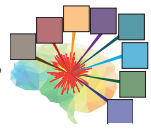
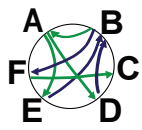
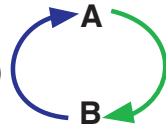
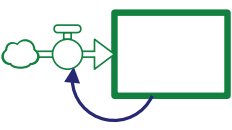
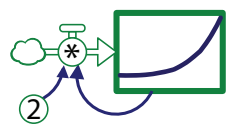
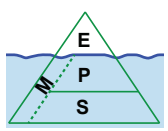
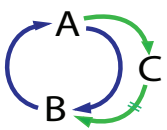
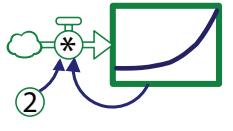


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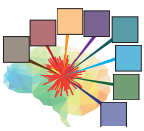
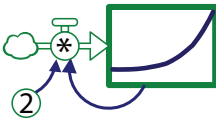
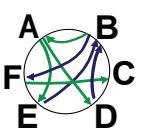
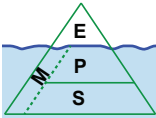
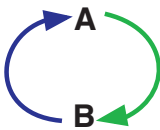
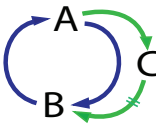
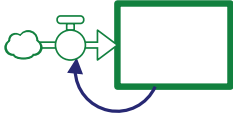
Systems Principles

When struggling to understand complex problems, sometimes it can lead to a feeling of déjà vu, a sense that we've been here before. Chances are a systems principle is at work. Systems principles are key ideas that repeat across time and within multiple contexts. This list is by no means comprehensive but provides a starting point for considering systems principles at play within a problem or issue of concern.

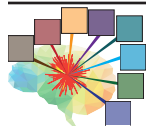
Everything is connected – there is no ‘away.’
Everyone uses mental models to make decisions.
Nothing grows forever – systems tend toward equilibrium.
Systems are usually resilient, resisting change but may still be pushed out of equilibrium.
Feedback is embedded in all actions.
Cause and effect are often not closely related in time or space.
There are seldom simple solutions.
Solutions often become problems.
Actions may be ineffective due to low leverage policies or incorrect application of high leverage ones.
What appears to be good in the short term is often bad in the long term, and vice versa.
Almost nothing is exogenous – causes of problems are within systems (endogenous).
Systems and problems within them may display parallel structures even though the contexts are unlike. (Generic structures)

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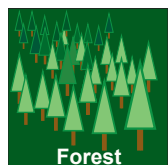
A Summary of Systems Tools

 Barry Richmond's Systems Thinking Skills Key question: How might looking at a system with different lenses help increase understanding and improve desired outcomes? Use: This set of thinking skills provides a framework for looking at any situation, whether current, theoretical, or historical. Practice the skills one at a time or in concert with one another.	 System Dynamics Models Key question: How can we mathematically define interdependent elements within a system? Use: Models help illustrate how systems really operate, showing results of their internal interconnections over time.
 Behavior over time graphs (BOTGs) Key question: What variables are changing over time? Use: BOTGs are usually a good starting point. Find data where possible and be clear when graphs represent mental models versus research findings.	 Simulations Key question: How can we test assumptions and try out “what if ...” strategies? Use: Simulations help compress time and space, so rather than having to wait a hundred years to see a particular result, a simulator can reveal that result quickly and in a contained space, either real or virtual.
 Connection Circles (CCs) Key question: What elements in a system are affecting change in other elements directly? Use: CCs are used for identifying important elements in a system and how they affect each other. Tracing causal connections can help find feedback loops.	 Iceberg Visual Key question: Looking beyond easily seen events, what lies under the surface, often unseen? Use: The iceberg provides a frame for looking beyond events to exploring a system more deeply - looking for trends, structures and mental models within. Because complex systems problems resist change, seeing a system through the lens of an iceberg can help reveal what's generating behaviors seen.
 Causal Loop Diagrams (CLDs) Key question: Where are feedback loops in the system? Use: Complex systems usually have “competing loops” – try to find reinforcing loops and balancing loops that may be in conflict.	 Archetypes and other Generic Models Key question: Can we identify a generic structure, a pattern or behavior that occurs in a variety of situations? Use: Archetypes (and other generic models) can help in the transfer of knowledge about a specific subject to other situations. Viewing behavior in a broader interdisciplinary context can reveal repeating patterns and increase understanding of potential outcomes that may be counterproductive to one's goals.
 Stock/Flow Diagrams (S/Fs) Key questions: What is accumulating or diminishing in the system? What are the rates of change? Use: Stocks are changed only by flows and their units must be the same. Stock/flow diagrams show how things actually work.	

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Barry Richmond's Systems Thinking Skills



Forest Thinking – As if viewing the system from 10,000 meters, seeing a big picture rather than focusing on details



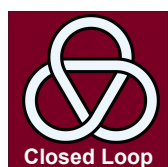
Dynamic Thinking – Recognizing patterns rather than events, realizing that continuous processes rather than discrete events create the conditions in the real world – understanding that you can always quantify, though you can't always measure



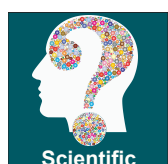
System as Cause Thinking – Placing responsibility for a behavior on internal actors, self-generating rather than external forces



Operational Thinking – Understanding how things really work, e.g., maintaining consistent units of measure, and expecting that factors don't always cause proportional effect



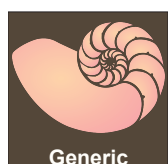
Closed-Loop Thinking – Tracing ongoing interdependent processes rather than one-way causal chains



Scientific Thinking – Testing hypotheses, applying rigorous simulation and quantification



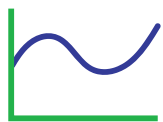
Empathic Thinking – Giving and receiving feedback, expanding personal boundaries, avoid taking a single rigid position, and appreciating a spectrum of opinions



Generic Thinking – Recognizing generic structures rather than specific events

Adapted from Tracing Connections by Creative Learning Exchange, 2021

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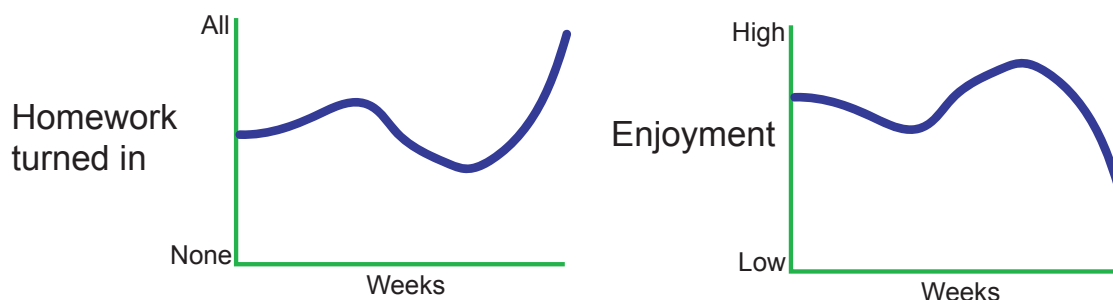
Introduction to Behavior Over Time Graphs (BOTGs)

Behavior over time graphs (BOTGs) are line graphs with time along the x-axis (horizontal) and the scale for one or more variables along the y-axis (vertical).

Emphasize the overall shape of the change rather than the exact position of the data points.

1. Hard versus soft variables - It's the shape that matters.

BOTGs are designed to represent our thinking. Some graphs display quantifiable or 'hard' variables. For example, scores on quizzes or number of homework assignments turned in. Other BOTGs represent 'soft' variables, such as confidence, satisfaction, or enjoyment. All BOTG graphs allow our 'mental models' to take a visual form so we can share them, or analyze them ourselves. Almost all BOTGs are more insightful for their general shape and trend rather than the actual data points. Are things moving in the right direction?

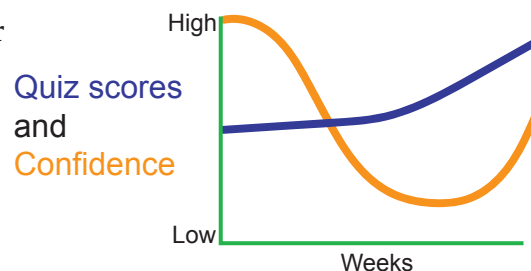


2. Two variables can be better than one.

Adding a second variable on the same graph often increases the learning by an order of magnitude.

For example, consider a student's performance graph that shows a fairly flat line for quiz scores over the first few weeks of school. Then the line rises, representing steady linear increase since November 1st. Add a second variable, like confidence, to the same graph pad, keeping in mind that the y-axis scale may have to be different for the second line.

Two or more lines on one graph can help when considering whether those variables are causal, correlated, or coincidental.



3. Questions raised by BOTGs

Reflect on the implications of the BOTGs using this simple structure:

- What is changing? Identify the variable(s) being graphed and the story it tells.
- How is it changing? Describe the trend, slope, or trajectory.
- Why is it changing? Think about the causes and structures driving the behavior shown on the graph.
- So what and now what? Evaluate the significance and consider what to do based on the information and insight gained.

See more about [using BOTGS: www.clexchange.org/gettingstarted/botg.aspx](http://www.clexchange.org/gettingstarted/botg.aspx)

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Behavior-over-time Graphs

A blank coordinate plane with x and y axes. The y-axis is labeled "y-axis" at the top and "What:" on the left. The x-axis is labeled "x-axis" at the right and "Time in _____" at the bottom. There are tick marks on both axes.

y-axis

Title: _____

What:

x-axis

Time in _____

A blank graph template for plotting a function. The vertical axis is labeled "y-axis" and the horizontal axis is labeled "x-axis". The origin is labeled "What:". The horizontal axis is also labeled "Time in _____".

y-axis

Title: _____

What:

x-axis

Time in _____

A blank graph template for plotting a function. The vertical axis is labeled "y-axis" and the horizontal axis is labeled "x-axis". The origin is labeled "What:". The horizontal axis is also labeled "Time in _____".

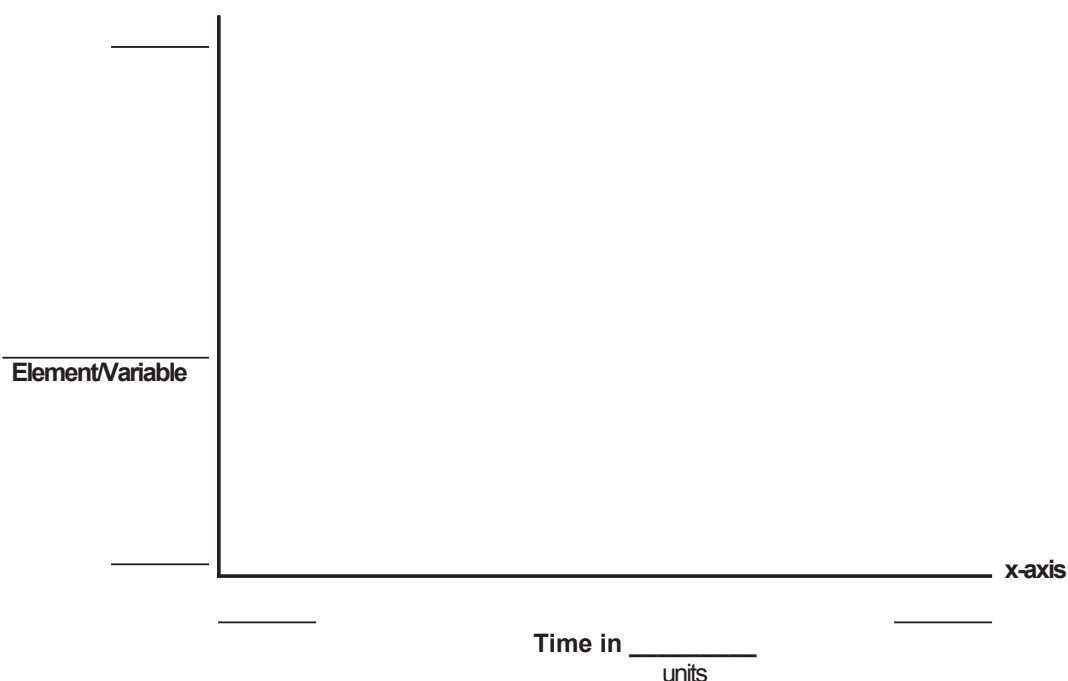


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Handout: Behavior Over Time

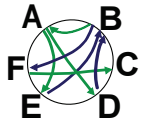
Create your graph and then answer the questions.

Title: _____



What is changing? Identify the variable(s) on the graph. Explain how the data was measured and other details that are important.	
How is it changing? Describe the rate of change shown by the shape of the graph.	
Why is it changing? Tell why you think (based on your research) the variables behaved as they did.	
So what and now what? What is the significance of the graph? Decide what policies or decisions these data might require.	

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Introduction to Connection Circles (CCs)

A connection circle is a visual tool that shows the relationships between variables in a story or complex situation. When using a connection circle consider:

What are the key factors or variables in this story?

What are the cause and effect relationships between the variables?

Instructions:

1. Use a template or draw a circle on a piece of paper.
2. Choose elements from the story or situation that meet these criteria:
 - They are important to the changes in the story.
 - They are nouns or noun phrases.
 - They increase or decrease in the story.
3. Write your elements around the circle. (Select no more than 5–10)
4. Look for causality. Find elements that cause another element to increase or decrease.
 - Draw an arrow through the circle from the cause to the effect.
 - The causal connection must be direct.
 - Label the arrowhead with a “+” or a “-”

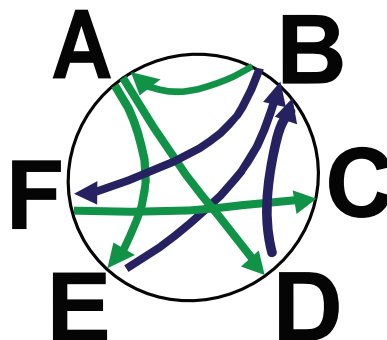
A “+” (plus sign) indicates that a change in the first factor becoming greater or less causes the second element to change in the same direction.

A “-” (minus sign) indicates that a change in the first element causes the second element to change in the opposite direction.

You can use different colored pencils to indicate “+” vs. “-”.

5. Find all possible causal connections. Some links may be based on actual data, and some may be simply a hypothesis. Try to draw at least one causal arrow into and out of each element.

In connection circles, you can trace closed loops of cause and effect, also called feedback loops or causal loop diagrams.

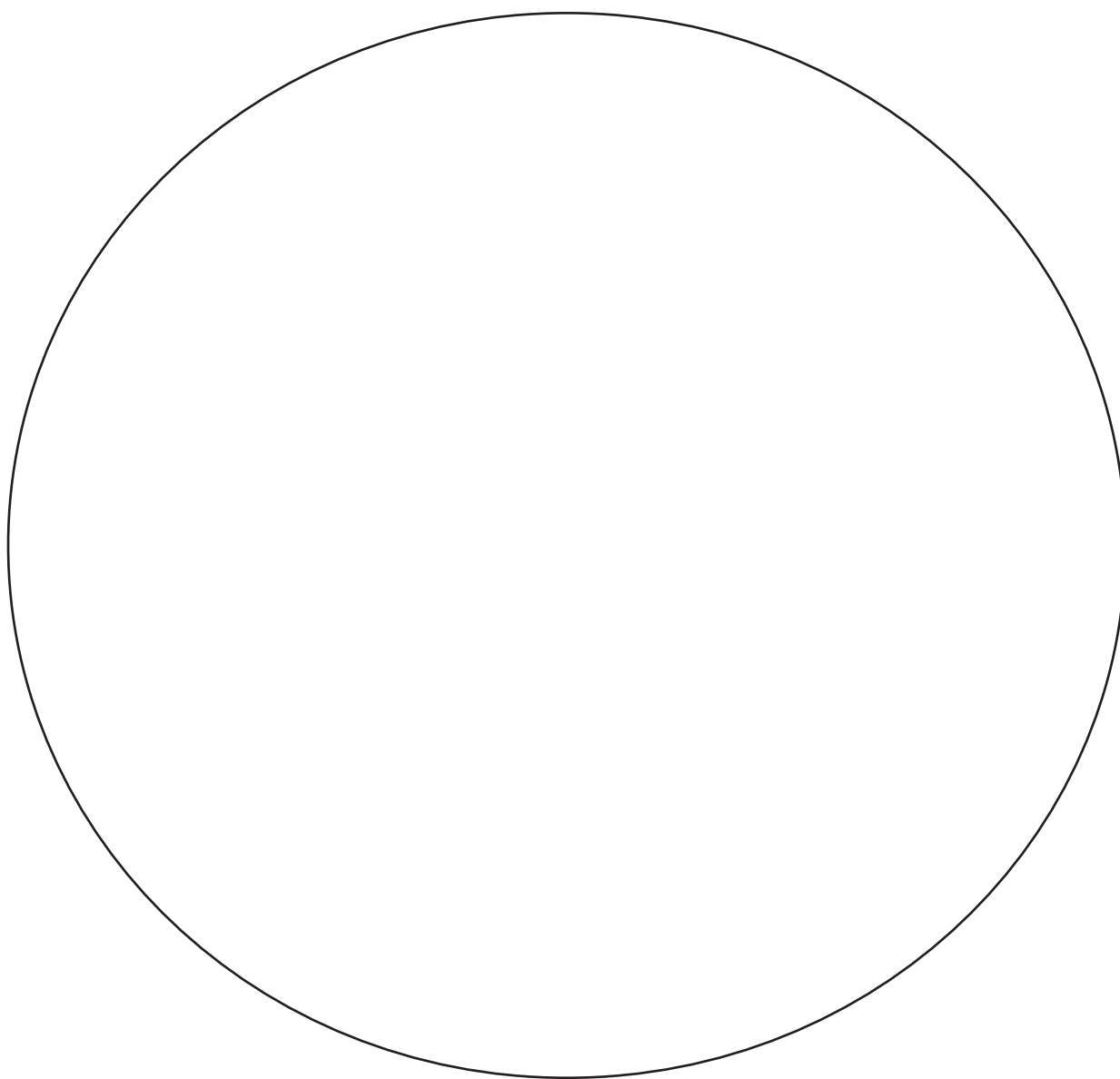


See more about [using Connection Circles at www.clexchange.org/gettingstarted/connectioncircles.asp](http://www.clexchange.org/gettingstarted/connectioncircles.asp)

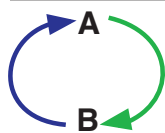
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Connection Circle Template with Guidelines

1. Draw a large circle and list 5-10 important elements (that can increase and decrease) around the circle.
2. Identify an element that causes another element to increase or decrease.
3. Draw an arrow through the circle from the cause to the effect. Make sure that the causal connection is a direct one.
4. Identify polarity (+ or -) of link and label at the arrowhead.
5. Continue to identify elements with causal connections.
6. Identify feedback loops and tell emerging “stories.”



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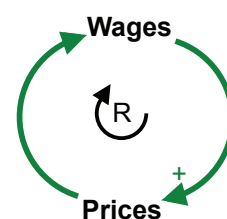
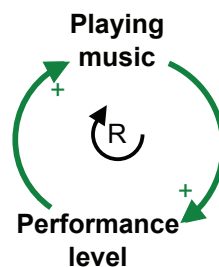
Introduction to Feedback Loops or Causal Loop Diagrams (CLDs)

“Feedback loops control a system’s major dynamic behavior. A feedback loop is a series of connections causing output from one part to eventually influence input to that same part.” (Jack Harich)

In systems thinking, which deals with changes over time and the causal elements that drive those changes, feedback is identified as a loop mechanism. Causal loop diagrams (CLDs) are visual representations of the two types of feedback loops.

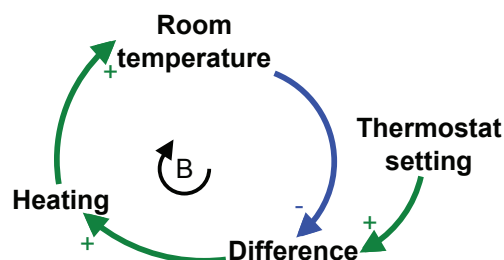
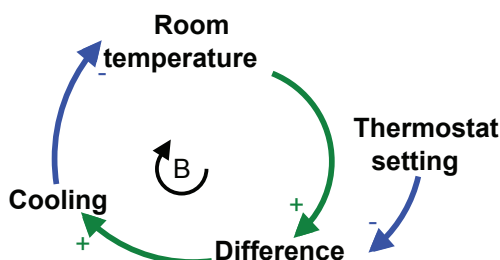
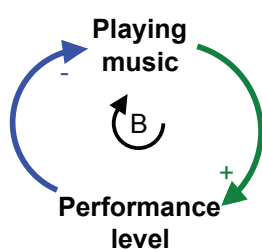
Reinforcing (R) or positive loops.

Think about a performance improvement loop, or virtuous circle. Practice some skill, such as playing music or athletics, and we get better. When we get better, we can perform at a higher level, and we can get even better. Unfortunately, vicious cycles exist also, like inflation. Prices go up, so workers negotiate higher wages. Higher wages increase buying power, but companies raise prices as it becomes more expensive to produce goods, partly because of increased wages. These up or down spirals are called reinforcing or positive loops.



Balancing (B) or negative loops.

Let’s look at performance in a different way. What if I don’t care about getting better at my lessons? But my parents care and apply pressure to me. So I practice and I get better. Once I satisfy them, however, I can back off on practicing. Then my skills begin to erode. That makes my parents react, so I have to increase practice again. I stay with this oscillating pattern, practicing enough to keep my parents off my case, but not working so hard that I forego other activities I’d rather do. This “wave-like” pattern is a balancing loop. A thermostat is a good example of a balancing loop in our everyday life. Heating or cooling is called for when a certain temperature criterion is passed. Once it is met, the machine doing the work shuts off, until the measure of heat in the room turns it on again. Notice how the heating and cooling loops are similar and different.



The examples above show two different mental models about practicing music and heating a room. They illustrate how using systems tools can help surface mental models and improve communication.

See more about [causal loops at www.clexchange.org/gettingstarted/causalloops.asp](http://www.clexchange.org/gettingstarted/causalloops.asp)

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Introduction to Naming and Labeling

Naming Elements

1. Elements in systems diagrams need to go up and down.
2. Avoid quantitative adjectives. For instance, say “Population” rather than “More population.”

Labeling Links (causal arrows) in CLDs and Stock/Flow Diagrams

1. Label each arrow at its head according to its polarity to indicate the direction of change
2. Be consistent and use either + and – or S(ame) and O(pposite)

+ or S means that a change in the first element causes a similar change in the second element or adds to the second element. For example,

- ◇ When the first becomes greater, the second becomes greater.
- ◇ When the first becomes smaller, the second becomes smaller.

- or O means that a change in the first element causes an opposite change in the second element or subtracts from the second element. For example,

- ◇ When the first becomes greater, the second becomes smaller.
- ◇ When the first becomes smaller, the second becomes greater.

+ and – are used in the diagrams in this book.

Note: Novices to systems thinking (both teachers and students) may find the S/O method of labeling to be easier than the +/- method as they initially explore connection circles and causal loops.

3. Causal arrows only have one head; they are one-way. When two elements affect each other, draw two different arrows.
4. Capitalize the first word of each element’s name.

Labeling Causal Loops

Causal loops come in only two flavors, reinforcing and balancing (See Introduction to Feedback Loops..., p 220.) By labeling and naming causal loops, it creates useful reference points for analyzing and discussing systems.

Steps:

1. Determine loop type with one of two methods
Option 1: Count link types

Tips for Labeling Links

TIP #1

To label a link, always start with the element at the beginning of the arrow going up. For ‘Element A’ → ‘Element B’, ask “If ‘A’ goes up, Does ‘B’ go up or down?” If ‘B’ goes up, label the arrowhead with a ‘+’; if ‘B’ goes down, label with a ‘-’. Do this same process to label each of the arrows independent of others. When all links are labeled, talk about the loop as a full story going all the way around.

TIP #2

If using the ‘S’ and ‘O’ method, an easy method for labeling links is using thumbs. Start at the origin and point one thumb the way that element is going and then go to the next element and use the other thumb to respond to the question, “When this goes up, does the other one go up or down?”

Continue around the loop until all links are labeled. Tell the story of the loop.

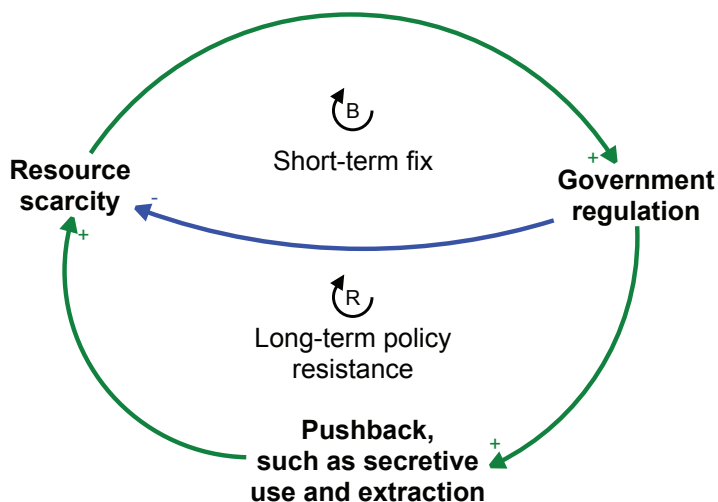
- Count the number of '-' links in any loop.
- An even number indicates the loop is reinforcing; an odd number indicates the loop is balancing.

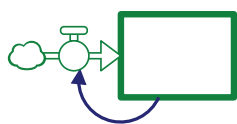
Option 2: Tell the story

- Always start with any loop element going up.
 - Tell the story of the loop going around until back to the original element.
 - If it's still going up, the loop is reinforcing. If it's now going down, it's balancing.
2. In the center of the loop, place an 'R' if the loop is reinforcing or a 'B' if the loop is balancing.
 3. Draw a circular arrow around the 'R' or 'B' to show the direction of the loop.
 4. Add a word or short phrase in the middle that describes the essence of the loop.

Labeling stock/flow diagrams

1. Stocks are accumulations. Label them as nouns or noun phrases.
2. Flows are the rates of change in the system. Labeling options include Gerunds (-ing words) e.g., Producing, Dying, Leaving, Growing, ...
3. Rates are an amount per time, e.g., Births per year, Widgets per month, ...
4. Be consistent with capitalization. In this book we capitalized the first word in the names of stocks, flows, and converters.
5. Be sure the units going into and out of stocks match the units of the stock.

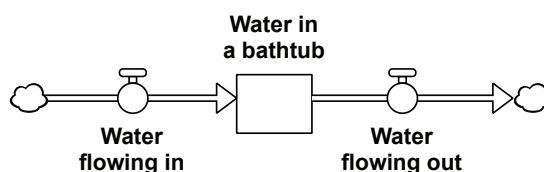




Introduction to Stock/Flow Diagrams (S/Fs)

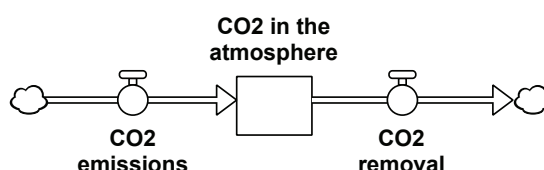
A principle of systems thinking involves stocks, accumulations of things, and flows, measurement of the rates at which the stocks change. The clarity of stock/flow diagrams aids in appreciation for rates of change, feedback, and other elements of systems.

“Water in a bathtub” is an example of a stock. The flow from the faucet is an inflow that fills the tub, while the drain is an outflow to empty it.



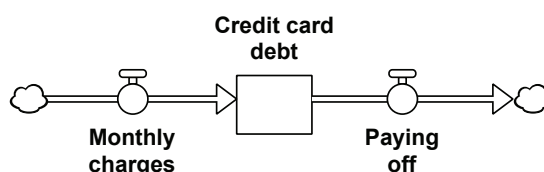
The clouds on the ends of the flows mark the model boundaries. It is important to know where water comes from to fill the tub and where it travels when it drains, but this diagram does not model the larger system. This is a simple bathtub diagram.

Substitution of other names for the elements in our diagram can give insight into other systems, e.g., “CO₂ in the atmosphere”:



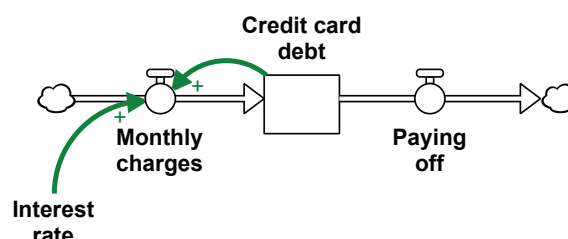
Most people agree this causes a big problem, climate change. If “CO₂ emissions” level off close to 2020 levels, the inflow will still exceed the outflow. And when inflow > outflow, the stock increases. That’s true for anything we can represent as a stock and flow.

Another substitution shows insight about the use of credit cards:

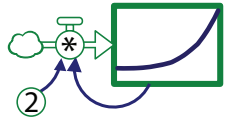


If spending is more than what is being paid off, the stock of debt rises. Debt costs money in the form of interest, and adding another element helps present a more complete picture.

“Monthly charges” are based on a rate represented by a circle called a converter. The “Interest rate” is multiplied by the existing debt, adding to the stock of “Credit card debt.” This feedback connection is shown by the arrows called connectors. Students can easily learn how to input numbers and equations in order to model this situation.



See more about [stock/flow diagrams at www.clexchange.org/gettingstarted/stockflow.asp](http://www.clexchange.org/gettingstarted/stockflow.asp)



Introduction to System Dynamics Computer Models

By creating system dynamics computer models, students of all ages can compress both space and time, thereby discovering long-term results of actions. Because modelers interact through computers and generate results in graphical, tabular, and animated formats, they maintain a high

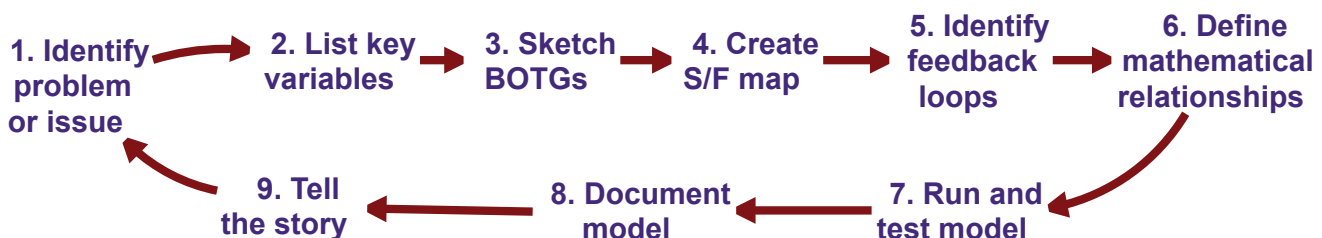
NOTE: This process can feel overwhelming to a novice, so one option is to find simple models that others have created that relate to the issue of concern. Then using the other steps in the modeling process, test and/or modify those models as a way to explore the issue. For example, if concerned about famine in a particular country, look for a basic population/resource model.

level of attention, engagement, and, therefore, learning. Even the simplest modeling of a system can reveal insights typically missed without it.

It's possible to model any dynamic, interdependent system. The system dynamics modeling approach involves the development of computer simulation models that portray processes of accumulation and feedback and allow for the testing of "What if" questions. Systematically testing models can help with identification of effective strategies for overcoming a system's natural tendency to return to a status quo or equilibrium. (Think about how difficult it is to change an ingrained habit.)

Steps in the modeling process:

1. Start with a specific problem or issue.
2. Brainstorm a list of key variables related to the problem. Possibly use connection circles to pull out pertinent feedback loops.
3. Sketch behavior over time graphs (BOTGs) for key variables as possible.
4. Create an endogenous (meaning from within) stock / flow diagram of the problem, preferably collaborating with at least one other person. With models, it's important that the dynamics of the problem are generated from within as opposed to being generated from an outside influence.
5. Make sure that the elements in the system are interconnected with loops that show information feedback, i.e., circular causality.
6. Create mathematical equations to represent the relationships among elements in the system.
7. Run the model (asking "What if" questions) to test it with relevant data and information.
8. Create documentation (e.g., define variables, discuss key elements, explain equations) for the model.
9. Tell the "story" of the model as a way to communicate learning and insights.



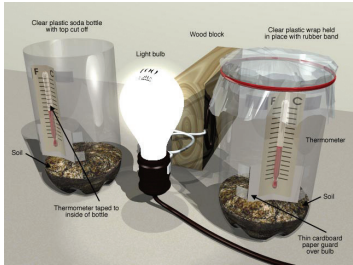
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Introduction to Systems Simulations

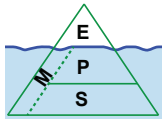
Systems simulations are dynamic activities that include the accumulations (stocks) in a system in order to compress time and space. Simulations enhance the ability to discover long-term results of actions taken within a system. They allow the participant to become part of the system in order to explore “what if” questions as well as to make predictions and track dynamic behavior that results from the systemic structure.

Simulations actively engage participants, usually in cooperative situations. The fun, hands-on experiential nature of simulations tends to increase learning and encourages asking good questions. Several types of simulations can help students of all ages grasp the principles of systems as well as aid in exploration of individual systems.

Type	Example
Kinesthetic Created with moving physical parts, such as people or objects that represent key accumulations of a system. Use anytime, and in particular, to scaffold understanding towards more abstract representations of systems.	 The In and Out Game with individuals walking into and out of a stock of People.
Physical Aims to replicate aspects of a real world system, often in isolation or as a smaller version of the real one. Use as part of the scientific method to illustrate key behaviors and track data over time to later connect to understanding how the larger, real world system behaves.	 The creation of a mini-greenhouse out of easily obtained materials (Lesson 3.5)
Computer Has an interface that overlays a system dynamics model, guiding users to explore how changing a model's assumptions can change resulting behavior. Use as a way to explore “What if” questions, especially when building one's own model is not possible or practical.	 Use a computer simulation to learn about Predator/Prey relationships.
Computer and Physical Combines elements of real and virtual representations of systems. Use to enhance understanding of a physical system when testing potential impacts of proposed policies.	 The World Climate Simulation from Climate Interactive allows participants to run a computer simulation to generate results with data from interactions among participants during the simulation. (Lesson 3.7)

To learn more and to find links to other available simulations, visit the [Creative Learning Exchange](http://www.clexchange.org/curriculum/simulations/) at <http://www.clexchange.org/curriculum/simulations/>

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Introduction to Iceberg Thinking

Beyond Events

Thinking beyond individual events to deeper elements of a system can help create more effective change. This is called iceberg thinking. Events, like an oil rig fire, are what we can typically observe at the top of an iceberg. These events are very important, but changing any individual moment is unlikely to create systemic change. To find real leverage, we must delve deeper to examine what we don't typically see, 90% of an iceberg (system) that's below the water's surface.

Patterns of Behavior

Below the surface are underlying patterns of behavior, i.e., trends. For example, "What is happening to carbon emissions over time?" or "How many cars are on the road over time?" Notice the common thread is the phrase "over time." It means weaving data points into a representation that shows an underlying trend. Notice the overall trend on the graph for global carbon emissions shows compounding growth.

Tool to Use: Behavior over time graph

Systemic Structures

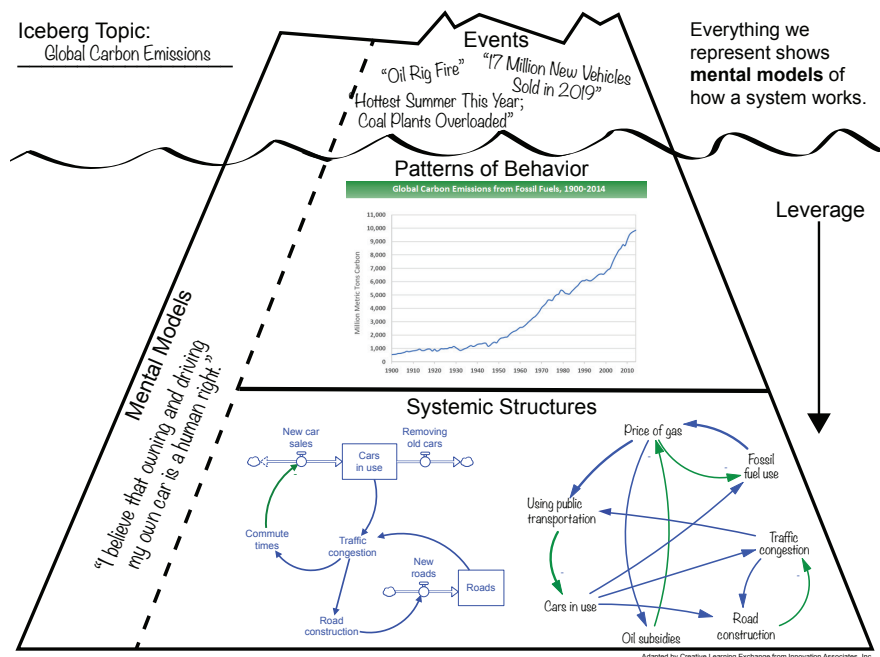
Interconnected structures generate the trends that emerge. For example, if car sales are increasing over time, how does that affect road construction and fossil fuel use? How do policies and laws, e.g., subsidies for the fossil fuel industry, impact fossil fuel use in comparison to renewable energy use? The stock/flow and connection circle diagrams show some of these interdependencies with arrows that illustrate cause/effect relationships and feedback loops.

Tools to Use: Stock/flow diagram, connection circle, causal loop, simulation, system dynamics model

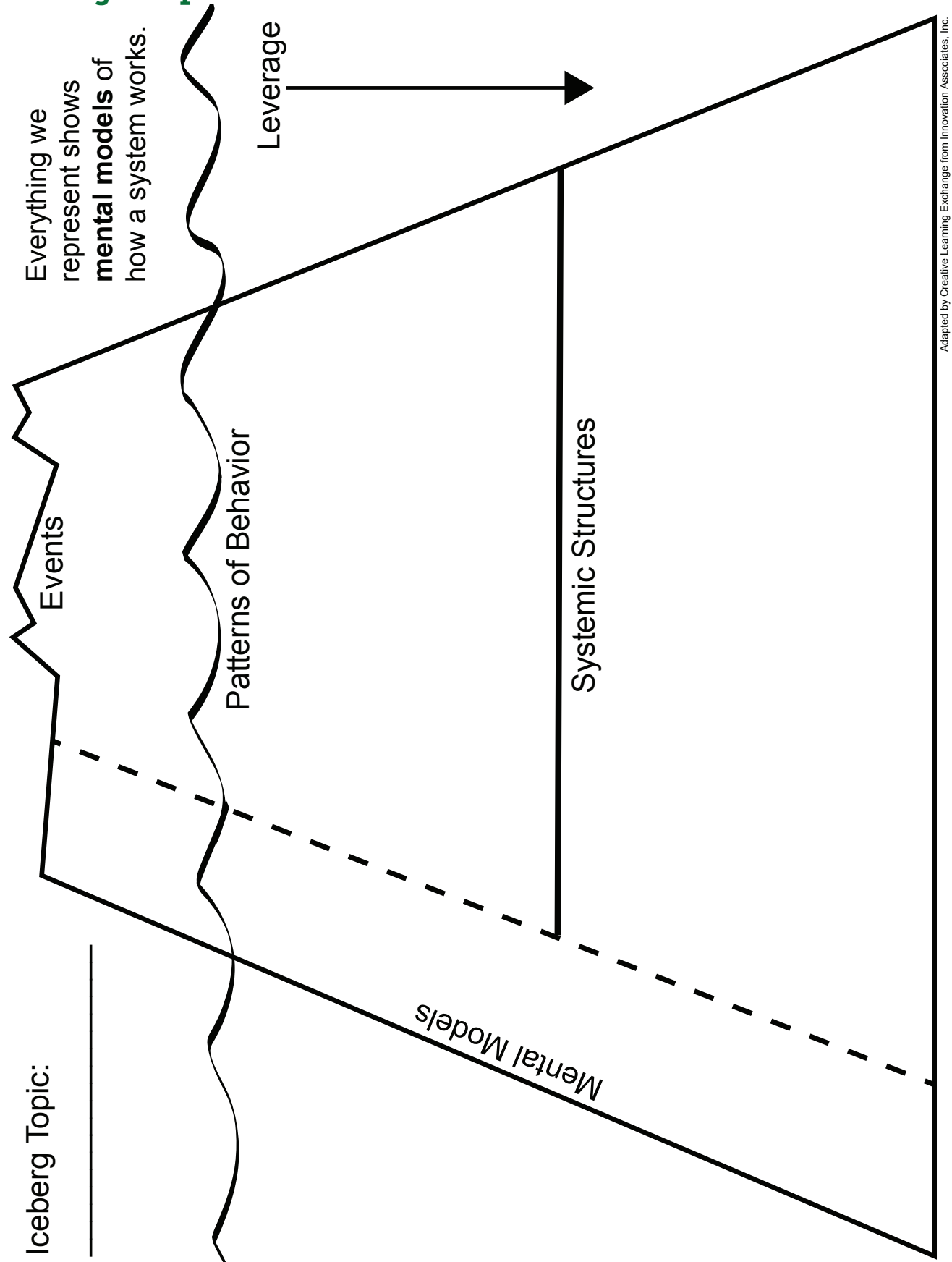
Mental Models

Peter Senge defines mental models as "... deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action." There's a place on the iceberg diagram to make note of these mental models, but keep in mind that anytime we discuss or represent how systems work using systems tools, we are really surfacing our mental models. Talk with a dozen people about emissions from fossil fuels, and you'll surface at least a dozen different mental models.

Tools to Use: All systems tools

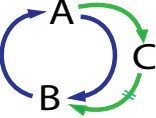


Iceberg Template



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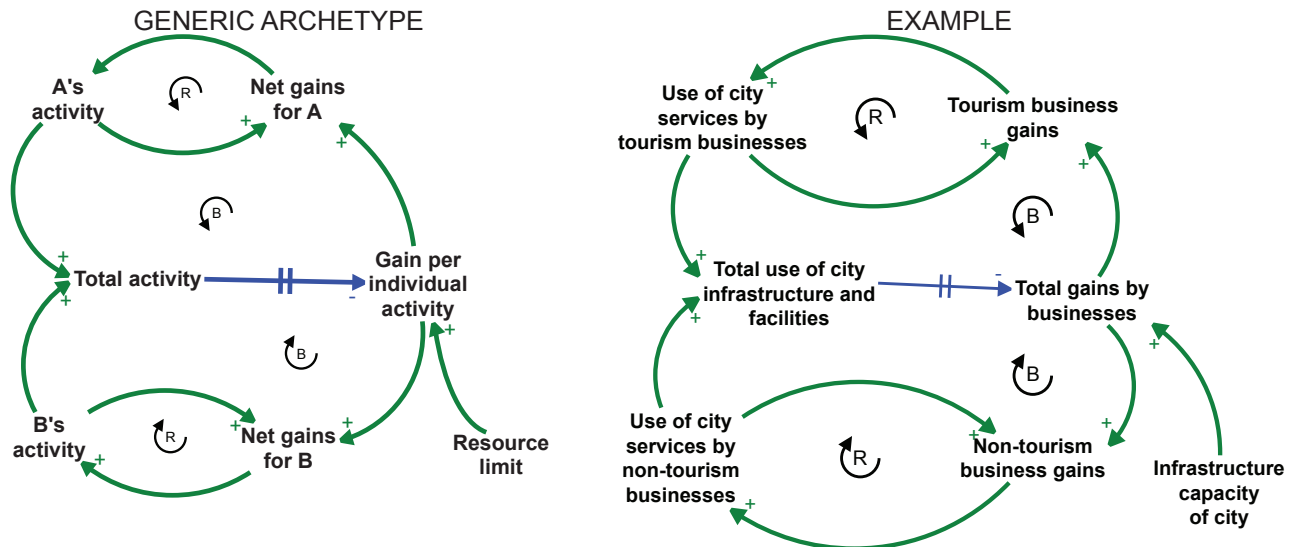


Introduction to Systems Archetypes (and Generic Models)

Systems archetypes are tools that capture common stories of dynamic behavior that repeat in diverse situations. Although others exist, these are particularly useful for the contexts in this book.

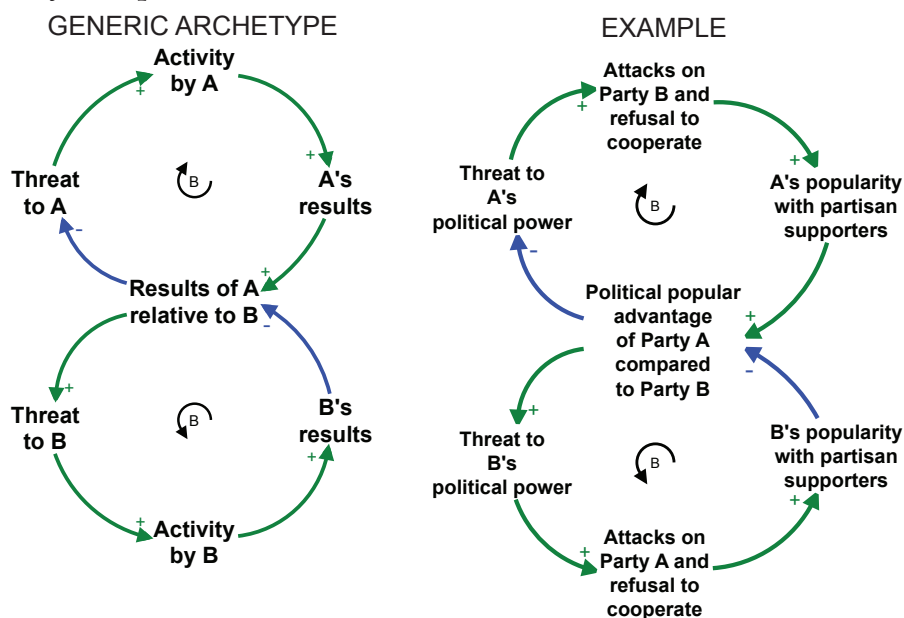
Tragedy of the Commons

When too many people exploit resources that are held in common, those resources are potentially used faster than they can regenerate (in the case of renewable resources) or disappear entirely (in the case of non-renewable resources). Example: As businesses open to serve both residents and tourists, it increases demand for services, which can put a strain on city infrastructure.



Escalation

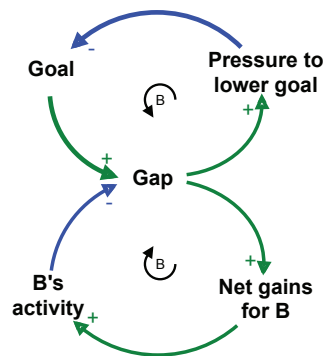
Competition creates an “arms race” in which two entities regard the actions of the other as a threat. Example: Destructive behaviors among political parties can escalate as a way to maintain popularity and power.



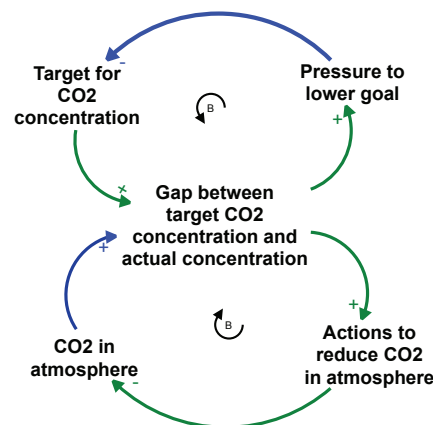
Drifting Goals (also called Eroding Goals)

A fundamental solution for reaching a goal is ignored or changed because of pressure to lower the goal. Example: The further we are from reaching a desired level for CO₂ concentration, the more pressure exists to lower that goal.

GENERIC ARCHETYPE



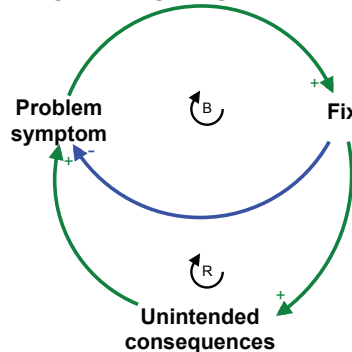
EXAMPLE



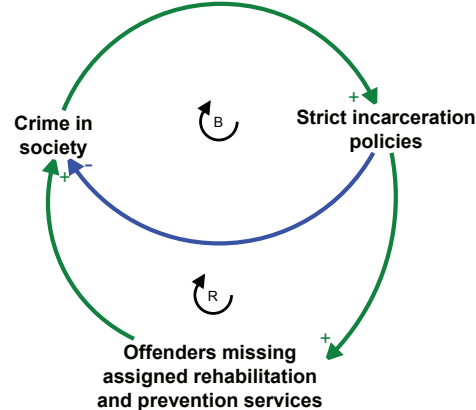
Fixes that Fail/Unintended Consequences

An apparent solution to a problem causes unintended consequences that make the situation worse. Example: Strict incarceration policies can backfire, leading to even higher levels of crime.

GENERIC ARCHETYPE

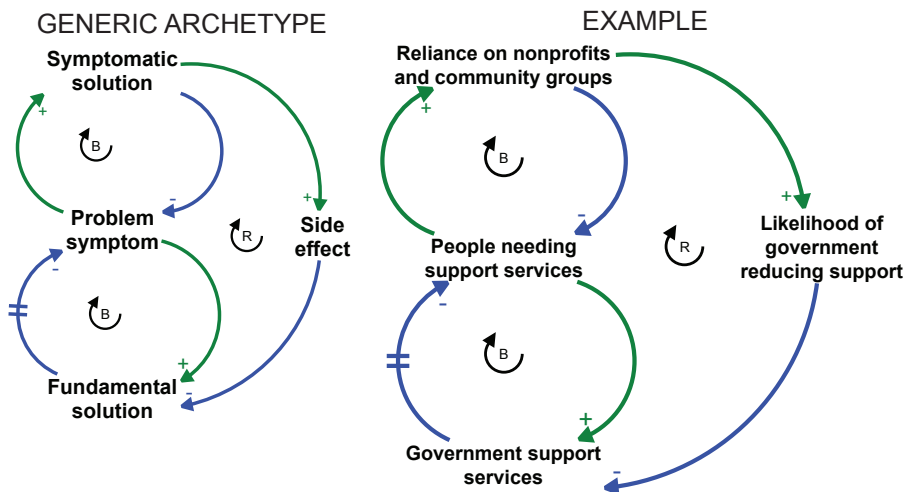


CRIME POLICIES THAT BACKFIRE



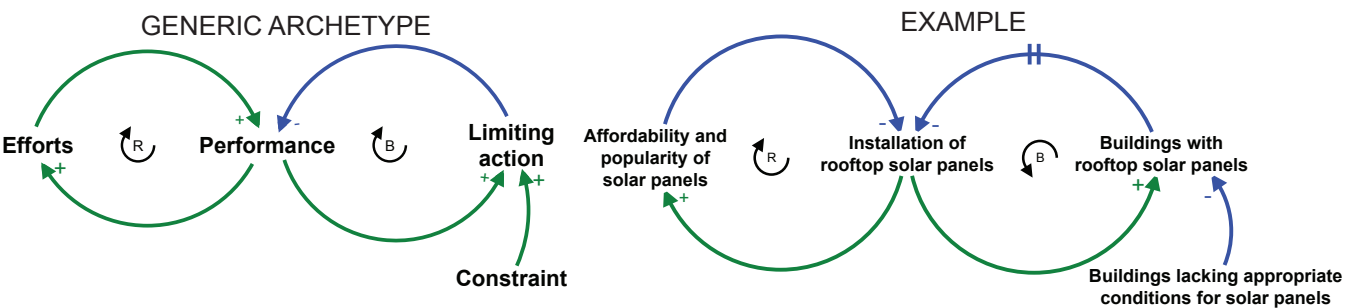
Shifting the Burden

A strategy is used to treat symptoms with a short-term solution in place of choosing a fundamental solution. The more a short-term solution is used, the greater the side effect is, thus diminishing the use of the more fundamental solution. Example: Government may reduce services as community organizations try to help needy populations.



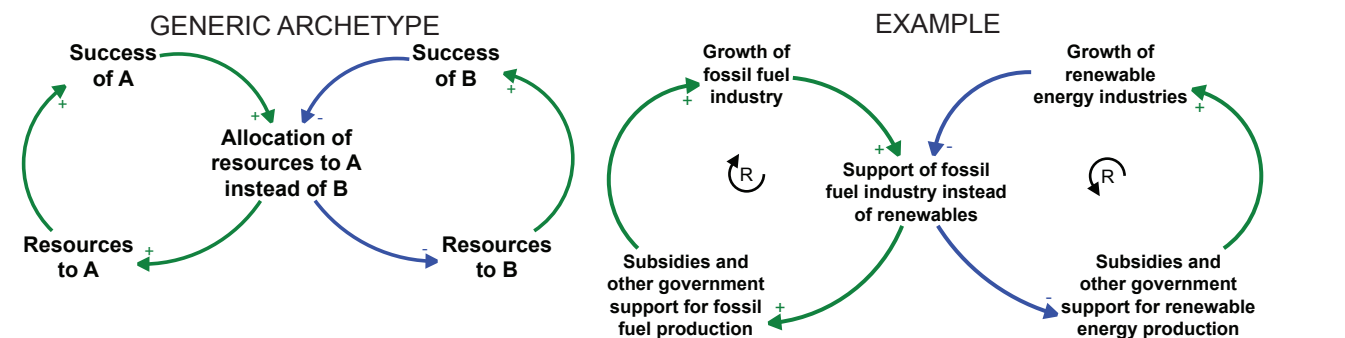
Limits to Growth (also called Limits to Success)

Growth can be rapid, building as a reinforcing loop. But encountering limiting factors will eventually create a balancing loop that dampens and even reverses the success. Example: Buildings that are not ready for solar panels can slow down a conversion to solar energy.



Success to the Successful

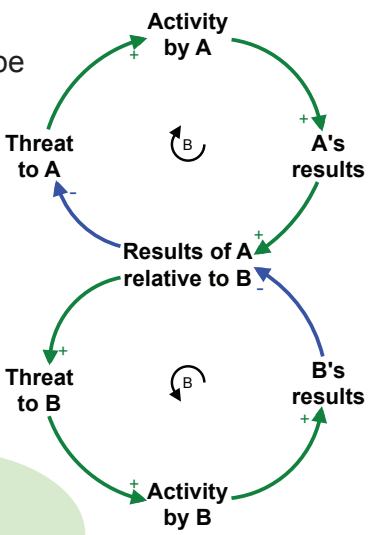
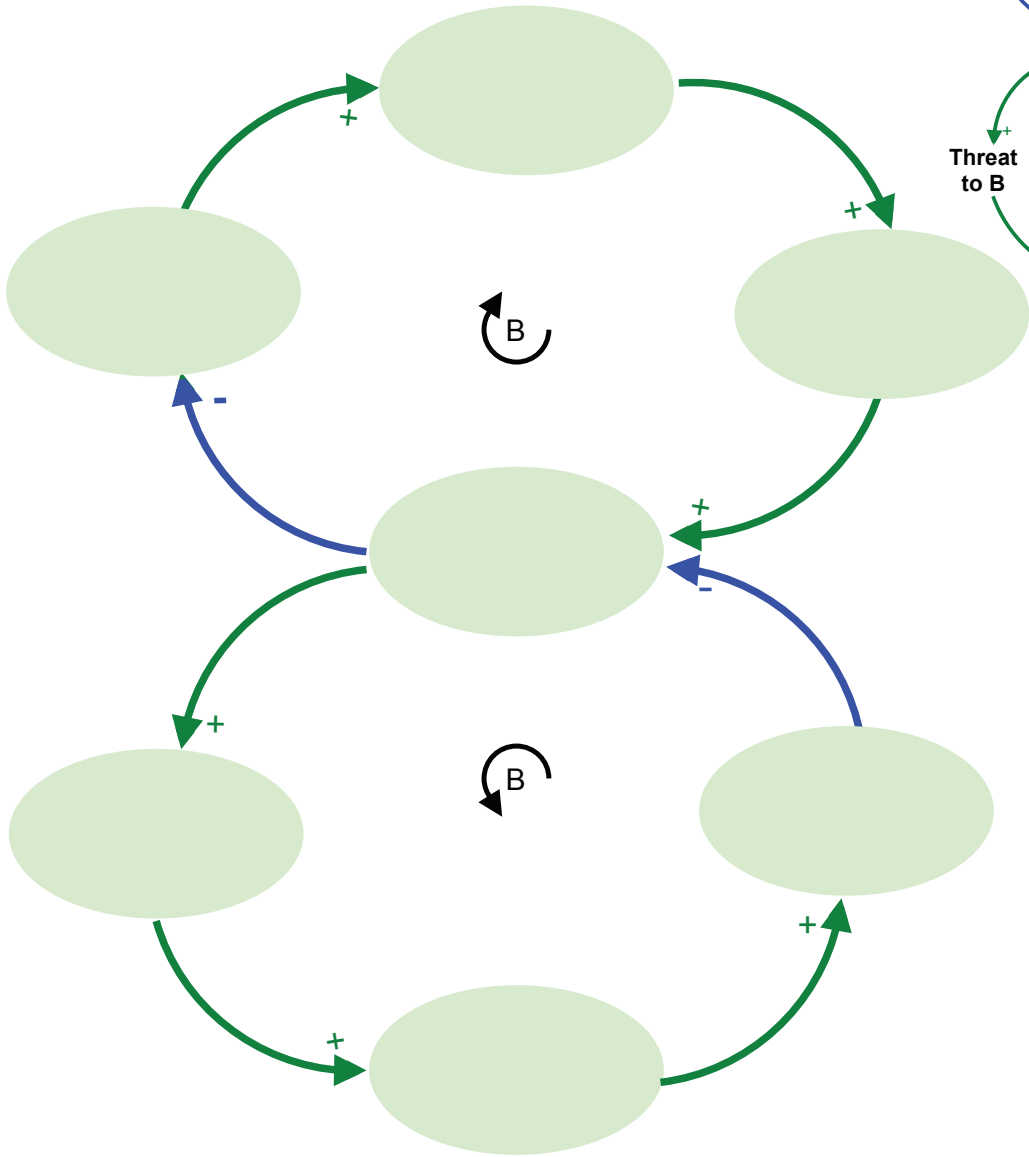
As one group is more successful than another, that group may receive more resources in comparison to another group that's struggling with success. Example: The fossil fuel industry has received subsidies, possibly reducing or eliminating subsidies for renewable energy conversion.



Template: Escalation

Use the guide at right as you complete your own example of this archetype below. Create a title and tell the “story” that explains your example.

Title: _____



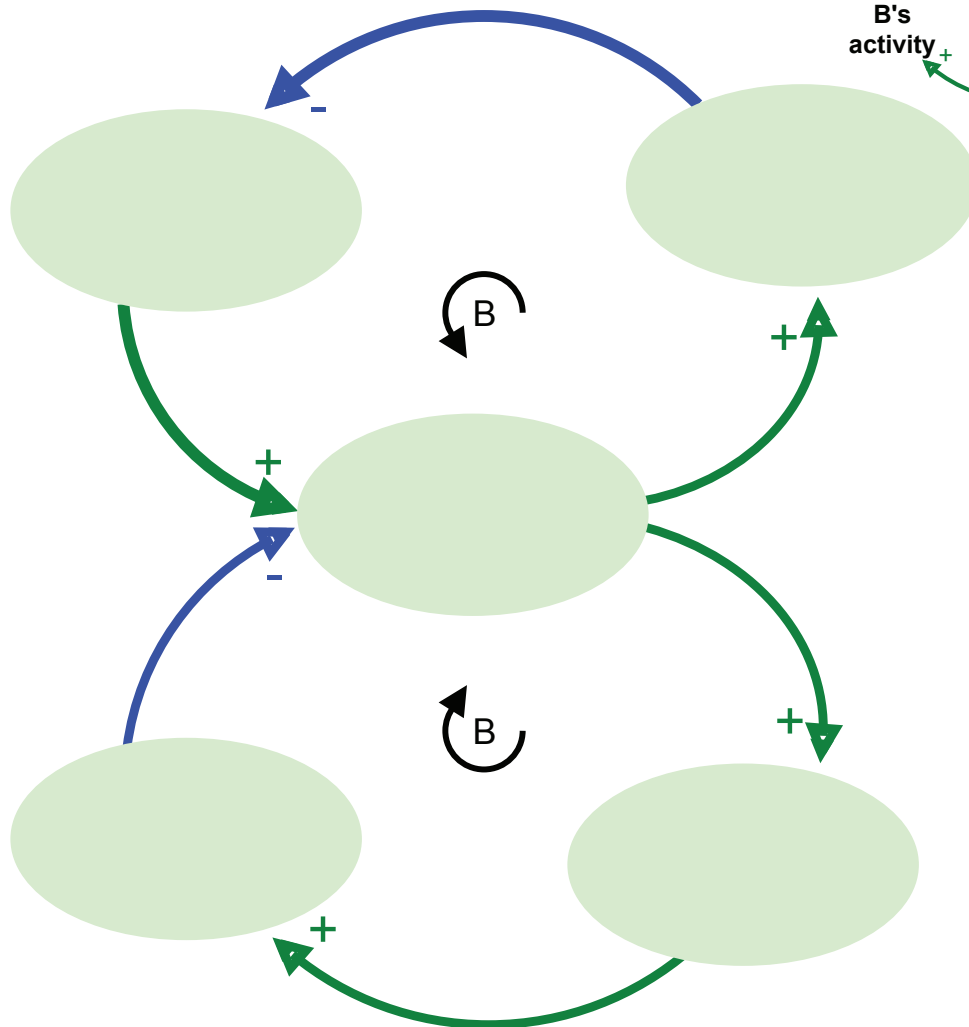
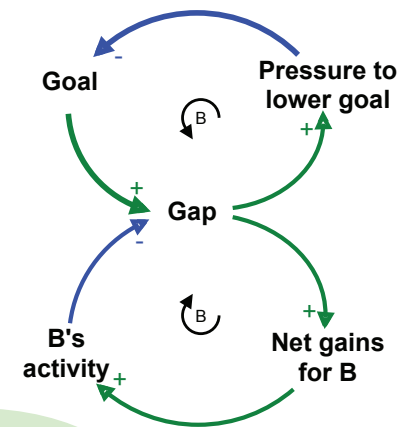
Story:

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Template: Drifting Goals

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Title: _____



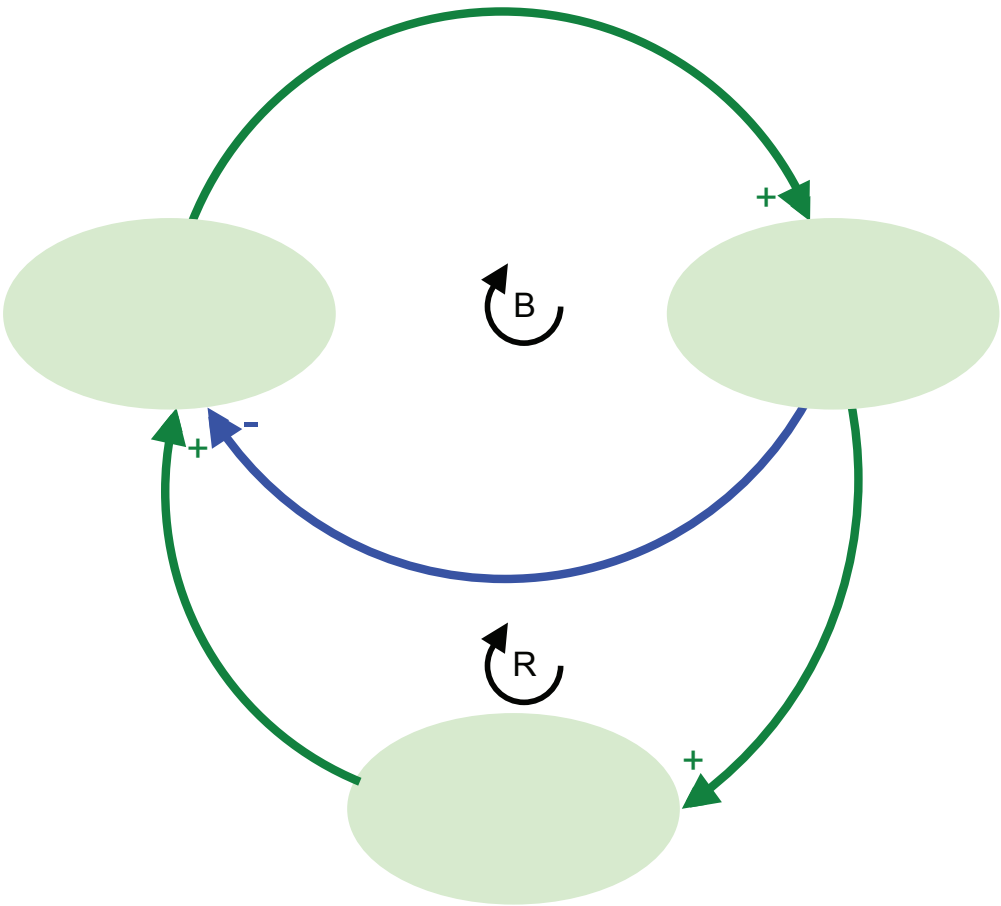
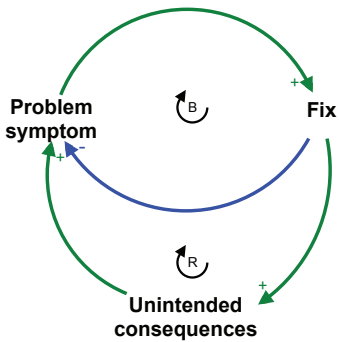
Story:

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Template: Fixes That Fail

Use the guide at right as you complete your own example of this archetype below. Create a title and tell the “story” that explains your example.

Title: _____



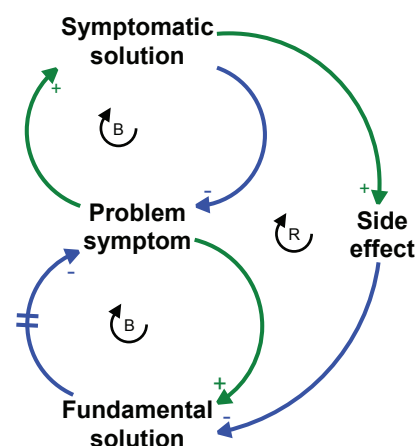
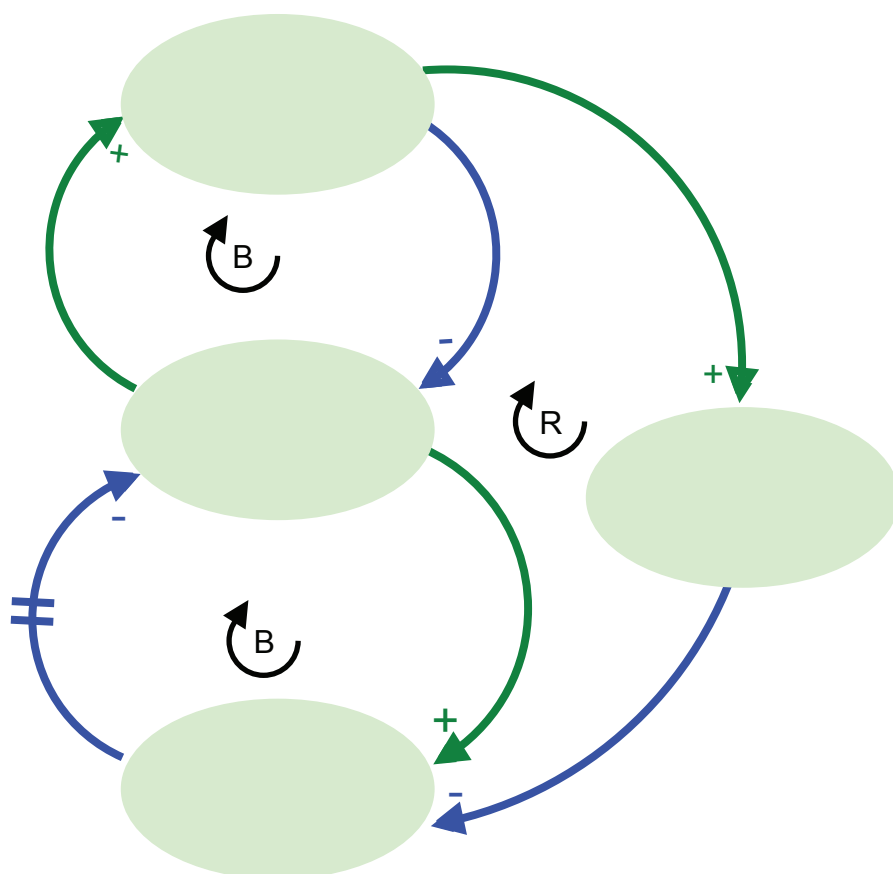
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Template: Shifting the Burden

Use the guide at right as you complete your own example of this archetype below. Create a title and tell the “story” that explains your example.

Title: _____



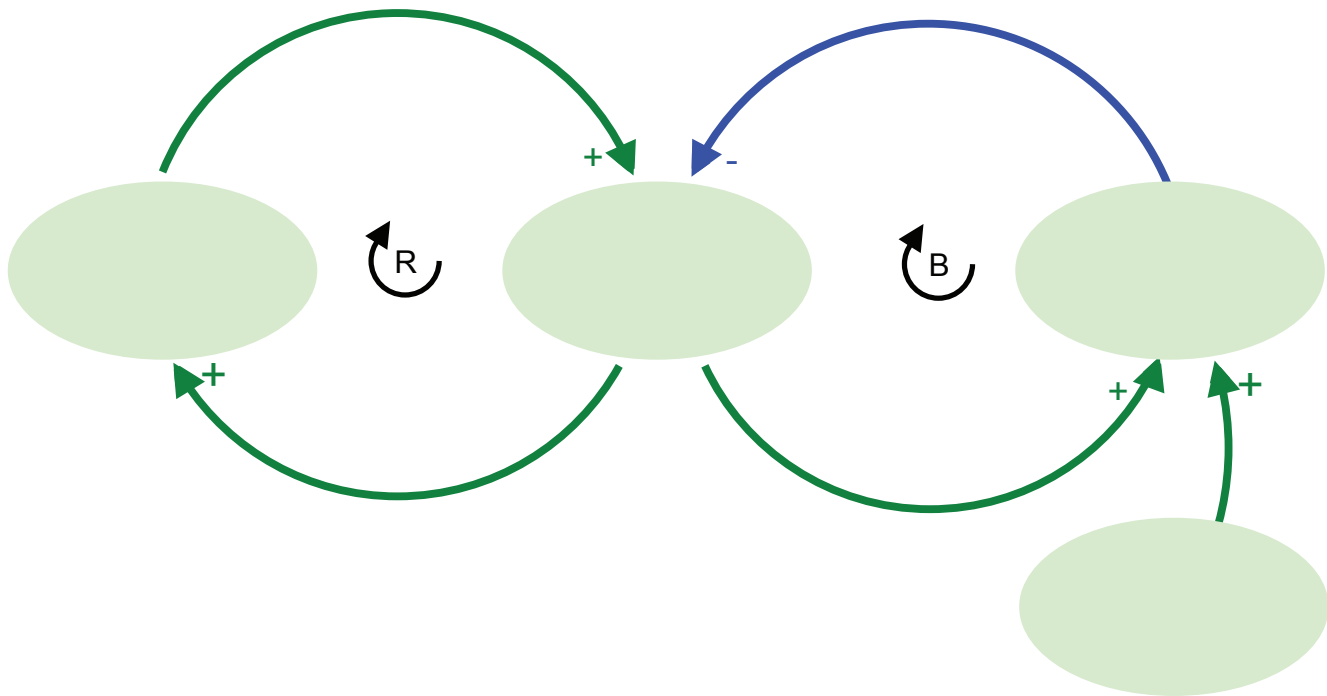
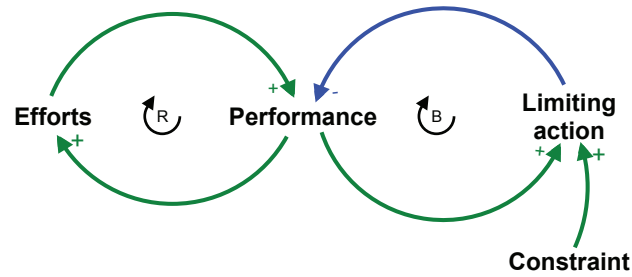
Story:

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Template: Limits to Growth

Use the guide at right as you complete your own example of this archetype below. Create a title and tell the “story” that explains your example.

Title: _____



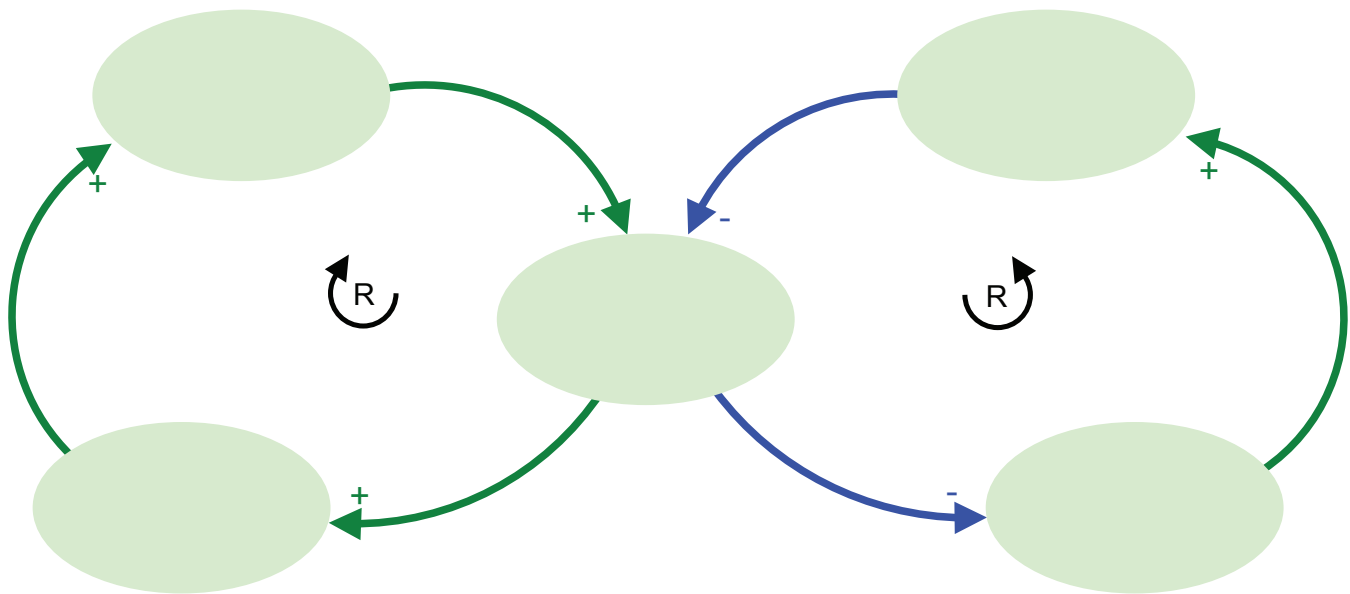
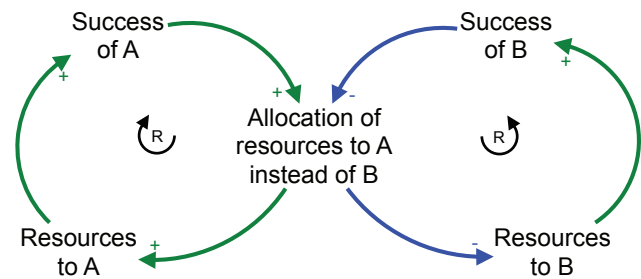
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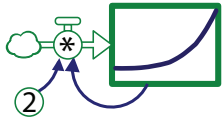
Template: Success to the Successful

Use the guide at right as you complete your own example of this archetype below. Create a title and tell the “story” that explains your example.

Title: _____



Story:



Introduction to System Dynamics Modeling Software

System Dynamics Modeling software comes in many shapes and sizes. One size does not fit all. These are a few that may be helpful for beginners who wish to get into more sophisticated modeling. The ones listed here are most familiar to the author. This in no way diminishes other available options.

[Splash! and SplashExchange](#)

These have been created by the Creative Learning Exchange and BTN, Ltd. to be visual, fun and interactive. Splash! is a free app useable on tablets and phones. It is terrific for creating very simple models and helping teach/learn the basics of stocks and flows as well as feedback. SplashExchange is a full mathematical modeling software with visual appeal. It will run in a browser on laptops and desktop machines.

clexchange.org/splash.

Stella (isee systems)

isee systems has a variety of offerings for Stella, ranging from a free, limited, web-based, modeling package to a sophisticated, complete software package. Stella is very accessible and has the easiest learning curve of the professional software packages.

iseesystems.com

[Insightmaker](#)

This free modeling software is built and maintained by Gene Bellinger. It comes with free tutorials, and many find it easy to grasp. It also has models that are primarily agent-based (each individual modeled), as well as those that are typical system dynamics models.

insightmaker.com

Other professional modeling software:

Vensim (Ventana Systems)

Vensim is a very sophisticated system dynamics modeling package that has the advantage of a free downloadable version (Vensim PLE) with many capabilities. They also have professional versions for the modelers who are creating complex and extensive models.

vensim.com.

[PowerSim Software](#)

powersim.com

[Silico Software](#)

strategydynamics.com

Note that the stock/flow and causal loop diagrams in this book were created using Stella software.