Introduction to Systems Thinking for Early Childhood Leaders

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Characteristics of Complex Systems

All systems have boundaries. System boundaries include:





spatial (size of the system)

and temporal (time frame)

Most systems have subsystems that are nested and interconnected.

For example, schools are subsystems of school districts and classrooms are subsystems of schools.

Systems also have:

Elements or Parts

Examples include people, policies and resources

Interconnections or Relationships among the Parts

A system consists of interconnected parts. The word "interdependence" is sometimes used to describe system relationships.

Dynamics

Systems tend not to stand still and continually change and adjust over time.

Goal or Purpose

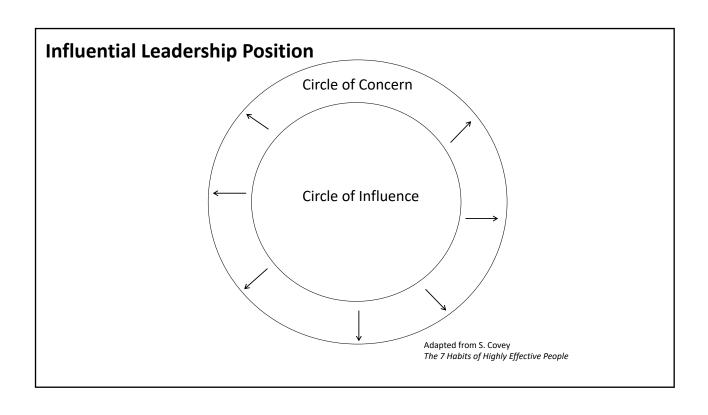
All systems have goals or purposes. Some goals are explicit and others are implicit.

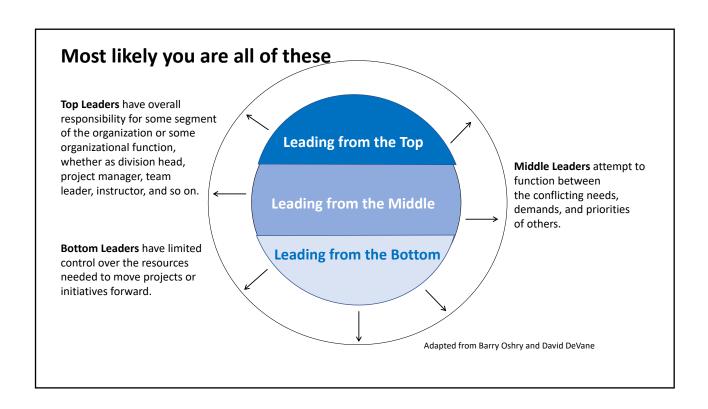
The Five Systems

Your understanding of the systems in your life and work will affect your decisions, your actions and the way you choose to live. We have identified five basic life systems that involve people. In this guidebook, each system is represented by a circular icon. These sample systems are included throughout the guidebook and are used in practice exercises and anecdotal examples. To get started, reflect on each of the five system types.

Icons	Sample Systems	Describe how each of these five systems relate to your life. How and why are they applicable and important to you?
SEAMPLE	Well-being Personal well-being as a system involves your physical, emotional and social health. It also considers your state of being happy and prosperous.	
CAMPLS CAMPLS	Family This system considers all of the people you choose to identify as your family, both immediate and extended, and may include people of all ages.	
CSAMATE CS	Workplace Your workplace considers systems that could include paid employment, a volunteer position, your life's calling, or any role you play where you make a contribution to others.	
SCHOOL SCHOOL PRAMPUS	School As a place for learning and preparation, school is a system that is common to all of us. Your school could be a public, private, charter or home setting and could be a system that you attended or any other place of learning.	
CHAMPLE STAMPLE	Community Your community could be a place where you reside or a place where you belong. It could be a town, city, an affiliation or network. Your community involves relationships that are formed around a common purpose.	

as a System
ers at your table)
What are 2 changes your system is currently experiencing?
1.
2.
Describe 1 goal or purpose of your system.
1.





Seeks to understand the big picture



Identifies the circular nature of complex cause and effect relationships



Surfaces and tests assumptions



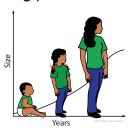
Considers how mental models affect current reality and the future



Pays attention to accumulations and their rates of change



Observes how elements within systems change over time, generating patterns and trends



Makes meaningful connections within and between systems



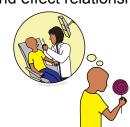
Habits of a Systems Thinker



Uses understanding of system structure to identify possible leverage actions



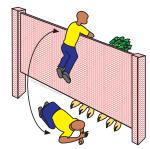
Recognizes the impact of time delays when exploring cause and effect relationships



Recognizes that a system's structure generates its behavior



Changes perspectives to increase understanding



Considers an issue fully and resists the urge to come to a quick conclusion



Considers short-term, long-term and unintended consequences of actions



Checks results and changes actions if needed:
"successive approximation"



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Habits of a Systems Thinker Reflection Matrix

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Big Picture				
Patterns & trends				
System structure				
Circular cause & effect				
Changes perspectives				
Surfaces & tests assumptions				
Mental models				
Short, long-term & unintended consequences				
Resists the urge to come to a quick conclusion				
Connections				
Accumulations & rates of change				
Time delays				
Leverage				
Successive approximation				

The Visual Tools of Systems Thinking

The visual tools of systems thinking provide students and adults dynamic ways to engage in critical thinking, problem solving and deeper learning.



Behavior-Over-Time Graph

Tool that illustrates patterns & trends
Demonstrates how something changes over time



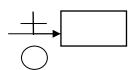
Connection Circle

Tool that helps you see causal connections within & between systems



Causal Loop Diagram or Feedback Loop

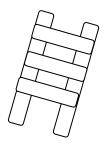
Tool to show the casual relationships that exist between elements or variables Arrows are used to illustrate causality



Stock and Flow Map

Tool to map out and draw attention to accumulations and their rates of change

Assists with understanding changing elements and the identification of leverage in a system



Ladder of Inference

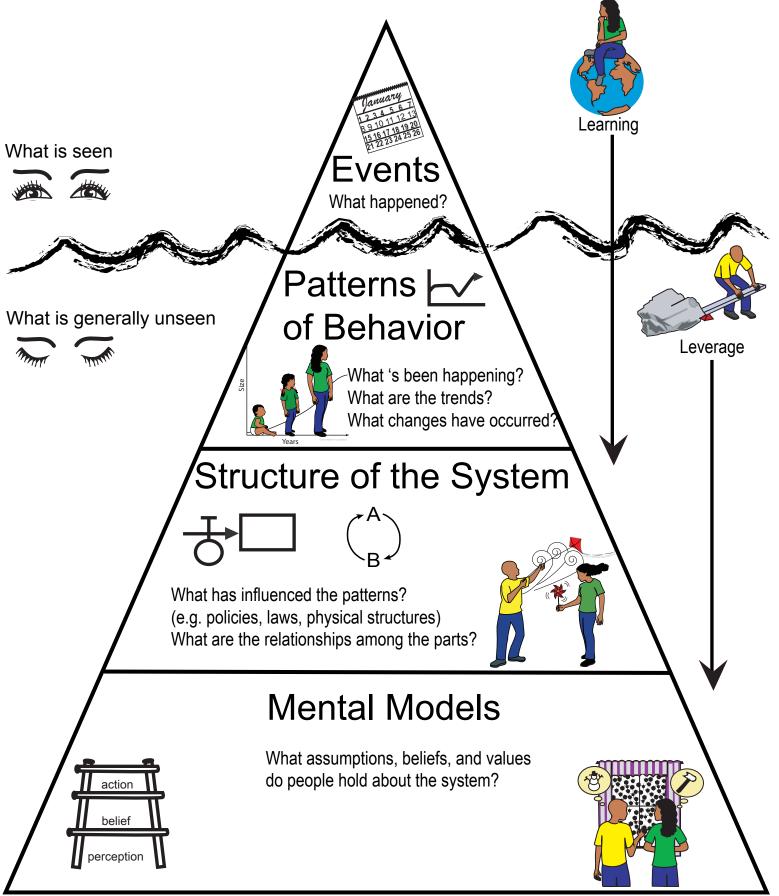
Tool that is helpful in recognizing behavior in systems – surfacing and testing assumptions



Iceberg Model

A framework that applies systems thinking tools and habits to the understanding of complex systems

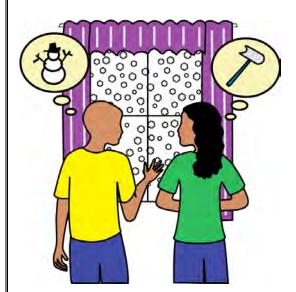
Iceberg... Seeing What's Below the Surface



Mental Models

Mental models are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action.

Peter Senge, The Fifth Discipline, 1990



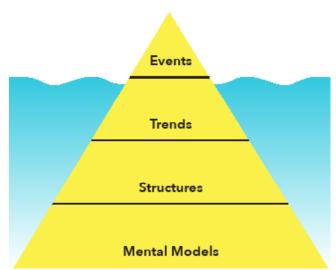
A Systems Thinker considers how mental models affect current reality and the future.

The systems thinking iceberg: mental models as the foundation

The systems thinking iceberg is a framework that applies many of the systems thinking Habits to the understanding of complex systems. Each level calls for a specific way of thinking about a system of interest.

This framework helps deepen the understanding of complex systems. The tip of the iceberg, the only visible piece above the water level, involves the day-to-day events and occurrences that you experience. This common, but limited view produces a surface understanding of what a system is about. For example, a store manager can greet customers, observe how employees are serving those customers and assess inventory by looking at shelves and storage rooms.

From these day-to-day events, she can get some sense of whether or not the business is thriving.



Good managers are systems thinkers. They intentionally go below the surface of the waterline of the iceberg and view their business systems at a variety of levels. Each level of the iceberg below the water line connects with specific Habits of a Systems Thinker.

Trends

Trends focus on the dynamics of a system. What are the essential elements that are changing over time? How are elements changing and what is causing those shifts? This level of the iceberg connects to the Habit, observes how elements within systems change over time generating patterns and trends (see chapter 5 for a more detailed description and additional practice exercises). Obvious trends for a store manager include sales, total revenue, inventory and outcomes from price reductions. Broadening the boundary of what could be important when focusing on essential elements that change over time might be market research, customer needs, local conditions and competitor activity. In addition, trends in employee satisfaction, skill development, employee turnover and promotion opportunities are also important to a successful business.

Structure

Systems thinkers pay attention to what is causing the shape of trend lines. For our store manager, one obvious structure is the relationship between supply and demand. It is at this level that systems thinkers fully examine the design of their system and how one aspect affects another, which in turn influences others. When supply is high and demand is low, it is time to hold a sale and cut prices. On the other hand, when demand is high for a popular product, it is important to make efforts to order and stock that product in order to maintain customer satisfaction and revenue.

The structure level helps show how important system elements (like inventory, customer demand, pricing and customer satisfaction) are interdependent. And the interdependent structures influence the previously identified patterns and trends. The Habit of a Systems Thinker that connects to this level is, recognizes that a system's structure generates its behavior (see chapter 7).

This structural understanding can help individuals like our store manager trace a potential ripple effect when a small change or adjustment generates other changes in seemingly unexpected places. For example, our manager may want to give careful attention to competitors' efforts so that she can gain new insights and ideas that could positively influence the business. Encouraging positive relationships among the competition may seem counterintuitive to a business wanting to get ahead and beat out the competition, yet this relationship could provide strategies for initiating a positive ripple effect resulting in mutual benefits for all.

Mental models

Mental models are an essential aspect of a system's structure. Think about all of the stakeholders who contribute to and are affected by the system. When the various mental models from this diverse stakeholder pool are made explicit, a deeper understanding of how human elements contribute to the workings of the system become evident. It is difficult to fully understand a system without an appreciation of the different mental models of all involved. Without consideration of mental models, changes in systems structures (e.g. policies, laws, procedures) will only result in surface modifications. In order for the small business manager to best address her challenges, she should carefully consider the mental models of her employees, her customers and her competition, in addition to giving conscious attention to the mental models she holds about the business. This human aspect of system structure is often considered the highest leverage area. When individuals embrace a mindset that is open, flexible and honest, a system will be adaptive and productive.

Shifting gears a bit, consider the tension that exists globally because of vastly different mental models around serious issues like gun control, immigration, social justice, healthcare and religious freedom. These issues inundate our news feeds and social media sources daily. News events draw our attention to the day-to-day event level of the iceberg. Policy makers react to these events and struggle to create structures to help alleviate the existing tension. They look for structures that will help change the course of events and adjust the system to more desirable trends. The iceberg helps us



realize that in order to change undesirable patterns of system behavior (e.g. violence, hate, inequity and blame), it is essential to rise above one's own mental models and deepen the understanding of the system by considering a wide variety of mental models that drive how a system behaves. Isolated experiences, individual values, socio-economic position and culture are just some of the factors that influence the mental models that are formed across sectors. Without intentional efforts to surface and understand the mental models of diverse groups and individuals, a reliance on change in physical structure, like policies or laws, will only place a temporary band-aid on the symptoms of ongoing problems. In order to sustain lasting positive change in systems, a more fundamental approach centered on the mental model level of the iceberg is essential.

QUESTIONS TO ASK WHEN PRACTICING THIS HABIT:

How are current mental models helping achieve the system's desired outcomes of the system?

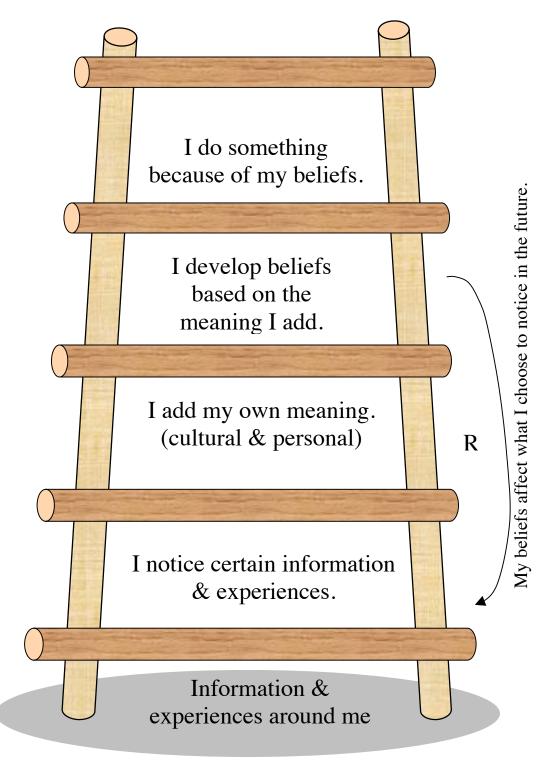
How are they hindering progress?

How am I helping others see the influence that mental models have on our decision-making?

Practice the Habit

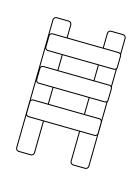
Think of a time when you shared your mental model about something you care about. What did you learn about yourself when you shared it?	
How can you invite others to share their mental models?	
How do you respond when mental models differ?	
Think about the last meeting you attended or facilitated. It could be a work-related meeting or a community-based gathering. What was your impression of the meeting?	
How did people hear and interpret what was being said?	
How did the facilitator provide participants opportunities to voice their interpretations?	
How might you interpret silence?	

Ladder of Inference



Adapted from <u>The Fifth Discipline Fieldbook</u> Systems Thinking in Schools, Waters Foundation

Practices that help you use The Ladder of Inference



Reflection

- Suspend judgment
- Become more aware of your own thinking and broaden your observations

• Inquiry

- Inquire into other's thinking and reasoning
- Ask open-ended questions that seek clarification

Advocacy

 Make your thinking and reasoning more visible to others by describing what influenced your thinking and your actions

Notes:

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CEELO Leadership Academy Practice Scenarios

- Various stakeholders have been meeting over the past few months to discuss
 accountability measures for infant/toddler care and preschools. A good number of
 individuals would like to see a transition from QRIS to CLASS. While others see the value
 of ECERS-R/ITERS-R because of their own past experience. You are facilitating the
 process and are unsure how to bridge the divide as there are so many strong opinions.
- 2. You are meeting with a group of Head Start Directors and want to encourage them to join a network you are initiating with District and School administrators to help bridge the transitional gap between preschool and kindergarten. Many of the Head Start Directors have voiced reluctance because, "We've tried that before and nothing came of it."
- 3. One of your goals as a state affiliate is to increase the quality of early childhood learning environments. Your data indicates many early childhood teachers and directors in the field with low skills, very little if any post-high school education and very low compensation. Despite your efforts to provide excellent professional development opportunities, very few take advantage and lack motivation to build new skills.
- 4. You were just promoted to your position as a state level director/chief. You have inherited a team that has very strong and long-held opinions about policy and accountability systems that differ from your own. Members of your new team have been working at the state level for many years and seem to be holding on to outdated practices. You are among the youngest member of the team and as the new leader sense some tension. You are very knowledgeable about current research and were hired to bring the department to more up-to-date, research-based practices to influence policy.
- 5. You are in the middle of two camps of thought in PreK state standards development. One side believes strongly in developmentally appropriate play-based PreK. The other side is concerned about kindergarten readiness and believes that PreK needs to be more academically structured so that 5-year-olds will come to kindergarten as readers who can also demonstrate basic math fluencies.

Ladder of Inference Practice Scenarios

1.	With a partner, select a scenario that most closely relates to your work situation. Discuss the fictitious scenario and add context to increase the relevancy.
2.	 Consider the problem. What might contribute to the different perspectives of all people involved with the scenario?
3.	Which Habits of a Systems Thinker will be important in addressing the challenge in your scenario?
4.	 Use the Ladder of Inference. How could reflection, inquiry and/or advocacy be used to manage movement up and down the ladder of inference as you think through your challenge?

- 5. Consider unintended consequences of possible solutions/responses.
 - What unintended consequences should be considered before taking action or responding?

Practice the Habit

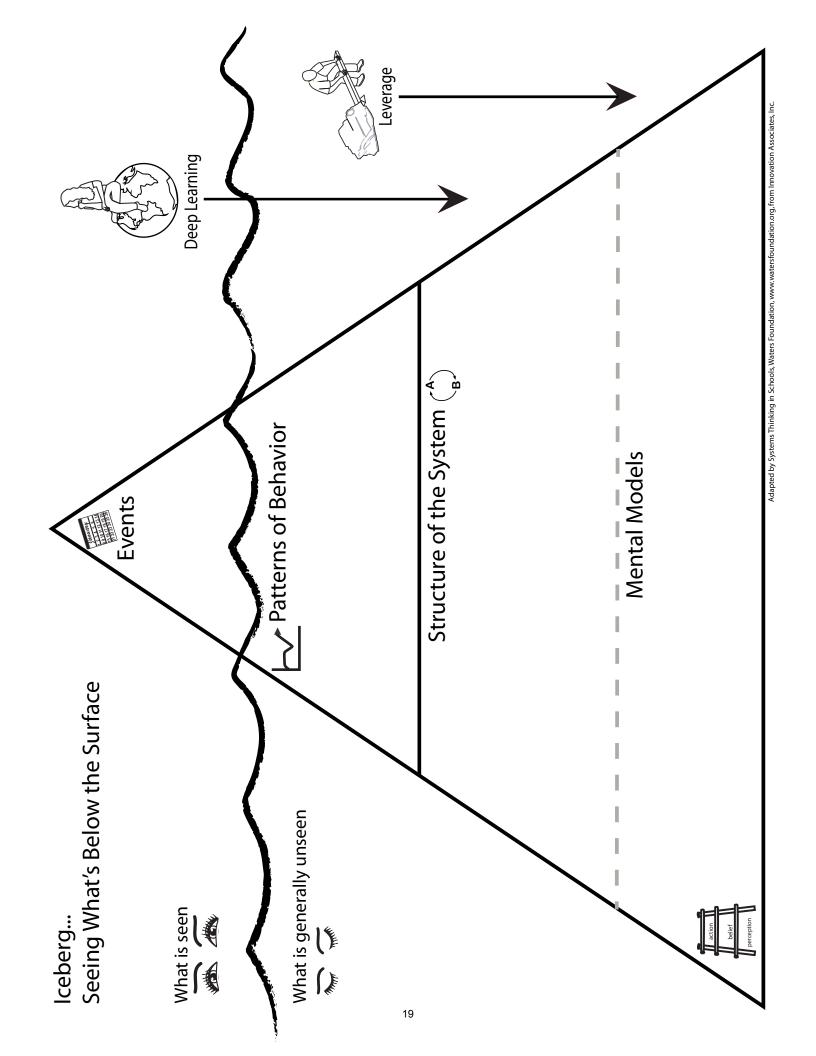
A systems thinker looks ahead and anticipates not only the immediate results of actions, but also the effects down the road. Think about a decision you are about to make that will lead to action. Read and respond to the following questions to help you consider both expected and unexpected consequences.

What are possible unintended consequences of your decision? They might involve reactions, attitudes, results or new challenges.
Identify the benefits and trade-offs of your decision. How will you minimize the impact of the trade offs? What structures can you put into place (e.g. communication, safeguards, modified practices) to address the potential impact of trade-offs?
Will your decision involve short-term hardship to achieve long-term success? If so, what is your plan to minimize the challenges you expect to face in the short run? If not, describe the road to long-term success.

WHAT'S NEXT?

Systems thinkers carefully consider the interrelationships among key elements that influence change over time. Their full attention to the consequences of actions and the patience required when responding thoughtfully is important in the next chapter. Resisting the urge to come to a quick conclusion is a high priority for systems thinkers.





Practice the Habit

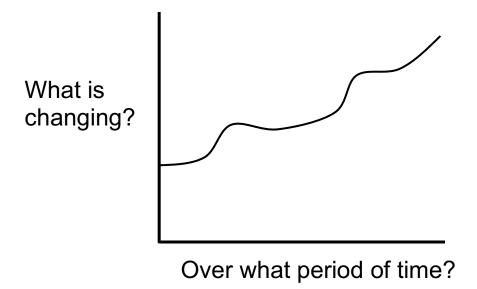
Identify a situation where you might be able to gain some clarity by changing your perspective. Apply the following questions to the situation to help you in seeking additional perspectives.

How does my point of view influence my understanding of the situation?
How might a different point of view inform my understanding of the situation?
Who could I approach to help me gain new perspectives on the situation?
If I truly understood that other person's perspective, what would I notice about my current situation?
How do different points of view influence my understanding of the system?

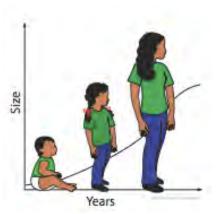
Behavior-Over-Time Graphs (BOTGs)

BOTGs show trends and patterns of behavior in a system, rather than discrete events.

BOTGs measure change over time and show "what" has happened in the system as represented by the graphed component.



Habit of a Systems Thinker related to BOTGs



A Systems Thinker observes how elements within systems change over time, generating patterns and trends

Balloon Dynamics





Don't forget to:

- _____ Title the graph
- Identify the X & Y axes
- ____ Label the X axis
- ____ Label the Y axis
- ____Use a line to graph the changes in "Y"
- ____ Use appropriate scale

Practice the Habit

Exercise #1: Choose one generic BOTG graph from the previous page (e.g. Linear growth or decline, oscillation, s-shaped growth, goal-seeking). Think of a scenario or story from your work or family setting that has a trend that matches the graph you chose. With another person, talk through your story while pointing at various parts of the graph, and see what kind of conversation develops.

Questions to think about:

Which graphs were easiest to apply to your workplace or family setting?

Which trends were more difficult to connect to your workplace or family setting?

Why?

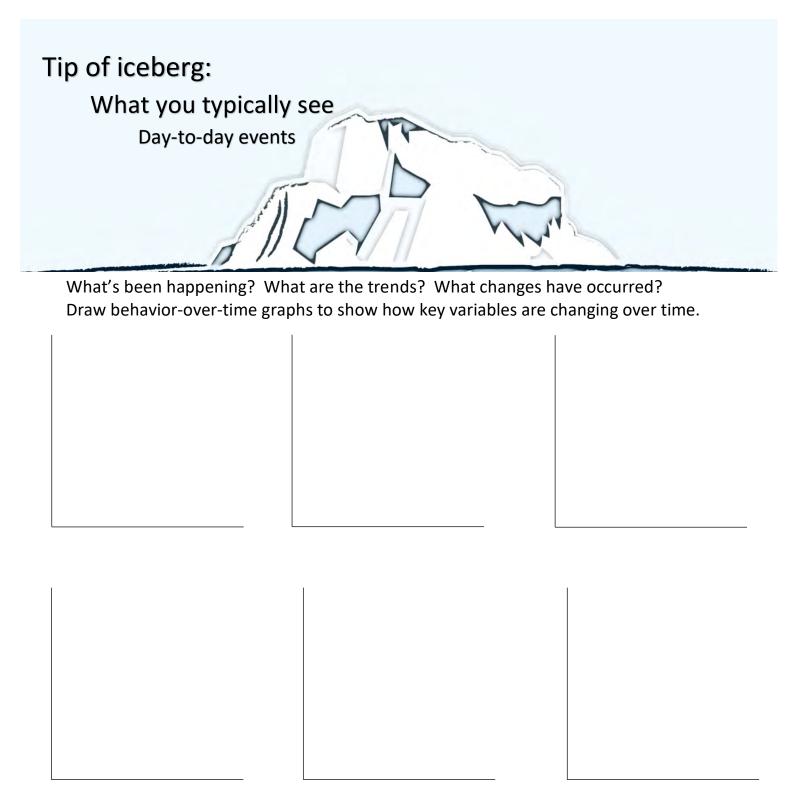
Exercise #2: If you keep a journal, identify important trends in your life that you are trying to impact. In addition to words, draw a BOTG in your journal to track your progress and make the change visible. For example, "I am trying to not be so negative when I am in team meetings." Draw a BOTG as a part of your journal entry and use it to show how your level of negativity changes over a week's time. This is a very quick way to enter a reflection in your journal even if you do not have the time to write a meaningful entry. Use the graph to show the shape of change as influenced by causal factors.



Changing Element _______

"Progress is impossible without change, and those who cannot change their minds cannot change anything." — George Bernard Shaw, author

Based on what you see in your system, what are some of the key variables that are changing over time?



Some sample questions to ask when identifying parts of a system that change over time:

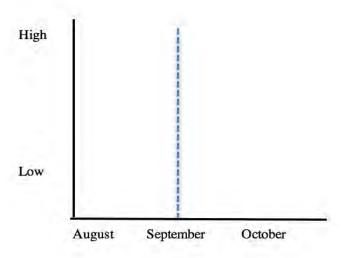
- What important elements have changed over time?
- How has _____ changed over time?
- During what period of time have the changes occurred?
- Where on the y-axis should the graph start and why?
- How would you label the bottom/middle/top of the y-axis?
- What evidence supports the graph being created?

Questions to consider once BOTGs have been created:

- What caused any changes in direction or slope?
- How are interpretations of a graphed element the same or different?
- What changes may happen in the future based on what has been happening?
- Do you see any connections (interdependencies or causal relationships) between/among graphs?

Use BOTGs to make trends and future possibilities visual:

• How has this element in the system changed over time, and how would we like it to change in the future?

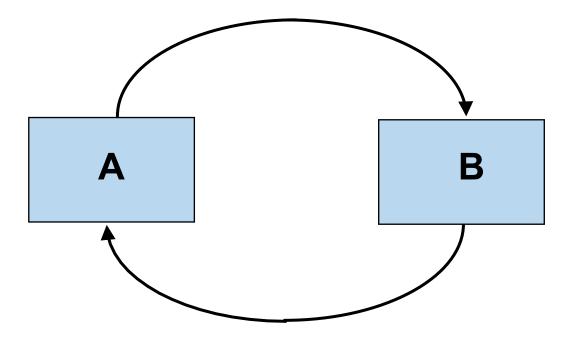


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Causal Loop Diagrams (CLDs)

also known as Feedback Loops

Feedback: As different parts of a system affect each other, causes become effects, which in turn become causes.



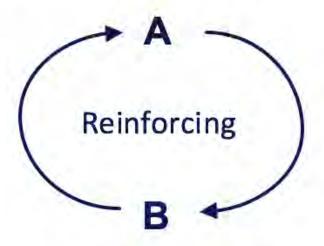
Habit of a Systems Thinker related to Causal Loops

A Systems Thinker identifies the circular nature of complex cause and effect relationships.



Reinforcing Causal Loops

Like a snowball rolling down a hill that gets bigger with each rotation, reinforcing loops represent escalating, compounding growth or decline.



Language one might hear when reinforcing feedback is present:

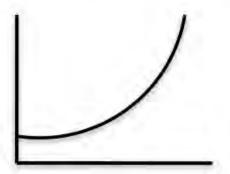
"Things are getting out of control!"

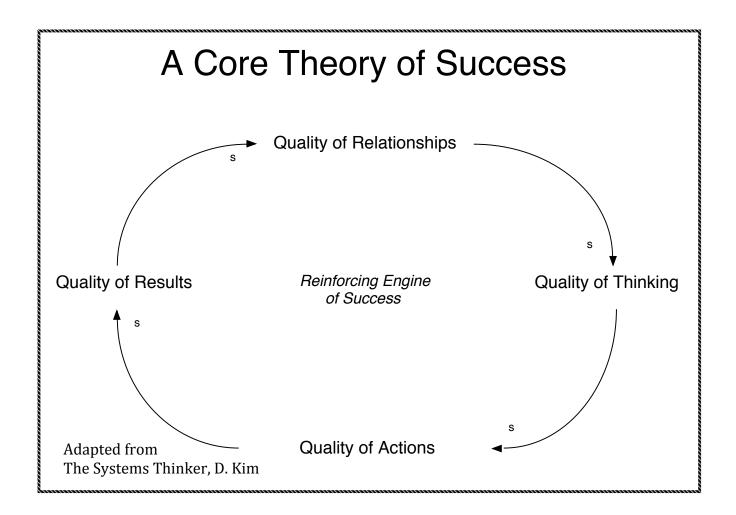
"I can't keep up!"

"We are really on a roll now!"

"The change seems to be doubling."

The behavior-over-time graph that shows reinforcing feedback





Quality of Relationships →

Capacity to work together, change perspectives to increase understanding, and recognize the importance of interdependence, team learning and mutual respect and trust

Quality of Thinking →

Use both divergent and convergent thinking.

Pose questions that generate innovative possibilities

Consider short and long-term consequences

Consider unintended consequences

Surface and test assumptions

Consider how mental models influence the ways people interpret situations

Quality of Actions →

Creative problem-solver

Informed decision-maker

Consider impact of results

Check results and change actions if needed: Successive approximation

Quality of Results →

Serving the needs of children, educators and community

Increased wellness of children, families and community

Increased efficiency and effectiveness of work teams

Ability to manage change

Healthy, engaging environment- "Joy in the workplace"

Employee buy-in

Consider the rollout of a new initiative for your organization. The following example includes questions and sample responses that lead to the development of a causal loop. This example serves as a lead-in to the causal loop practice on the next page.



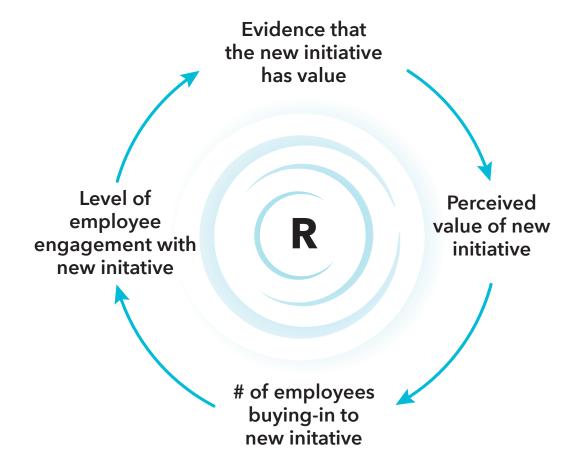
What aspect of your system would you like to see increase or decrease? Employee buy-in to a new initiative is critical to my organization.

What key factor causes an increase in employee buy-in? Itseems important for the employee to believe that the initiative has value, so a key factor may be perceived value of the initiative.

How is perceived value grown over time?

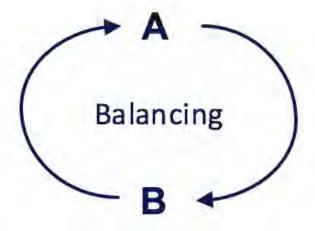
Having a quality experience that produces evidence that the new initiative has value would increase the perception of value. So, engaging employees in ways that surface this evidence would be an important factor in this system.

The more employees are engaged in ways that demonstrate proof of value, the more their buy-in will undoubtedly increase. This is a reinforcing loop.



Balancing Causal Loops

Balancing situations strive to achieve system goals or reach equilibrium.



Language one might hear when balancing feedback is present:

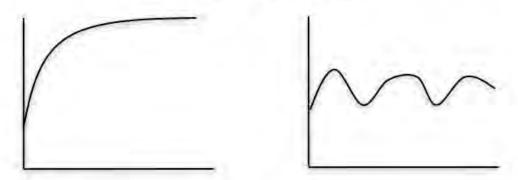
"We are experiencing some subtle ups and downs."

"I can sense that things are beginning to settle down."

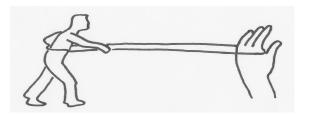
"We seem to be achieving balance and stability."

"The system is reaching our goal and closing the gap."

Examples of behavior-over-time graphs that show balancing feedback

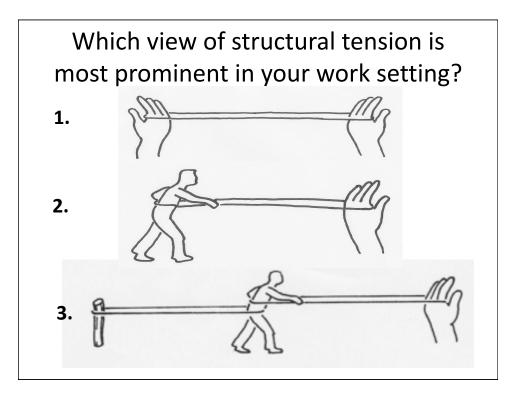


Creative (Structural) Tension



The gap between vision and current reality can be a source of energy. If there is not a gap, there would be no need for any action to move toward the vision.

The gap is the source of creative energy.

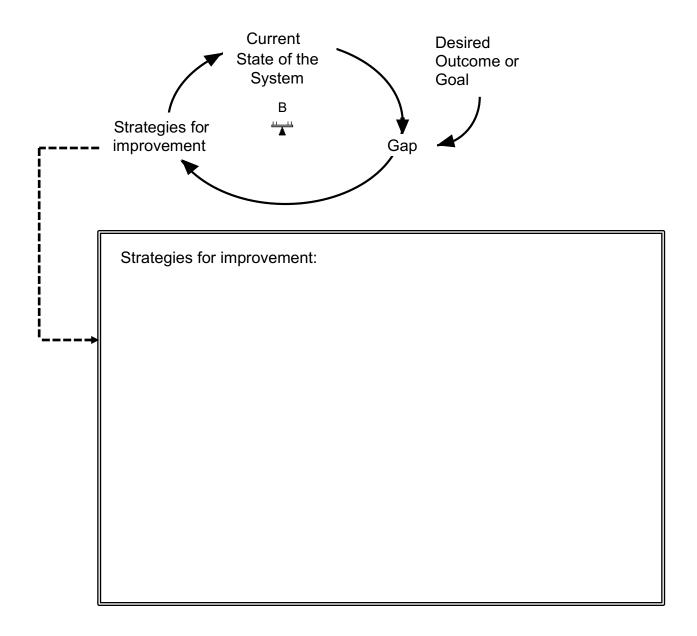


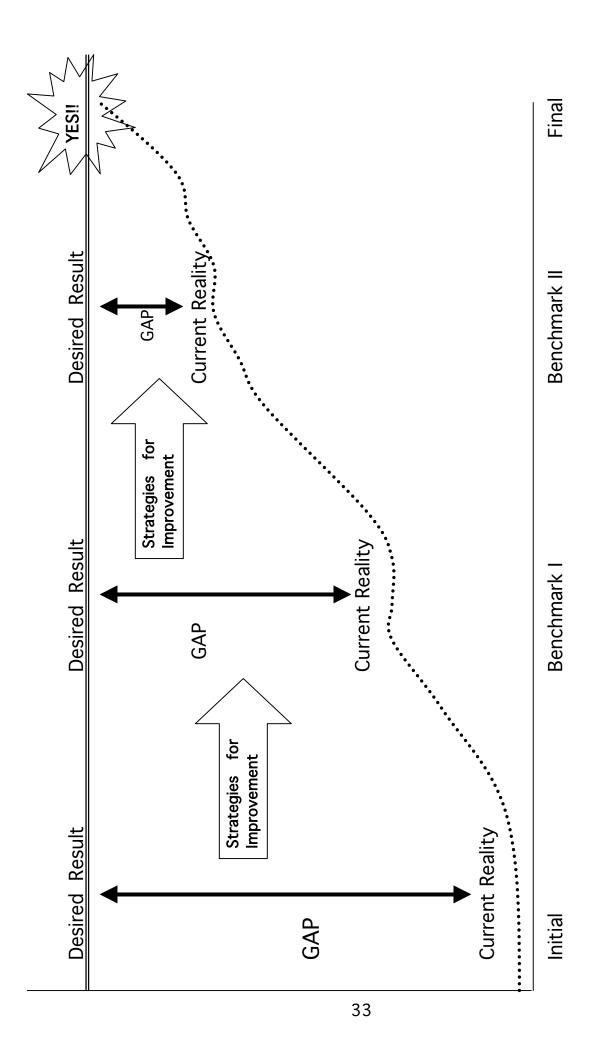
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Goal and Gap Planner

Indicators of Current State are:

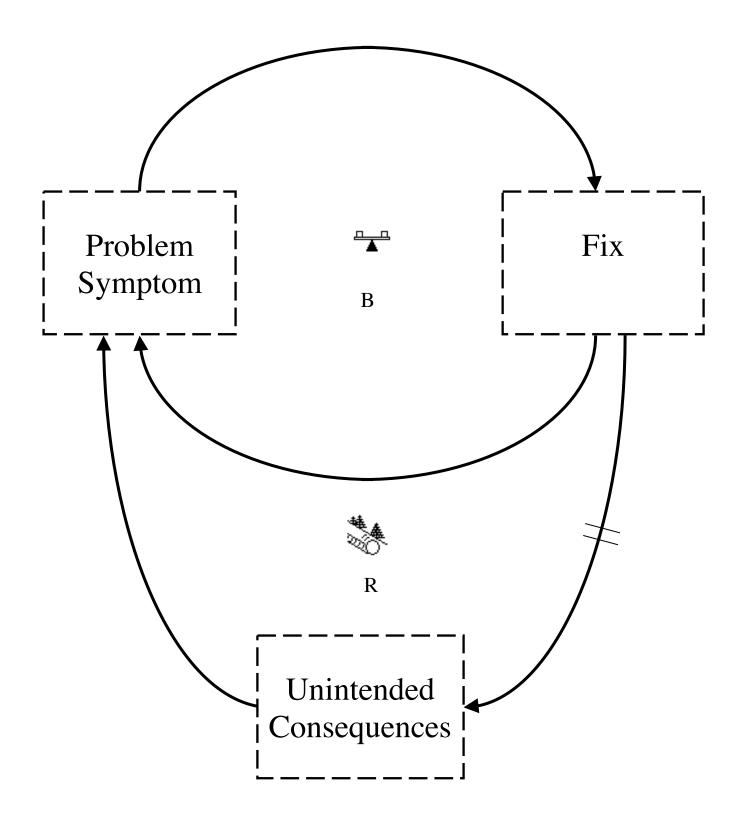
Desired Outcome or Goal is:





gap by a diminishing over time as illustrated Continuous improvement a vision: Realizing

Fixes that Backfire



Practice the Habit









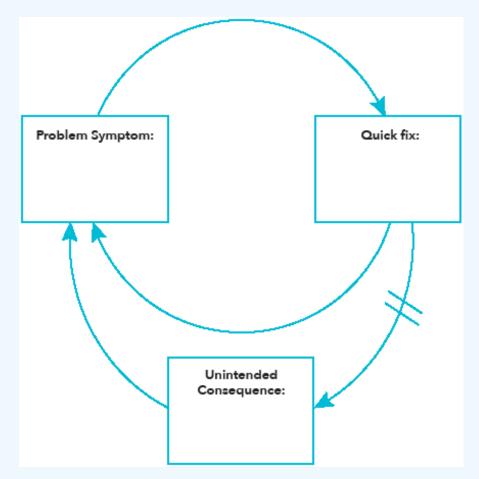


The causal map that illustrates the unintended consequences the children faced when they were asked to clean their room is a causal loop archetype called **Fixes that Backfire**. Causal loop archetypes tell common stories that are relevant to a wide range of contexts. **Fixes that Backfire** is just one of many causal loop archetypes.¹

Think of an issue in which you are weighing possible solutions.

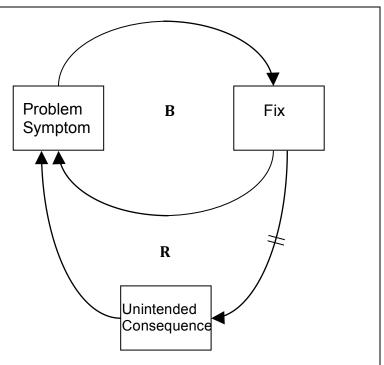
Use the Fixes that Backfire template below and identify the following:

- Problem symptom
- Possible quick fixes that would make the symptom go away (at least temporarily)
- Unintended consequences that would backfire by increasing the problem symptom (Notice the time delay symbol between the Quick Fix and Unintended Consequence.)



Tell the story of your Fixes that Backfire:

Systems Archetype: Fixes that Backfire



...when you think you've solved a problem in the short run, yet the solution actually makes the problem worse in the long run.

Description:

In a Fixes that Backfire scenario, a problem symptom requires a fix, oftentimes a "quick fix." The fix then alleviates the problem, resulting in a balancing dynamic that addresses the problem in the short-term. However, unintended consequences emerge as a result of the fix that come back and actually cause the original problem symptoms to reoccur and even become worse.

Ways out:

Breaking this cycle usually requires an acknowledgement that the fix was shortsighted. Efforts to generate a solution that minimizes the effects of the unintended consequences are needed.

As a tool for prevention:

The fixes that backfire archetype is a valuable tool to use before a fix is implemented. Ask people to consider the possible unintended consequences of a proposed fix. Both short-and long-term consequences and unintended consequences should figure into the discussion. An informed decision that considers all of the trade-offs of applying the fix will minimize the potential for backfire.

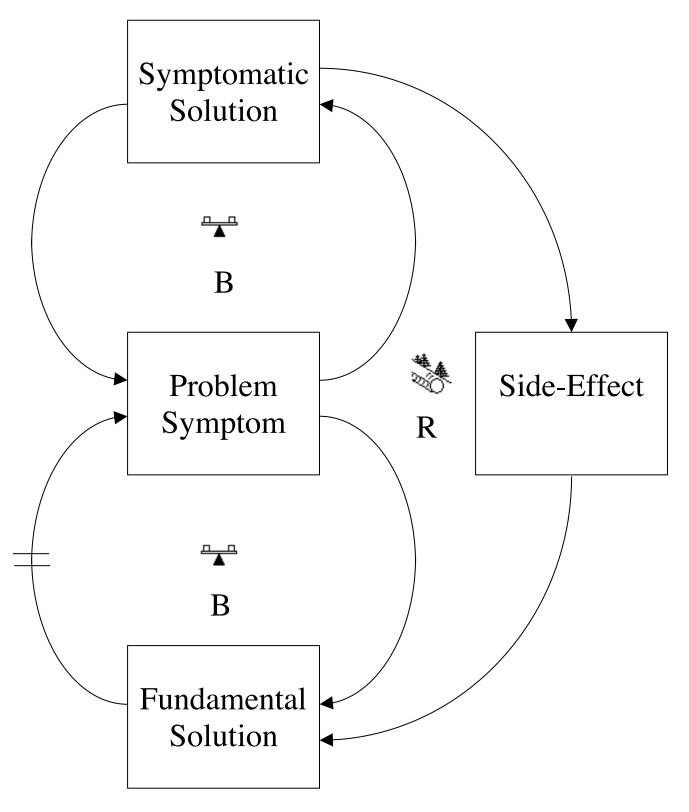
Questions to ask

Has the need to respond quickly to a problem been greater than the importance of investigating potential unintended consequences?

Did the response help to reduce the problem in the beginning, but overtime, did consequences actually contribute to the original problem?

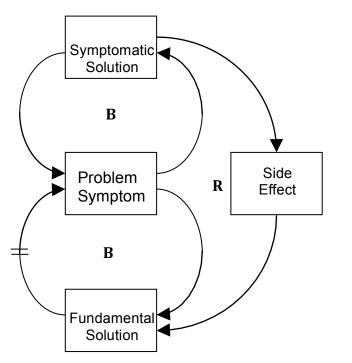
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Shifting the Burden



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Systems Archetype: Shifting the Burden



...when you choose a short-term solution and its side effect undermines your ability to implement a long-term, more fundamental solution.

Description:

In a Shifting the Burden scenario, a problem symptom is solved with a symptomatic "quick fix." The fix then alleviates the problem, resulting in a balancing dynamic that addresses the problem in the short-term. However, a side effect emerges that diverts attention away from more fundamental solutions. Side effects are often related to addictions or dependencies. The system can become more and more dependent on the symptomatic solution and less and less able to achieve a desired state.

Ways out:

Breaking this cycle usually requires an acknowledgement that the fix was shortsighted. Efforts should focus on the fundamental solutions and minimize the effects of side effects. Beware of symptom–relieving practices that don't really address the problem or delay attention to sustainable solutions.

As a tool for prevention:

The shifting the burden archetype is a valuable tool to use when deciding on solutions to problems. Whether a solution is symptomatic or fundamental often depends on one's perspective. Explore possible solutions from various perspectives. An informed decision that considers the potential for addictive or dependent side effects is preferable.

Questions to ask

Are actions taken to address the problem making it difficult to implement more fundamental, sustainable solutions?

What side effects result from solutions that may increase dependency and erode the capacity to implement a fundamental solution?

Practice the Habit

Identify an important decision that you need to make. Some possible examples include:











- Well-being analyzing the pros and cons of various health insurance plans
- Family selecting the best long-term care options for an elderly parent
- Work when to address an uncooperative co-worker
- School choosing a college or preschool
- Community how to vote on an upcoming ballot measure

1.	What is the decision that needs to be made?
2.	What is the timeline for making the decision?
3.	Is the timeline reasonable? What are the potential consequences of acting too quickly? What are the potential consequences if the decision is delayed?
4.	How can you manage the tension that may arise if the issue is not resolved immediately?
5.	What are the different perspectives that need to be taken into account when making this decision?

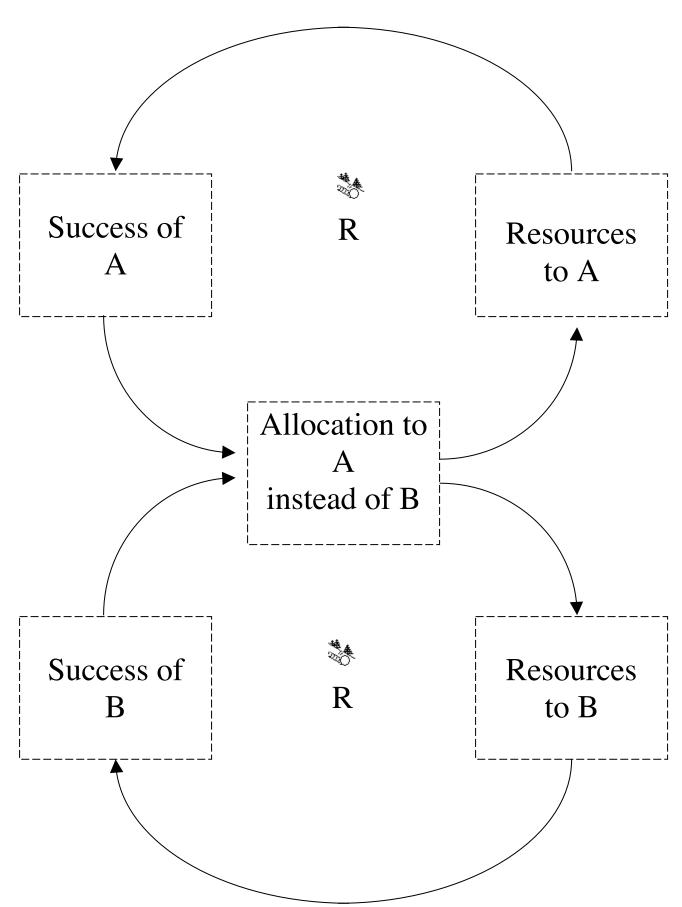
6. How can you help yourself and others be patient while living with an unresolved decision?

WHAT'S NEXT?

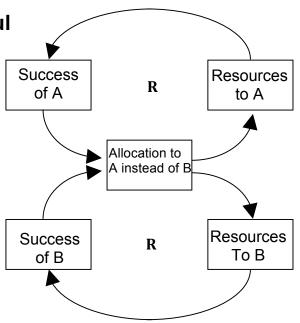
An additional way to consider an issue fully is to map the system or create a visual picture of the system. In the next chapter you will learn how a systems thinker uses accumulations and their rates of change to create a visual picture of the system.



Success to the Successful



Systems Archetype: Success to the Successful



... when one party receives resources because of past success which decreases the allocation of resources to a similar party

Description:

In a Success to the Successful scenario, one party has an increased chance of success when compared to another because the advantaged party continually receives more resources. An initial level of success justifies the award of additional resources. Systems tend to invest in entities that have demonstrated success. The diminished success of those who do not receive as many resources reinforces the justification of resources to the more successful entity.

Ways out:

Encourage collaboration and make efforts to seek equity. Address the tendency for groups to be labeled as winners or losers Eliminate the designation of "A" and "B," and bring all parties to one reinforcing feedback loop that tells the story of fair allocation of resources and success for all.

As a tool for prevention:

The Success to the Successful archetype is helpful when groups who do similar work tend to divide into competing groups when resources are limited. In order to minimize competition for resources, seek ways where resource allocation is fair and mutually beneficial. (or the group is involved in deciding on allocation ...)

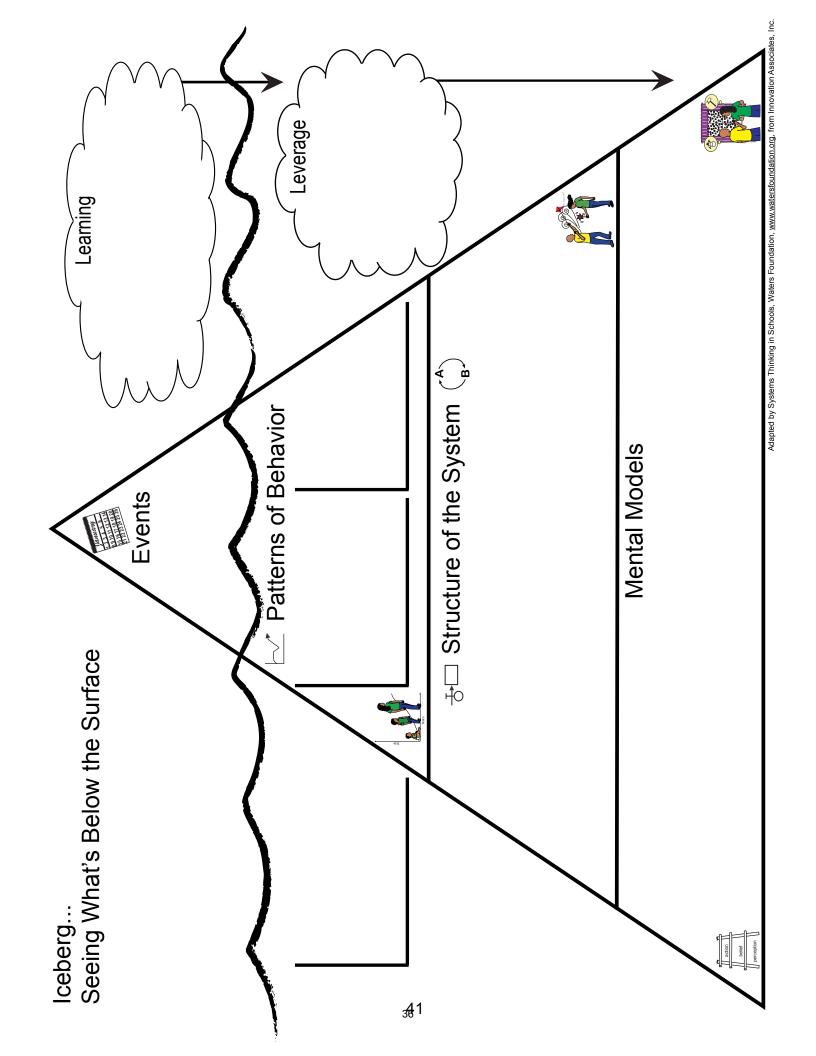
Questions to ask

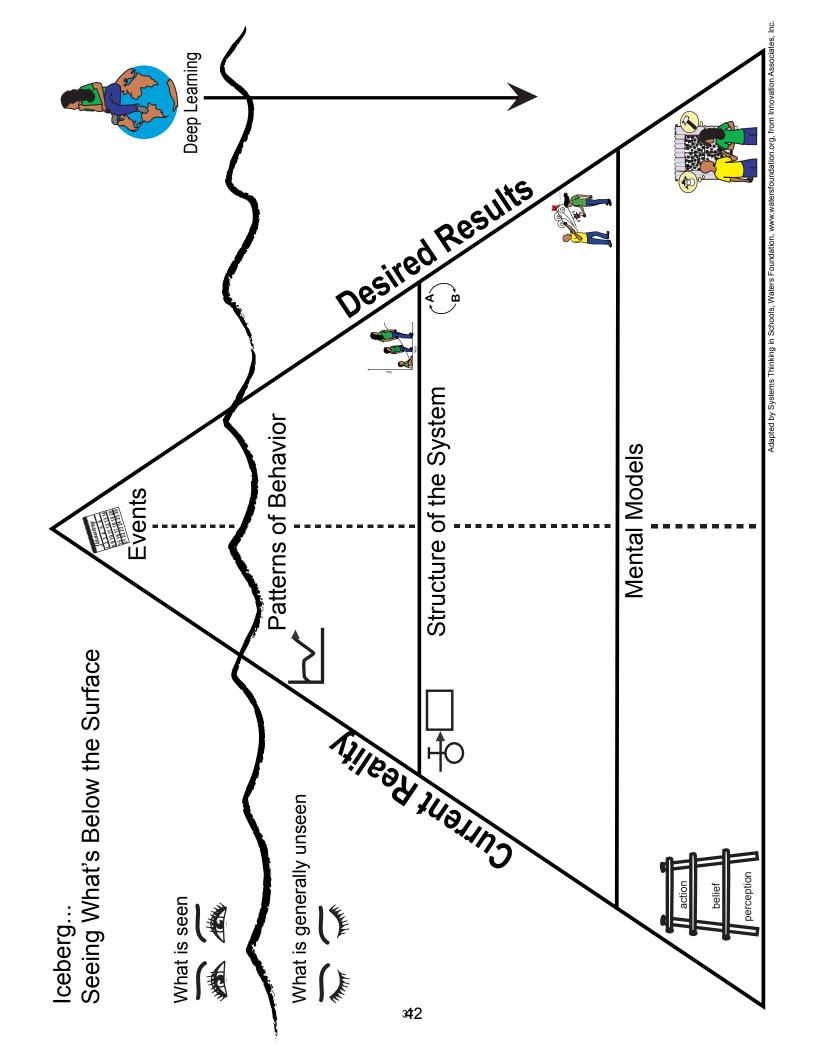
What options exist when allocating resources?

What results can we anticipate when resources are allocated?

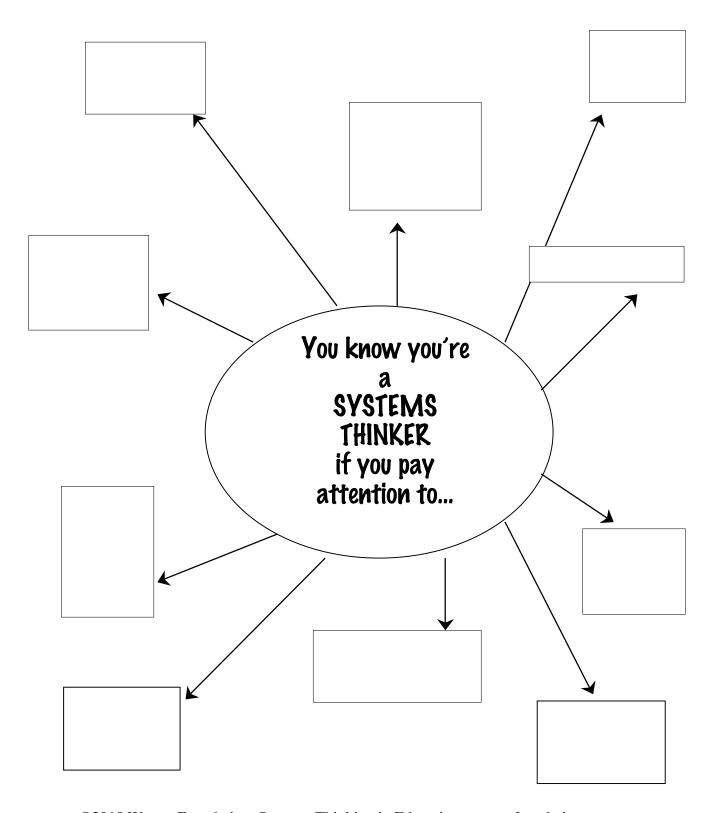
How can we foresee when gain for one will result in loss of support and limited gain for another?

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Habits of a Systems Thinker



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