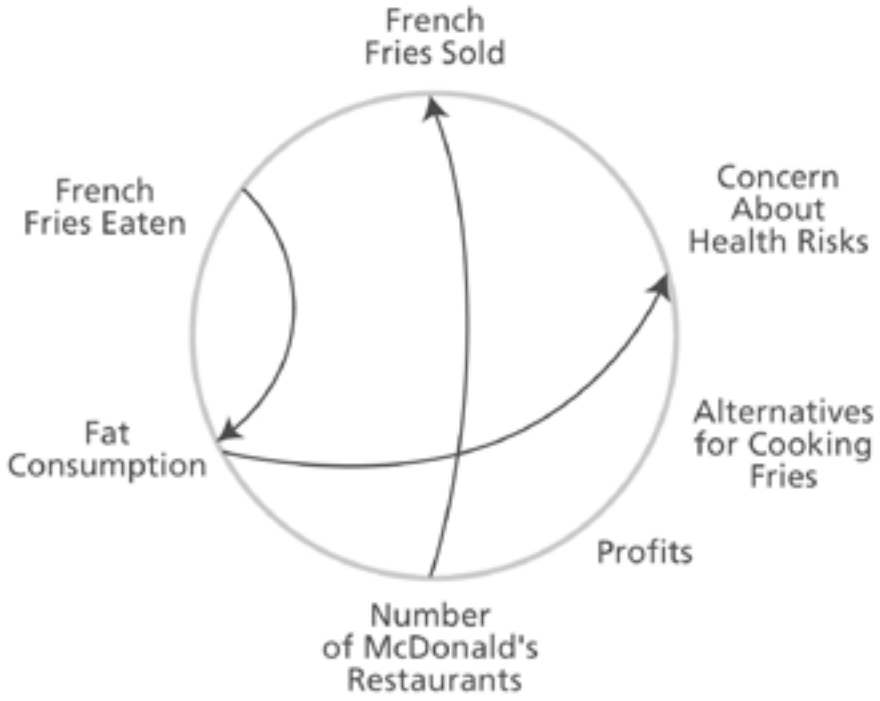


Remember, these are examples only. Student work will vary in the elements chosen and their placement around the circle. Let students generate their own circles to explore their own mental models.

Here are two other possible connections shown in the next circle, below.

- An *increase* in "Fat consumption" can cause an *increase* in "Concern about health risks."
- An *increase* in the "Number of McDonald's restaurants" will likely cause an *increase* in "French fries sold."



9. Let students work in teams to connect the elements in their connection circles.
   - Emphasize that elements are not limited to one connection, and that some elements may not have any connections.
   - Students should be prepared to state explicitly how and why the arrow connections work. For example, in our sample connection circle, an arrow leads from "Fat consumption" to "Concerns about health risks." Here's the reasoning: an *increase* in fat in a persn's diet causes an *increase* in susceptibility to higher cholesterol levels, obesity, and other conditions detrimental to well being.

On the next page is a sample of a complete connection circle with causality arrows drawn. Notice that arrows frequently cross, making the diagram somewhat confusing to follow. Connection circles begin as brainstorming tools and can get messy.

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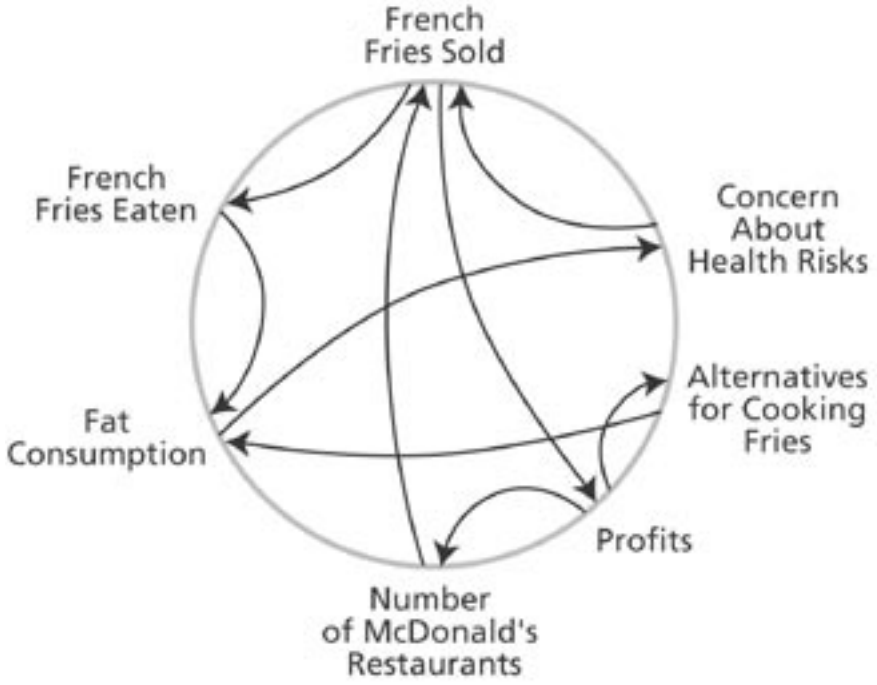
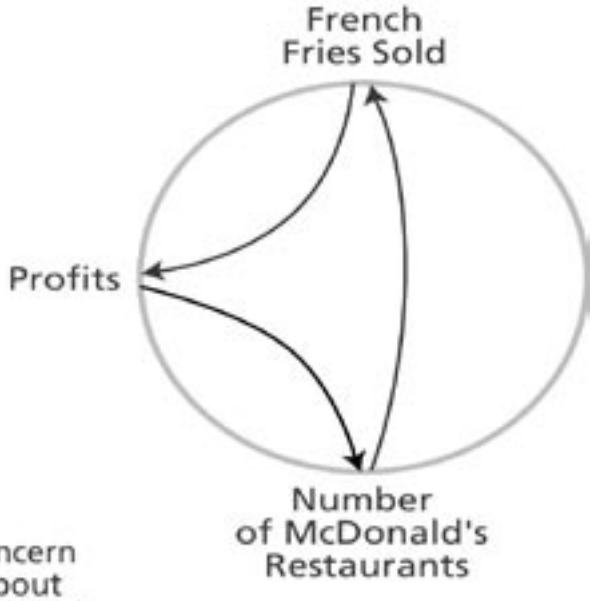


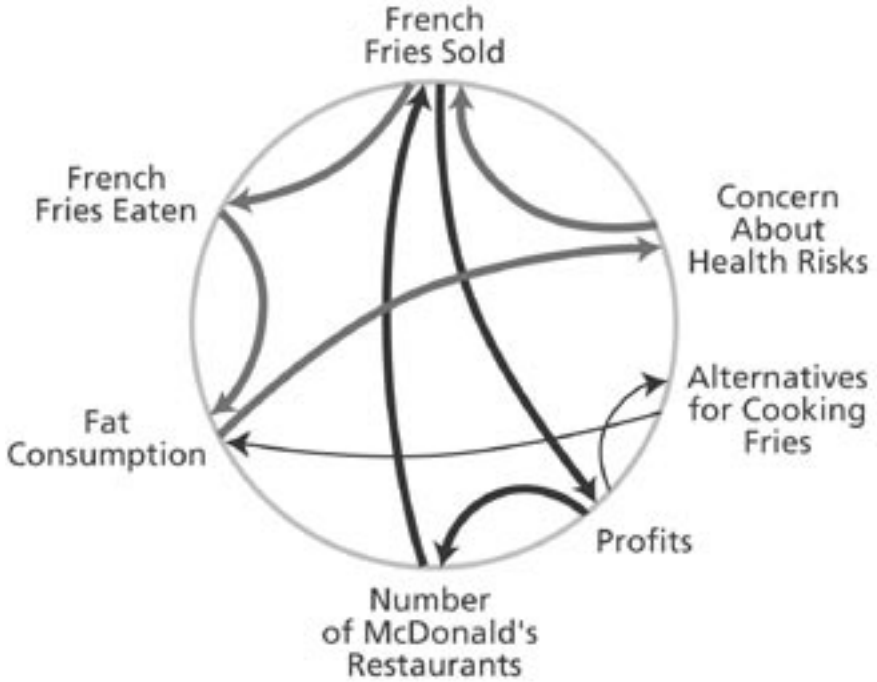
Closed pathways are called ***feedback loops***. Tracing the causal links around the loop, a change in one element comes back to effect that element again, and around again.

Ask students to draw each closed loop separately and tell the story of that loop. Below is an example from our sample connection circle.

An *increase* in the number of french fries sold causes an *increase* in profits which can be used to open *more* restaurants. An increase in restaurants causes an *increase* in french fries sold, and the loop begins again, **reinforcing** itself each time around.

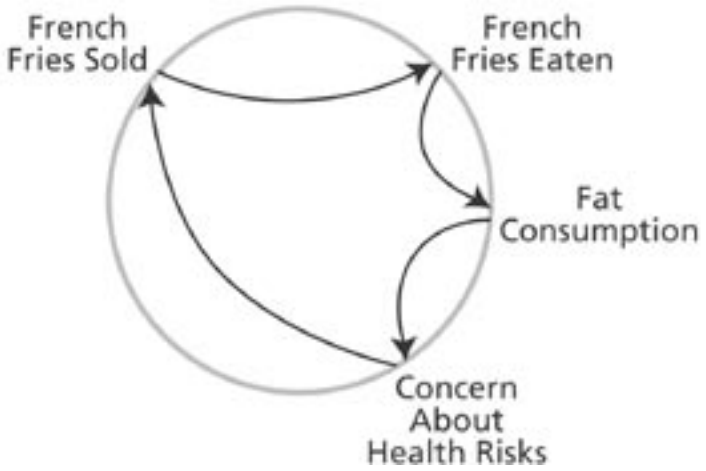


10. After students have had a few minutes to draw their arrows, ask them to search their circles for paths that make a closed loop. In other words, can they begin at one element of the circle, follow connecting arrows to other elements, and end up back at their starting point, as shown below? Students should trace each loop in a different color.



11. Distribute a blank overhead transparency sheet to each team. Assign one student in each group to draw a feedback loop on the sheet and prepare to share it with the class. Resume the class discussion with a representative of each team describing the feedback loops and sharing the group's thinking.

Another feedback loop from our sample connection circle is drawn on the next page.

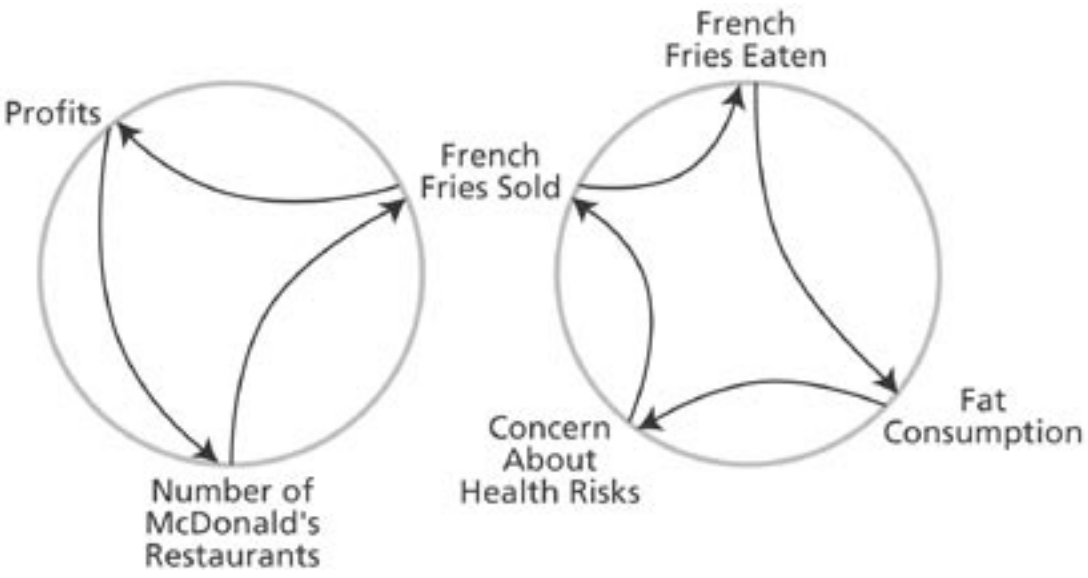


Note: Students may use circle templates to draw their closed loops at first, but soon they will be quickly drawing the loops freehand without the underlying circles, as shown at the end of the lesson.

In the loop shown above, an *increase* in fries sold causes an *increase* in fries eaten. That causes an *increase* in fat consumption, which in turn *increases* the level of concern about health. When concerns grow sufficiently, it may cause sales of fries to *decrease* as customers try to eat more healthy foods. Continuing around the loop again, fewer fries sold causes fewer eaten and consequently less fat consumed. A drop in fat consumption *decreases* people's health concerns. With fewer health concerns, french fry sales might *increase* again, sending the loop around again with changes reversing.

This feedback loop is **self-balancing**. Tracing around the loop, an initial increase in one element comes back around to cause a decrease in that element, balancing back and forth each time around the loop.

12. When the work of each team is displayed, challenge students to discover loops that share a common element. In our sample connection circle, "French fries sold" appears in at least two feedback loops. As students talk their way around the loops, they will be describing the changing behaviors of the elements in the story. The following drawing shows two intersecting feedback loops drawn together.



As students uncover feedback loops in their connection circles, they are surprised to find that many changes are interdependent and simultaneous. They are beginning to make sense of complexity.

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Mental Models

Everybody needs a way to make sense of the world. You could say that we build "mental models" of the way things work. Reading comprehension strategies are often tools to help build mental models of the author's message and the ideas presented. A connection circle works in this way by constructing pathways of causality. We reason out how and why things changed – this increased, causing a second thing to increase, which caused a third thing to decrease, and so on. Lots of elements can be changing at one time or in some sequence that isn't linear, and the connection circle can represent that.

Bringing the Lesson Home

The first time students use a connection circle a number of questions will arise about how it "works." Looking at the arrows can immediately tell some important points about the story.

Students like using connection circles to figure things out. It may appear complicated at first, but after one class demonstration, students are usually ready and able to use the tool in a wide range of applications.

? Which elements have lots of arrows going in and out? Why?

An element with lots of arrows in and out tends to be important to the story. Because of all their connections, key elements create lots of changes. Also, the circle builder chose to highlight it by examining its relationship to other parts of the story. In a connection circle about "Eyes on the Fries," 'French fries sold' might have a lot of arrows connected because it drives the issues raised in the article.

? What is the significance of an element that has no arrows pointing to it?

When an element has no arrows pointing to it, it is not being changed by any other element chosen for the circle. It may be not as important as the drawer thought at first. If it is important, another element causing it to change may need to be added to the circle.

? What is the significance of an element that has no arrows coming from it?

No arrows out means that the element doesn't influence anything else currently in the circle. You may need to add one or more new elements to your circle.

? What is the significance of an element with no arrows connected to or from it?

No arrows at all definitely means the element is not critical to the part of the story being traced, or other elements have been omitted that need to be included.

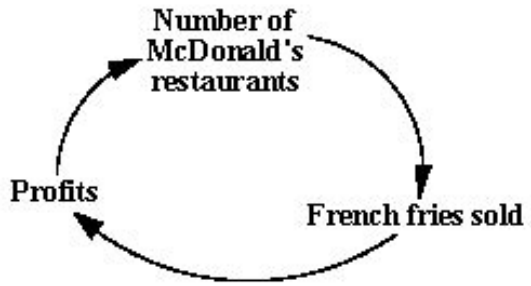
? What does it mean when a pathway of arrows leads back to your starting element?

*When an arrow pathway loops back to the original element, there is feedback in the story. Each closed loop identified is a **feedback loop**. When one element in the loop changes, the effect ripples through the whole loop, affecting the original element as well.*

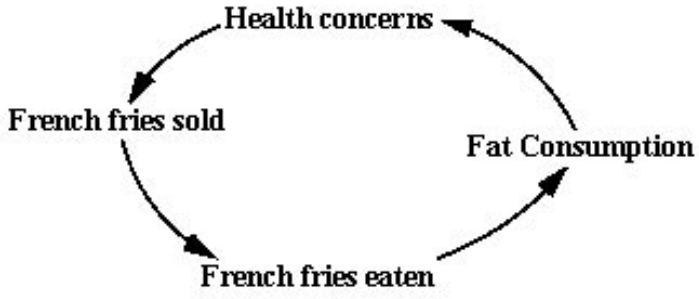
*For example, in the drawing on the next page, as the number of restaurants goes up, the amount of french fries sold also goes up. That causes profits to increase which will tend to increase the number of restaurants being opened, starting the process again. This is **a reinforcing loop,** commonly known as a vicious or virtuous cycle.*

*Another kind of feedback loop is a **balancing loop, as drawn on the next page**. In contrast to a vicious cycle, a balancing loop does not spiral in the same direction, but rather see-saws back and forth. For example, "French fries sold" increases "French fries eaten." That leads to more fat consumption and on to greater health concerns. If health concerns grow strong enough, french fry sales will be driven down. Follow the loop around a second time and notice what happens to the change among the elements.*

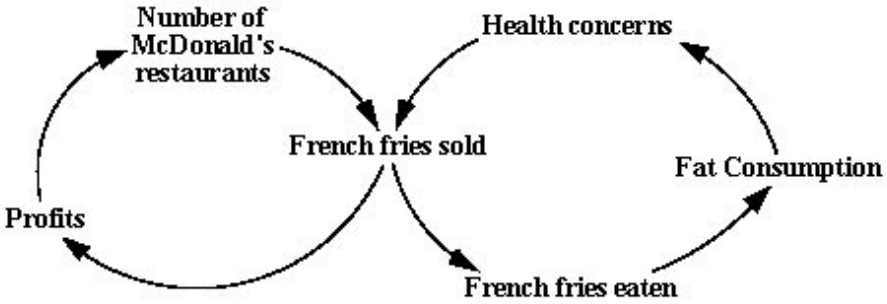
When concern grows strongly, the number of french fries sold goes down. The number of french fries eaten goes down, fat consumption is reduced, and eventually concerns should lessen. With less concern about health, people might buy more french fries again.



Feedback Loop



Reinforcing Loop



Balancing Loop

Although it is not always possible to do, identifying multiple feedback loops usually brings the reward of deeper insights. There are seldom simple answers to real world problems. Connection circles can help us understand change more clearly.

? What happens when elements from the connection circle are in more than one feedback loop?

The loops will interact in ways that make the behavior interesting, and often quite complex! As demonstrated in the previous paragraph, the sale of french fries creates profits but also creates health concerns. Profits increase the number of restaurants, and more restaurants mean more french fries are sold. But health concerns tend to reduce the number of french fries sold. The loops push in different directions, causing tension and complexity in the story.

(Endnotes)

[1] The connection circle was conceived by Julia Hendrix, then a fifth grade teacher in Carlisle, Massachusetts, when she used the circle in the Connections Game (Lesson 9 in ***The Shape of Change***) as a template for examining causal connections in a story. Alan Ticotsky and Rob Quaden have since adapted and refined the method and application of the tool to help students probe causality and feedback in a range of complex systems.

[2] "Eyes on the Fries," by Rene Ebersole, appeared in the student magazine *Current Science,* March 1, 2002. It discusses the enormous quantity of fries eaten by Americans, and the parallel increase in cardiovascular diseases, and the history of the fast food french fry. Ebersole points out that the starchier than average potatoes and the oils used for frying are critical aspects of the health hazards of french fries, and suggests positive changes, including reducing consumption. The article is reproduced, by permission, in the Fries lesson in ***The Shape of Change,*** available from The Creative Learning Exchange at www.clexchange.org, or milleras@clexchange.org, or 978-635-9797 in Acton, Massachusetts.

This article/lesson is available from the CLE in the book The Shape of Change, *and also is free to download from the CLE website. It is listed under Cross Curricular lessons as* Shape of Change: Do You Want Fries with That?

Lessons from India, *continued from page 2*

in America has unfortunately become divided and labeled as "conservative" and "liberal" values, e.g., *individual responsibility and traditional family values* mixed with a sense of *collective responsibility and a hunger for new and creative ideas*.

Mental Models

For teachers to effectively use Systems Thinking, they must be secure and open-minded enough to admit their own mental models may not be perfectly aligned with reality. This idea can feel threatening to adults, and can be especially difficult for teachers because many of us have gotten attached to the idea that we must have all the answers. In *Schools that Learn* (2000), Peter Senge writes

> We live in a world of self-generating beliefs that remain largely untested. [Those beliefs] are inferred from what we observe, plus our past experience. In any new experience, most people are drawn to take in and remember only the information that reinforces their existing mental models...Mental models [can] thus limit people's ability to change. The practice of "working with mental models" helps us see the metaphorical pane of glass we look through and helps us re-form the glass by forming new mental models that serve us better. Two types of skills are central to this practice: reflection (slowing down our thinking process to become aware of how we form our mental models) and inquiry (holding conversations where we openly share views and develop knowledge about each other's assumptions).

Several authors have written that "forming new mental models that serve us better" is a primary reason to use Systems Thinking in the first place, and personal experience has shown that there is a reinforcing relationship between *flexibility of mental models* and ability to teach using Systems Thinking. According to Senge, reflection and inquiry are two key abilities for forming new mental models. Reflection and inquiry came very naturally to the staff of RBA; after some brief initial shyness, most of them very easily adapted to the disciplined yet open-ended conversational style that characterizes many ST lessons. Using the ST tools of behavior over time graphs, causal loop diagrams, stock flow diagrams, and STELLA models, we were easily able to have productive, fact-based conversations about uncomfortable subjects that Indian tour books typically tell foreigners to avoid such as government corruption, overpopulation, poverty, and the conflict in Kashmir. It turns out that reflection is an integral part of the meditative spiritual traditions in India, and that open-ended intellectual conversation is almost a national pastime among many Indians. So fruitfully exploring and exchanging mental models came quite naturally to them, and the ST tools gave them a productive framework to guide and focus their explorations of specific topics and issues.

Natural Awareness of Interconnectedness

Detailed, useful knowledge of how interconnectedness shapes change is an important outcome of Systems Thinking; a general awareness of interconnectedness is a powerful piece of prior knowledge developing new Systems Thinkers. All of the Indians we met demonstrated an effortless, high level of awareness of the interconnectedness of all things; it is a part of their spiritual and cultural teachings from birth. This first became apparent in the almost startling, immediate connection we made with them as fellow teachers. They deal with very similar challenges of student motivation, maintaining discipline, too much to teach, and lack of planning time. But there was something more than the bond of dealing with similar challenges. It is difficult to explain but they just seemed more "with" each other and with us, less separated by individualism. One business man at a dinner joked about how it seemed that when he was in America everyone was obsessed with "S and P...S and P... S and P".... Space and privacy! Perhaps this difference is a natural outcome of the ruggedly individualistic history and wide-open-spaces mythology of the United States versus the physically crowded history of India. When I remarked on this clearly apparent greater interpersonal closeness, Rajinder replied that it was a direct outcome of the practice of Hinduism, and that a non-Hindu would have a hard time fully grasping it! Whatever the reasons for the difference, their natural instincts for connectedness seemed to accelerate the speed with which they picked up on Systems Thinking.

A Productive Blend of "Liberal" and "Conservative"

America today appears to be extremely divided along ideological lines. This perception may be more a product of deliberate manipulation by politicians and businesses (including the media) rather than an actual deep division among the people. But our current public discourse does seem extremely fragmented. Universally positive traits seem to have been co-opted by one "side" or the other: conservatives lay claim to matters of individual responsibility and family values, and liberals take credit for any sense of collective responsibility and striving for new and creative ideas.

Traditional Indian values do lean toward the so-called "conservative" side of the spectrum, with a high value placed on tradition, family ties, religion, respect for elders, and general politeness. But at least at this particular school, there was also a very "liberal" sense of intellectual energy, belief in change for the common good, and the pursuit of all types of creative expression. This exactly describes characteristics of good Systems Thinkers: disciplined and focused, yet very flexible and creative. So again,

this particular group of teachers seemed very pre-disposed to rapidly becoming Systems Thinkers.

No Utopia

Despite all of the naturally systemic traits evident in teachers and students at this and some other schools, India as a whole faces large systemic difficulties. Our contacts talked frankly of these challenges. While India has the largest middle class in the world- 300 million people- they are also very well aware that the plight of the more than 700 million Indians who range from poor to destitute (and who have the highest birth rate) can no longer be ignored if the country as a whole is to prosper. The Indian middle class has access to good private schools. But despite the efforts of a few dedicated individuals, as a whole the public school system ranges from inadequate and corrupt to simply non-existent: many Indian children still simply have no school at all, and the national literacy rate remains at about 65%. And there is sometimes a desperate sense of competition in India, perhaps born of poverty; an example of this hyper-competitiveness is the recent case of an Indian student who completely faked an American academic honor. In this current world of rapid change, cut-throat competition has been shown to be counterproductive to profitable, systemic living. And government corruption remains a challenge. However the current Prime Minister, Dr. Manmohan Singh (a PhD economist) has shown some signs of actually cracking down on corruption.

Yet despite these challenges, everywhere there was an overall positive attitude about the future of India. A striking example of this is a new graduate business school that we visited in Pune, the Sadhana Centre for Management and Leadership Development. Conceived and set up from scratch in 40 days by Professor M.S. Pillai and his grateful and financially successful former students from another business school, the Sadhana Center is dedicated to shaping the future of business by "sculpting principled and inspiring performers and business leaders towards spreading prosperity, peace, harmony and happiness around" (see http://www.scmld.org). To quote from the Sadhana brochure: "If [the poor] constitute more than 80% of India's population, who will buy your chips, Coke, cakes, and designer underwear?" This represents a dramatic departure from pure self-interested capitalism. The intelligence and enthusiasm of these 180 business students was evident even at 7:30 PM when Rajinder and I presented a 60 minute glimpse into Systems Thinking. Again, I was pleasantly surprised at the speed, breadth, and depth of their comprehension as evidenced in their questions and responses. It reminded me of the effort and excitement at Rewachand Bhojwani Academy. And it reminded me that if America is to remain competitive in the emerging markets of the global economy, we must continue to work towards the goal of increasing the level of Systems Thinking in our own educational systems.

References

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2006 Systems Thinking and Dynamic Modeling Conference
The Learning Center at Marlboro
June 24 - June 26, 2006

It is not too soon to begin to plan for the 2006 STDM Conference. In 2006, the conference will be held at the Learning Center at Marlboro, Massachusetts. The Learning Center offers deluxe single occupancy guestrooms, an on-site library and computer center, a full-service business center, three meals a day, plus continuous beverage and snack service, and on-premises recreational facilities, including billiards, cards, and arcade games, in addition to the indoor pool and whirlpool, state-of-the-art Nautilus Fitness Center, and outdoor basketball and jogging course. The Learning Center is easily accesssible from Boston, and offers a shuttle service priced as low as $38 one way from Boston's Logan airport.

Watch the newsletter and website for further information and a call for papers in the future.

Diana Fisher's new book available from isee systems

Diana Fisher's ***Modeling Dynamic Systems: Lessons for a First Course*** (2004) provides a set of tools that enable educators at the secondary and college levels to teach a one-semester or one-year course in System Dynamics. Developed for beginning modelers, the lessons contained in this book can be used for a core curriculum or for independent study. Course materials meet National Science Education Standards (NSES) and National Council of Teachers of Mathematics (NCTM) standards and are out-of-the-box ready for use in your classroom today.

Why Teach Systems Modeling

Modeling has been used for years to help scientists and policy makers find solutions to complex problems. It is one of the most valuable and useful applications of mathematics. However, most models are difficult to understand and require significant mathematics to interpret.

Systems Thinking software like STELLA offers an opportunity to create visual models that actively engage students to study a wide variety of problems. Creating a model allows for "real-time" analysis and a more stimulating environment to glean insights. *Modeling Dynamic Systems: Lessons for a First Course* provides an easy-to-use set of teaching materials that are paced gently enough for students to learn to create dynamic models using STELLA software.

About the Author

Diana Fisher received her bachelor's degree in mathematics from the University of Texas, El Paso and her master's degree in mathematics from the University of Montana. A teacher since 1969, she is currently teaching Advanced Algebra, AP Calculus, C++ and Java Programming, and Modeling Dynamic Systems at Wilson High School in Portland, Oregon.

Diana was one of the early pioneers of system dynamics in K-12 education, and has been an ongoing supporter of the Creative Learning Exchange and its mission. A number of the CLE's articles and curricula were written and developed by Diana for use in her classrooms. She has presented at each of the six System Thinking and Dynamic Modeling conferences sponsored by the CLE, as well as provided insight and leadership at CLE planning sessions.

She has presented at the International System Dynamics Conference since 1994, presenting plenary papers in 1998, 2000 and 2003. In 1995 she received the Presidential Award for Excellence in Mathematics Teaching for the state of Oregon. In 1996 she was first-place co-winner of the Intel Innovations in Teaching Award for the state of Oregon. She was the director of the National Science Foundation (NSF) CC-STADUS (Cross-Curricular Systems Thinking and Dynamics Using STELLA) grant (1993-1996) and also co-directed the NSF CC-SUSTAIN (Cross-Curricular Systems Using STELLA: Training and In-service) grant (1997-2000). She has worked in industry as a software engineer and co-authored (in the 1980s) three programming textbooks published by Computer Science Press.

Diana has also written.***Lessons in Mathematics: A Dynamic Approach***, published by isee systems (2001)

Mathematics is tough-sledding for many. The difficulty is that most students fail to appreciate that mathematics is "just a language." It happens to be a very rigorous language, one with very little ambiguity associated with its symbols. It's also a very abstract one. And it's primarily the latter attribute, abstractness, which causes many students to falter. ***Lessons in Mathematics: A Dynamic Approach*** by Diana Fisher, author of the new ***Modeling Dynamic Systems: Lessons for a First Course***, is going to help a lot of these students! Diana's book offers loads of problems that students will find both interesting and fun. She then makes use of the STELLA software's icon-based, non-abstract language to structure these problems in ways that students can easily visualize. Students then can make use of the software's simulation capabilities to explore solutions to the problems. Diana's years of teaching have helped to ensure that her lessons are right-out-of-the-box-ready for you to use in your classroom today.

*A Special Note for Teachers in the Sciences

Since the initial publication of this book, many have remarked that the lessons can add great value in science teaching. It turns out that many of the lessons provide powerful vehicles for explaining basic science concepts. Other lessons provide real-world case studies that are highly applicable to the more mathematically rigorous classes in the sciences. So even if you're not a teacher of mathematics, these lessons can be useful to you. If you're a science teacher, we encourage you to peruse the lessons. As you do, you'll quickly see how they might be adapted to your curriculum.

From a content perspective, you'll find that the majority of the lessons are drawn from topics covered in the sciences. The motion lessons found throughout the book, for example, can be used to introduce, reinforce, or supplement concepts taught in the physical science and/or physics curriculum. Similarly, the population dynamics lessons found in Chapters 3 and 4 can be used in the context of many classes in the life sciences. Lessons such as "Contagious Diseases" (Chapter 7) and "Lead in the Body" (Chapter 7) can form the basis for student work in a variety of classes.

To order Diana Fisher's books, go to http://www.iseesystems.com/store/ModelingBook/default.aspx
http://www.iseesystems.com/store/college_university/MathBook.aspx

DynamiQUE*ST* 2005

On March 4th this year, we held our sixth annual DynamiQUE*ST* celebration. Students made presentations to coaches, played systems games and worked together in groups using systems tools and insights under the tutelage of coaches on a problem. It was fun!

As in past years, there was a wonderful turnout of system dynamicists to help coach the students. The support for K-12 from the professional system dynamics community is never more evident than at this event. With a 1 to 3 ratio of coaches to students (2 to 3 if you add in the teacher-coaches) each student gets personal attention and input in a non-competitive environment.

The Coaches this year included Michael Radzicki, Jim Lyneis, Elise Weaver and Oleg Pavlov from WPI, John Sterman from MIT, George Richardson from SUNY Albany with two of his graduate students, Patricia Quinn and Hyunjung Kim, David Packer, Richard Karash and Steve Peterson. Steve Peterson ably ran the afternoon group problem discussion session. One of the highlights of the day for the students and the teachers was having the father of system dynamics, Jay Forrester, join DynamiQUE*ST* for the morning presentations. We are extremely grateful to these world renowned system dynamisists for taking time from their busy lives to give us the benefit of their valuable assistance.

This year, as for the past four years, the Social Science and Policy Department of WPI has generously allowed DynamiQUE*ST* to use space at Worcester Polytechnic Institute in their lovely new Campus Center. WPI has a thriving undergraduate and graduate program in System Dynamics. The event was further enhanced for the participants by generous gifts from both Pegasus Communications and isee systems.

The 17 presentations were excellent and many showed understanding of complex, real world problems. See the list of presentations and presenters below:

STUDENT PRESENTATIONS

1. **Galen Yanofsky** (Grade 9) **and Ian Hollyer** (Grade 8) Vermont Commons School
Modeling and Managing Your Personal Finances
An Introduction to Financial Survival Skills – Part 1

2. **Nicholas Roby** (Grade 10) **and Ti Burnham** (Grade 9) Vermont Commons School
Modeling and Managing Your Personal Finances
An Introduction to Financial Survival Skills – Part 2

3. **Andy Howe** (Grade 12**), Matt Pifer** (Grade 10)**, and Michael Kidder** (Grade 10) Vermont Commons School
Teen Alcohol Use and Dependency
A System Dynamics Simulation

4. **Chrissy Devlin, Will Nocka, Samantha Wormser, and Jeff Yates** (Grade 6) Harvard Public Schools
Balancing Feedback
A simple device to illustrate balancing feedback and apply it to weather systems

5. **Adam Katcher and Jeff Lee** (Grade 9) Harvard Public Schools
Epidemics
The dynamics of the spread of an epidemic

6. **Chris Morgan** (Grade 11) Chelmsford High School
Student-Teacher Relationships
Students and teachers interact everyday. The dynamics of this relationship significantly influences student performance, which in turn affects their confidence.

7. **Letty Jacquez** (Grade 9) Lowell High School
Student Success in School

8. **Ben Knight** (Grade 6) Murdoch Middle School
Sugar Act Editorial
The Sugar Act was an important factor leading up to the American Revolution. This project reveals the impact of the Sugar Act from the colonial point of view.

9. **Morgan Wang and Lindsey Wilson** (Grade 6) Murdoch Middle School
How Do Companies Become Successful?
This project analyzes the structure of a successful engineering design company, IDEO. Students identify the behaviors, structures, and mental models of the company.

10. **Ian Crowe** (Grade 7) Murdoch Middle School
Presidential Elections
What makes the popularity of a candidate rise and fall? This work examines specific events that occurred in our last Presidential election and how that affected the popularity of the two candidates.

11. **Emma Beauchamp** (Grade 6) Murdoch Middle School
Voter Apathy Editorial
Voter apathy is a common problem stemming from a wide variety of causes. This work explores some of those reasons, including the Electoral College.

12. **Mason Glidden** (Grade 7) Murdoch Middle School
Euthanasia
Who decides when a patient has the right to die? Is it ever acceptable to kill a living person? There are many factors to consider about this topic which has no simple answers.

13. **Erica Hughes** (Grade 7) Murdoch Middle School
Global Warming
This project explores some of the connections which could lead to increased atmospheric temperatures. The feedback which exists among those factors makes this issue quite dynamic.

DynamiQUEST *continued on page14*

Newsletter Subscription Information

The Creative Learning Exchange newsletter is available in three different formats:

- On the web site at www.clexchange.org
- As an attachment to an E-mail
- In paper format via US mail ($15.00 outside the USA)

Since we vastly prefer electronic distribution to paper because it is so much less expensive, please E-mail us at any time when you would like to have an electronic subscription.

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DynamiQUE*ST* 2005 continued from page 13

14. **Adam Oriola, Alex Dinardo, and Sam Isaacs** (Grade 3) Carlisle Public School
Using Systems Tools to Understand Current Events
Students in grade three demonstrate how using diagrams helps them discover connections among parts of a system. By tracing causality, they can better understand current events and other issues important to them. What are the effects of the National Hockey League season-long cancellation? How does a snowstorm affect people's lives?

15. **Jake Dockterman, Shiobhan Galligan (**Grade 8) Carlisle Public School
Saving for College
A simple simulation to understand saving money for college

16. **Sam Dweck, Keinan Marks, Nathan Hsieh (Grade 8)** Carlisle Public School
Borrowing Money
A simple simulation to understand the effects of borrowing money

17. **Meg Parson, Ali Forelli, and Maxwell Droznin** (Grade 5) Carlisle Public School
The Mammoth Game - Played by Dice and the Computer
In Carlisle, students play a simulation game tracking a herd of mammoths. Mammoths are represented by dice, and the numbers rolled determine the fate of each creature. Fifth graders create a STELLA model of the game as well. These students compare the outcomes of dice games to the computer model.

INTERESTED IN INVESTING?

If you would like to invest in our effort here at *The Creative Learning Exchange*, your contribution would be appreciated. You may donate any amount you wish; perhaps $50.00 is a reasonable amount for a year. All contributions are tax-deductible.

Enclosed is _____ to *The Creative Learning Exchange* to help invest in the future of K-12 systems education.

Name _____

Address_____

_____

e-mail _____

Thank you!

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The Creative Learning Exchange is a trust devoted to encouraging exchanges to help people to learn through discovery. It is a non-profit educational institution and all contributions to it are tax deductible.