INSTITUTE of PLAY

Design Pack

Systems Thinking

What if your students were empowered to tackle difficult problems within their lives, their communities, and the world at large? What if they could figure out how the factors of a problem are related, and use that knowledge to affect positive changes? What if they left your class as agents of change?

From the experts in systems thinking and learning at Quest Schools, this design pack is full of tools and resources you'll need to begin or expand the integration of systems thinking into your classroom.

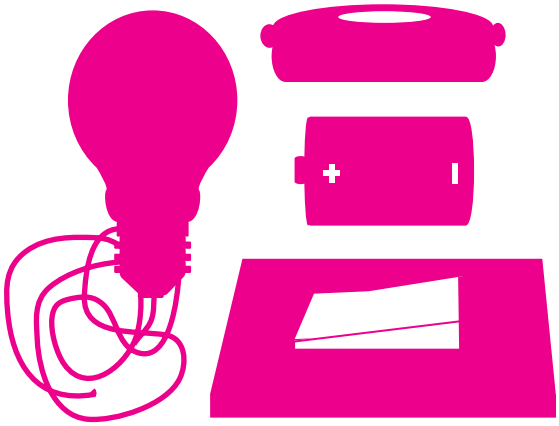
Version 1.0

Systems thinking means understanding a system by examining the linkages and interactions between the elements that compose the entirety of the system.

That is the core of systems thinking. And with this type of thinking, students and teachers can learn to make positive changes in systems.

What is a System?

Before digging into the details of systems thinking, let's look at what a system is and what it isn't.



This is a heap.
Not a system.

Nothing changes when a part is taken away or added to this heap.

This is a system.

Change definitely happens if you add or take away a part of this system.

Resource: Waters Foundation, 2013

How does a Systems Thinker Think?

Students wonder how to keep their school from being closed.

NOT A SYSTEMS THINKER

- **Think** of 1-2 reasons why the school is being closed.
- **Talk** to the principal about those reasons and see if he can stop the school from being closed.

A SYSTEMS THINKER

- **List** all factors that are involved in deciding to close the school.
- **Group** the factors according to similarities.
- **Identify** the largest group of factors and create a map of those factors showing how they are related to one another.
- **Find** places on the map where a specific change might improve the school.
- **Share and present** these changes at a school board meeting.

You wonder how you can stop feeling so tired every day.

NOT A SYSTEMS THINKER

- **Decide** to drink more coffee to increase energy.

A SYSTEMS THINKER

- **List** all factors that are involved with your tiredness.
- **Diagram** how drinking coffee affects your energy as well as sleep.
- **Identify** that coffee interferes with your sleep and that makes you more tired.
- **Decide** to stop drinking caffeine.

Teachers wonder how to lower hallway noise during passing periods.

NOT A SYSTEMS THINKER

- **Decide** to increase school security guards in the hallway during passing time.

A SYSTEMS THINKER

- **List** all factors that contribute to hallway noise, such as number of teachers in the hallway, number of students waiting to enter classrooms, number of students in bathrooms, etc.
- **Map** how all these factors are related to hallway noise and each other.
- **Identify** 1-2 factors from the map to change to see if hallway noise will lessen as a result.

How do I use this Systems Thinking Design Pack?

At our Quest schools, teachers and Institute of Play staff use the tools in this Systems Thinking Design Pack to support teachers and students in building knowledge and skills in systems thinking. We invite you to explore and playtest these tools in your own teaching and learning. After reading what is in this design pack, decide where you want to start.

Look for **tips & notes** for teachers and game designers.

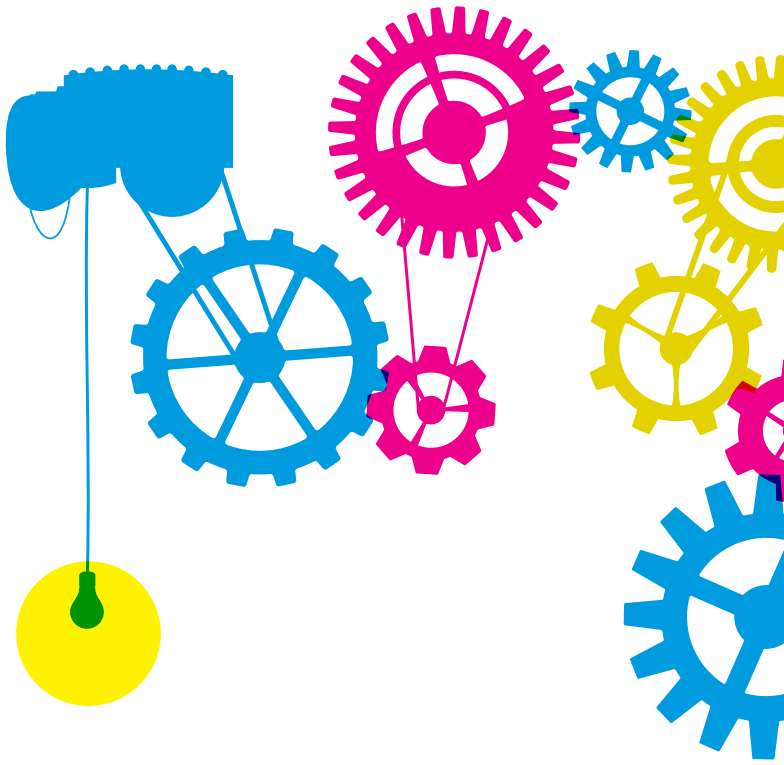
Here's what is in this pack.

TEACHING TIP

GAME DESIGN HINT

Systems Thinking Mechanics

To understand why systems thinking is an essential 21st century skill, it is important to learn more about systems thinking—what it is and how we use it.



What is Systems Thinking?

Systems thinking is looking at things as a whole rather than a jumble of parts.

"[Systems thinking] is understanding a world of interdependence and things continually changing. How do you see a system and not just a bunch of isolated things?
—Peter Senge, 2013

Using a systems thinking tool, students work with their teacher to examine a complex problem.

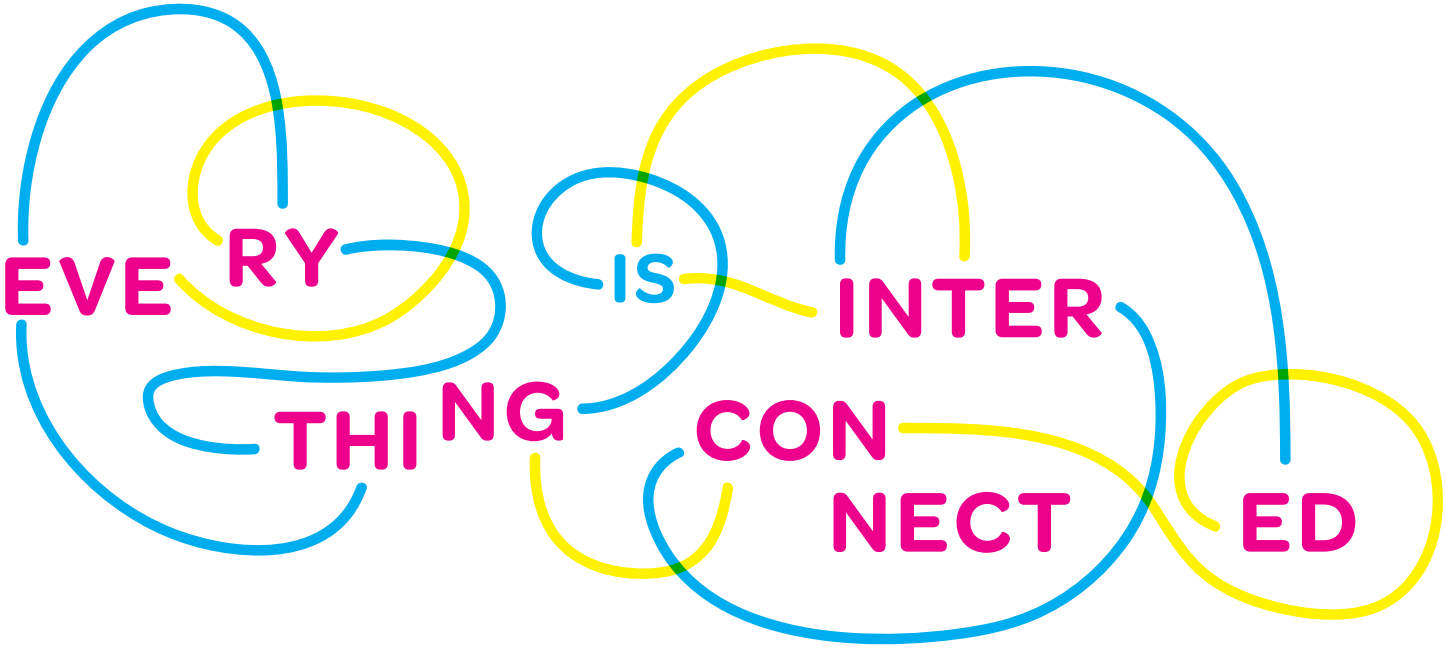
We believe it is essential to help young people understand how systems work, how they are represented, how they change—via direct or indirect means—and how to ask "what if" questions about future outcomes. We use systems thinking as a framework and set of tools to help students develop thinking skills that empower them to explore and understand complex problems.

So, what is a system? A system, human-made or natural, exists and functions as a whole through the dynamic interaction of its independent parts. When one part of a system changes, it affects other parts of the system, and ultimately affects the stability and sustainability of the system. Different systems include natural systems dealing with biodiversity, political systems made of associated institutions, economic systems that drive production, and social systems governed by rules.

Why Systems Thinking?

Systems thinking enables people to look at problems in new ways — and that leads to new solutions.

"Systems thinking pushes kids to really boost themselves up to think about a problem like they normally wouldn't."
— Quest student



By now, you might have realized that you have used systems thinking in your life, but that you never called it systems thinking. For instance, you may have taken a long-distance view of a problem and then zoomed in to examine details of the problem to figure out what you could change to address the problem. This type of thinking is systems thinking.

By using systems thinking, students can better organize and make sense of their experiences. As systems thinkers, students better understand how changes in one part of a system can affect other parts — everything is interconnected. Systems thinking also enables students to see patterns to help them organize their learning within and across content areas, as well as their experiences in and out of school. The power of systems thinking truly helps students build self-confidence and self-agency by enabling them to examine and address tough problems in their own lives, their communities, and possibly the world.

GAME DESIGN HINT

At Quest schools, game designers use systems thinking as much as teachers and students. Looking at games as systems provides structure for the design, critique and iteration of games.

Systems Thinking Habits of Mind

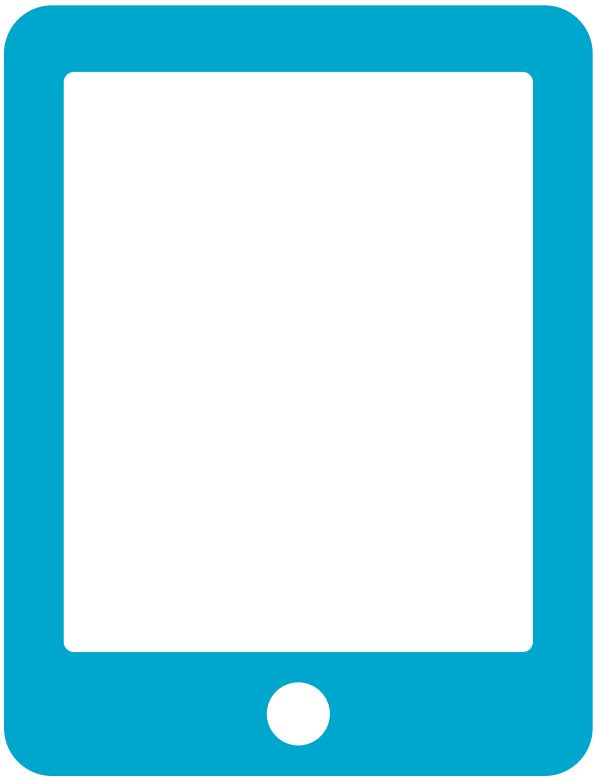
Systems thinkers use numerous habits of mind for problem-solving. These habits, which are useful in both school and life, include the following:

- Seeking to understand **the big picture**
- Seeing **patterns/trends** in systems
- Recognizing how a system's **structure** causes its behavior
- Identifying **cause and effect** relationships
- Surfacing and testing **assumptions**
- Finding where **unintended consequences** might arise
- Finding **leverage points** to change a system
- Resisting making quick **conclusions**

Resource: Waters Foundation, 2013

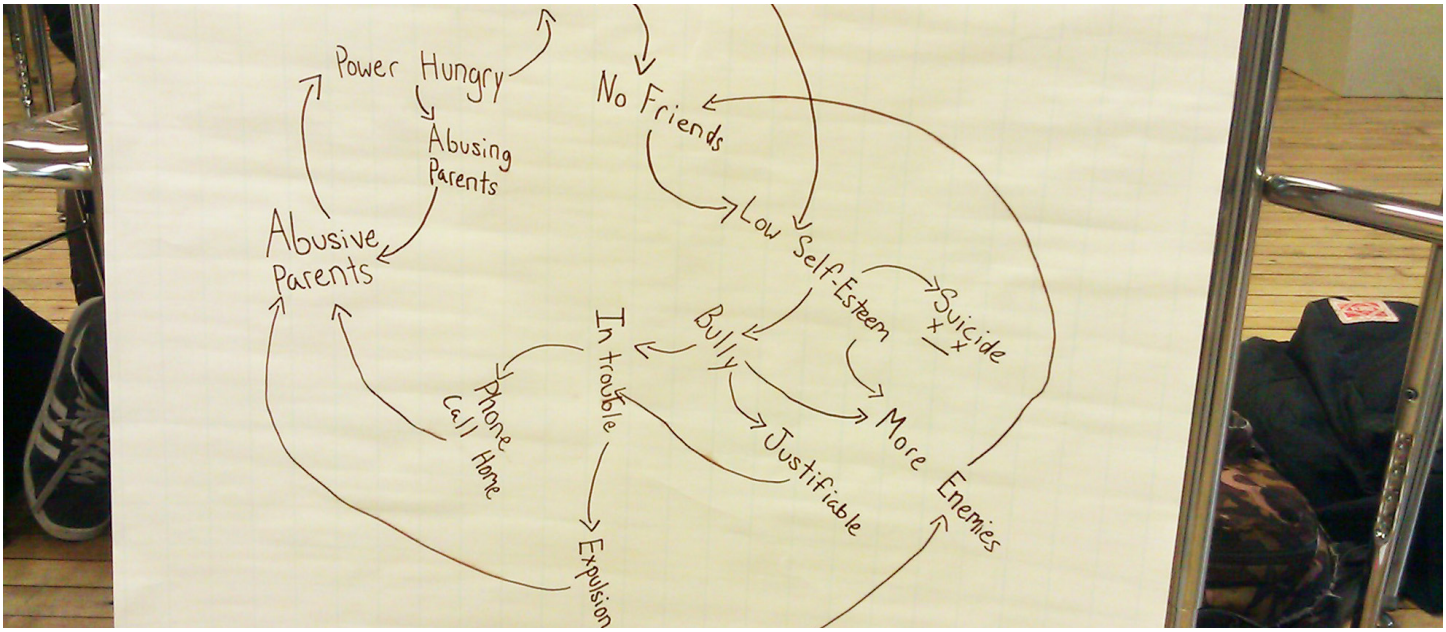
Systems Thinking in Schools

Integrating systems thinking into schools enables students to examine complex problems both inside and outside the classroom.



In the Classroom

Working together, students try to break the system of bullying.



Using a systems thinking tool, students work with their teacher to examine a complex problem.

Step 1: Observe.
"Jordan, would you mind sharing what you so courageously shared with me?" asked the teacher. Jordan, a 7th grader, looked at his shoes and repeated what he had said to his teacher. "I feel badly because I think I've been a bully sometimes."

Step 2: Define a problem.
Bullying is a widespread problem in schools. Jordan bravely acknowledged his role in the bullying problem as part of a weeklong immersion course during which Quest to Learn students created a campaign against bullying called Break the System.

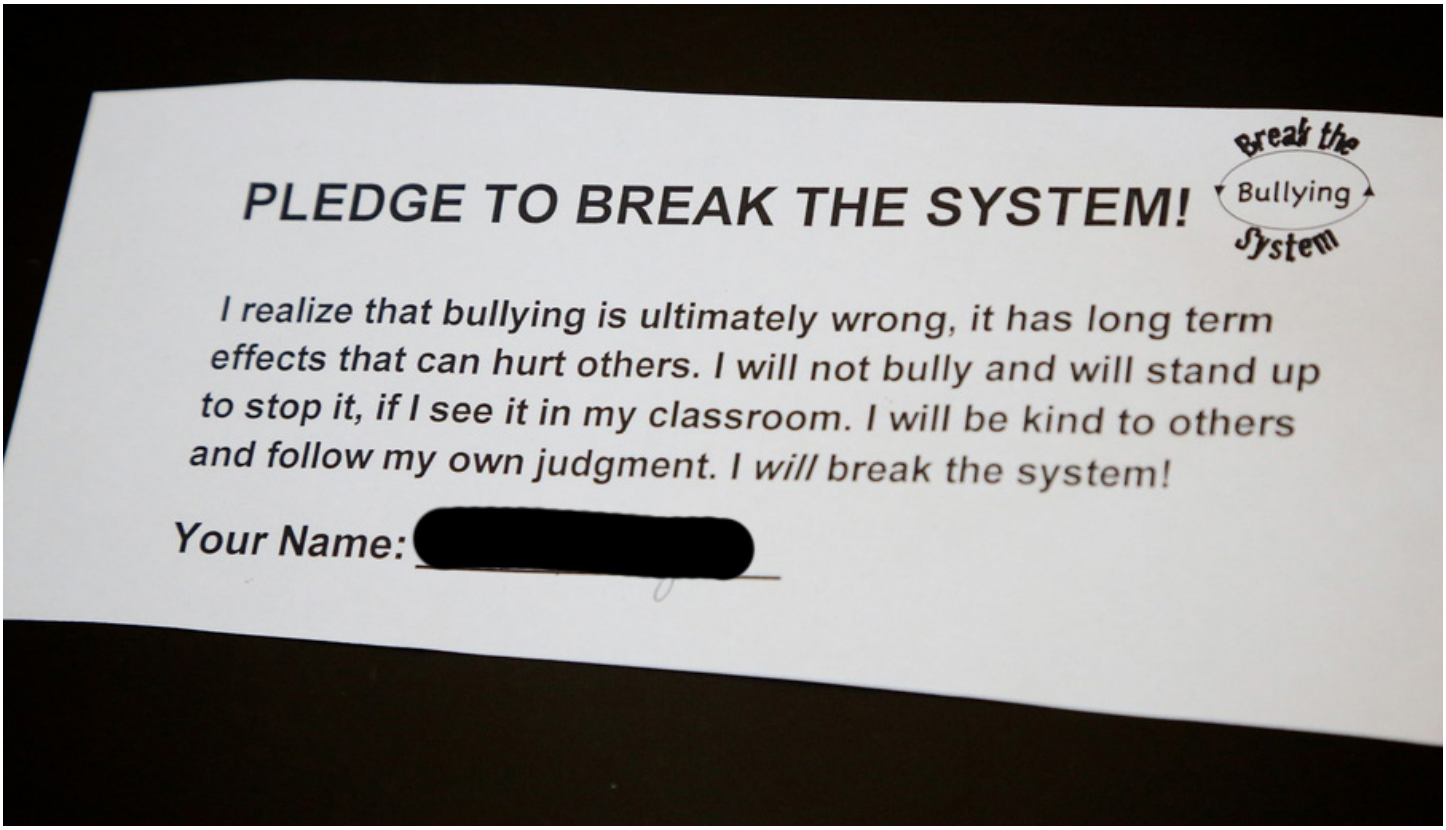
Step 3: Zoom in. Identify the parts.
At one point, noise of pens and pencils scribbling on Post-its filled the classroom as students wrote down as many factors involved in bullying as possible. Students then dropped to their knees and clustered similar factors together on the floor in the middle of the classroom. Looking down at the multicolored Post-its, students began to talk about relationships among factors in different clusters that they saw.

Step 4: See relationships. Look for the patterns and trends.
By looking at factors and their relationships, students now saw bullying as a system. They quickly realized that they might be able to stop bullying by changing things in the system of bullying. For instance, when kids don't stop bullying when it happens, more students are bullied. And when more students are bullied, more kids don't stop bullying when they see it happen. They knew they wanted to stop this cycle by helping their peers and other kids realize the important role of bystanders—to stop bullying when it happens.

Step 5: Identify leverage points. Break the system.
Jordan led the charge of creating a Break the System pledge that Quest to Learn students and faculty/staff could sign. They also believed that middle school bullying might lessen if they talked about bullying with younger kids. So, the students presented about bullying at neighboring elementary schools. This group of students took a problem, used different tools, and designed ways to affect positive change on bullying that was relevant to themselves, their community, and the larger world.

In the Classroom Reflection

Systems thinking enables students to see common structures and patterns within and across content areas.



A student created this pledge for all Quest students, staff and faculty to sign as one leverage point to address bullying in the school.

After reading about the bullying project, how did that student thinking differ from a learning experience in a typical classroom? The 12-year-olds in this class approached a relevant problem to their lives using habits of mind that enabled them to dig deep into the problem to both understand it and create thoughtful and positive change.

To think more about the value of systems thinking for youth, consider this question: how would the Quest students have addressed bullying without using systems thinking? We can imagine students might have only taken the perspective of the bullied into account, or focused on addressing bullying in only their school community, or immediately jumped to a fast solution. None of those actions would have dramatically changed bullying in Quest schools and possibly beyond.

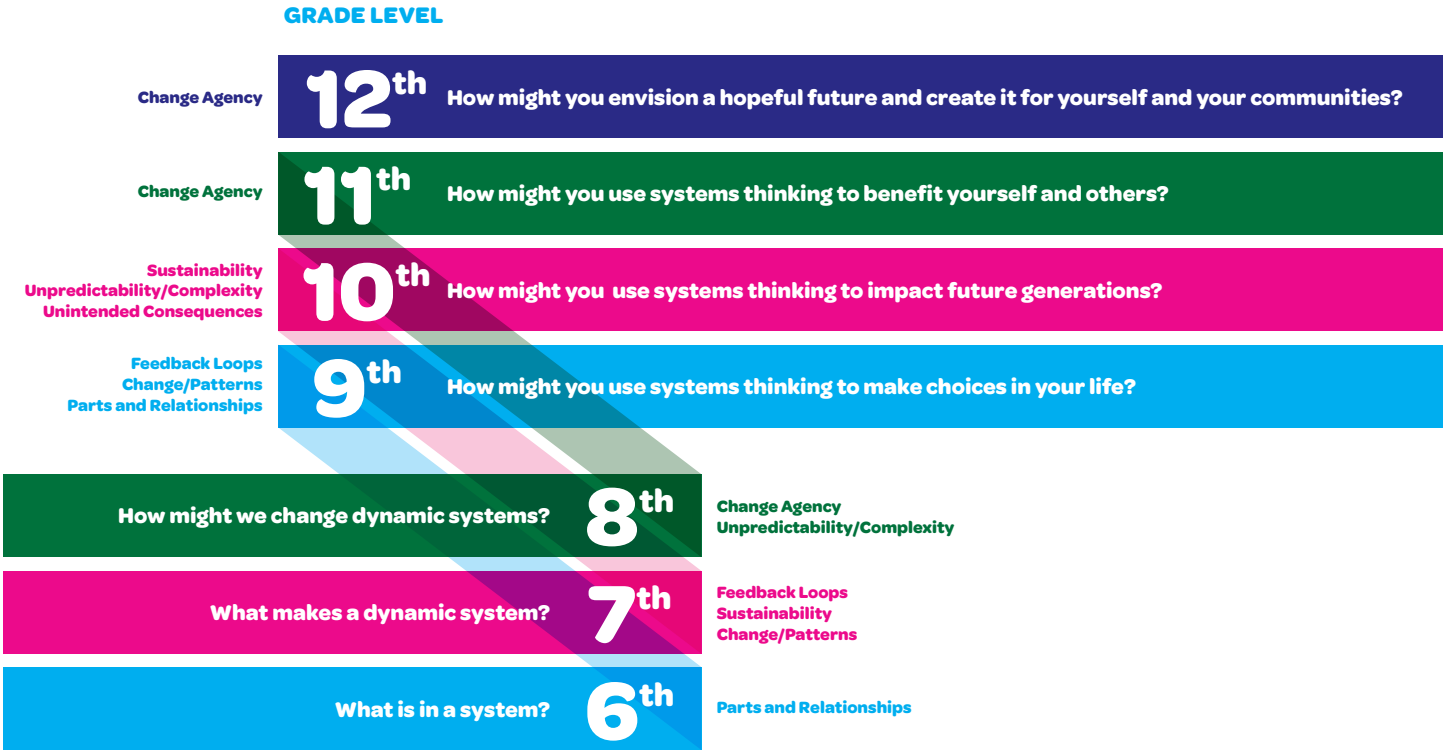
We use systems thinking as a framework to help students develop habits of mind that empower them to creatively examine complex problems.

Systems thinking is an invaluable 21st century skill for both youth and adults to use in educational and professional contexts, as well as in their daily lives.

Systems Thinking in Quest Schools

At Quest schools, we strive to develop not only systems thinkers, but also systems citizens who view themselves as members of a global community.

"I found systems thinking to be an amazing tool for me, as an educator, in breaking down large concepts that I wanted my students to understand."
— Quest Teacher



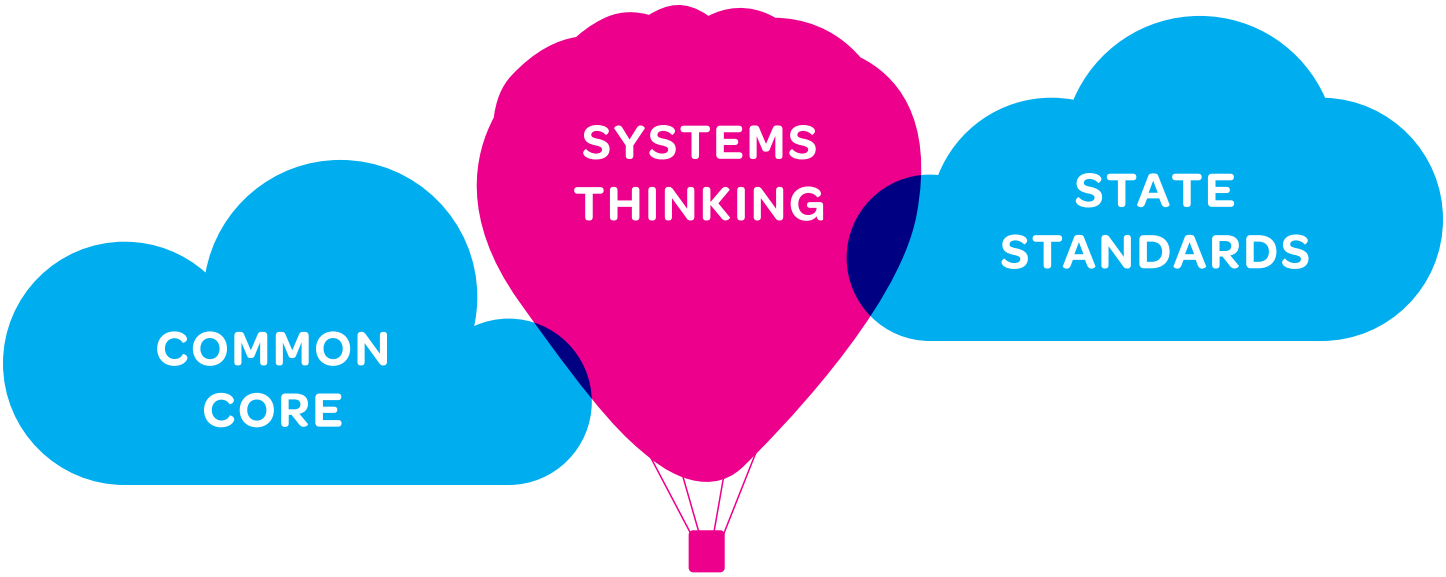
As systems citizens, Quest students strive to understand the complexities of systems in today's world, and to have the ability to tackle problems systemically to make a positive difference. We believe that it's not enough to instill this competency in current leaders—we must prepare the next generation to be effective and thoughtful stewards of the world they will soon inherit.

To guide students in their systems thinking/citizenship journeys, and teachers in designing this journey, we developed a middle and high school trajectory of concepts and questions. Year-long systems thinking questions and the corresponding concepts are connected to relevant subject matter within classes. This connection helps students understand how systems thinking can be used in not only one content area, but all content areas. Applying the same thinking across different classes helps students see interconnections among subject matter.

The trajectory begins with more basic systems thinking concepts and extends into more complex concepts. In 9th grade, students revisit concepts from middle school, but they use a lens focused on their own agency to make change in their communities using systems thinking. Throughout all the grades, Quest students repeatedly use a variety of systems thinking tools to help them both understand systems thinking concepts and apply systems thinking to new problems.

Systems Thinking and Standards

Systems Thinking provides ways of thinking and tools to help students reach learning goals aligned with Common Core and state standards.



A foundational component of present-day U.S. education is standards. Common Core and state standards contain what needs to be learned by students, but they do not highlight how students learn the standards. Teachers who use systems thinking and its tools to support their students in how they learn standards fully advocate for the widespread use of systems thinking.

First and foremost, systems thinking helps students make meaning of their experiences, both within and outside the classroom. Using systems thinking tools, students can take both birds-eye views and close-up views of complexity. And, in doing so, they come to understand the parts of a complex problem or concept and the relationships among those parts.

Understanding relationships and how a change in one part may impact other parts gives students ways to support their thinking with specific evidence. Argumentation and reading complex text are key aspects of the Common Core ELA standards. Additionally, because of its graphical nature, systems thinking enables students to make their mental models—or how they think about different concepts and constructs—visual. Creating representations of concepts and understanding are foundational to Common Core math standards.

Lastly, by using systems thinking tools, students begin to see structures and patterns common across concepts in different content areas. Seeing these common patterns and structures empower students to solve problems that might have seemed previously unsolvable.

What Makes a Good Systems Thinking Problem?

Here's a checklist.

Is the problem complex?
If so, it is a good systems thinking problem.

Do there seem to be multiple potential solutions?
If so, it is a good systems thinking problem.

Is the problem relevant to students?
If so, it is a good systems thinking problem.

If you can Google the answer,
it is NOT a good systems thinking problem.

Your Turn

To make learning about systems thinking more relevant to you, let's set you up to engage with the next section of systems thinking tools.

Reflection Questions

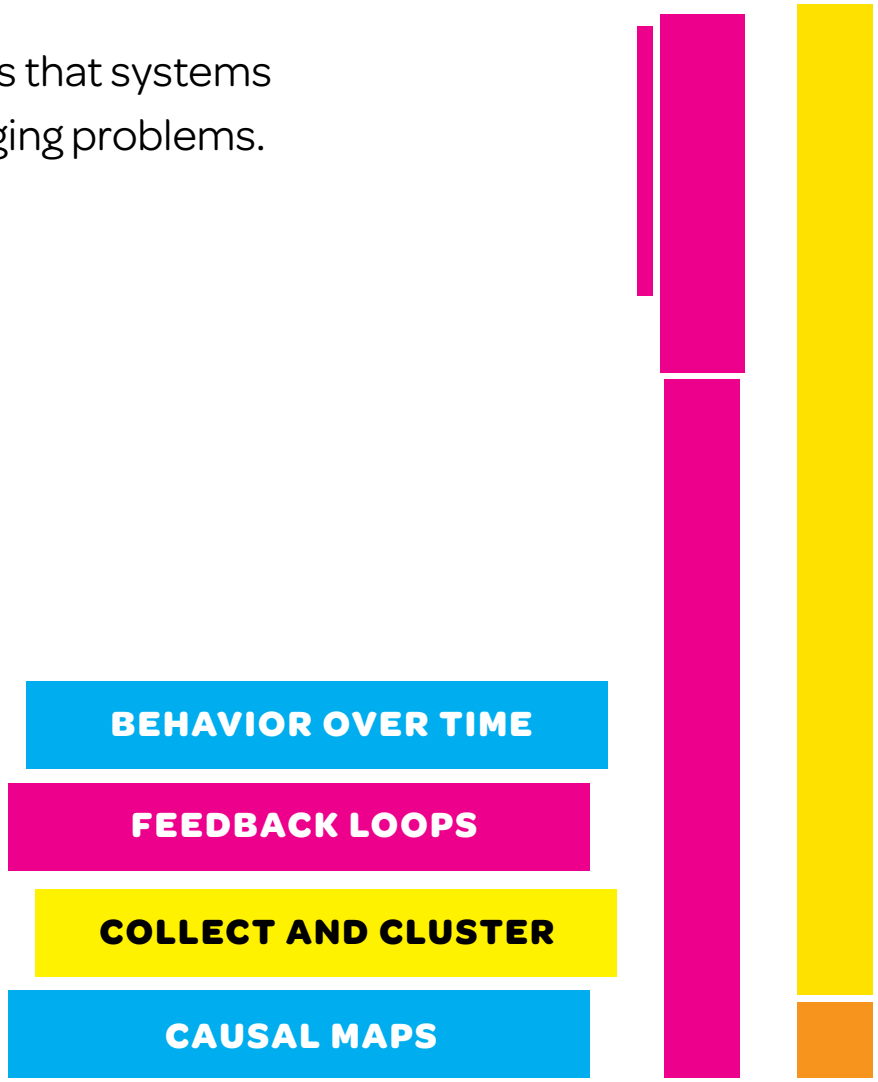
Take a couple of minutes and think about at least two problems you faced recently or are facing, either personal or work-related. *Examples may be trying in vain to cut down on eating sweets or constantly feeling stressed about spending too much time on work and not enough time with family and friends.*

Draw a picture, diagram, cartoon or whatever you want to represent these two problems in thespace provided and we'll return to them in a bit.

After learning about systems thinking and how it is integrated into Quest classrooms and schools, your next step is to learn about specific systems thinking tools and plan how to integrate them into your classroom.

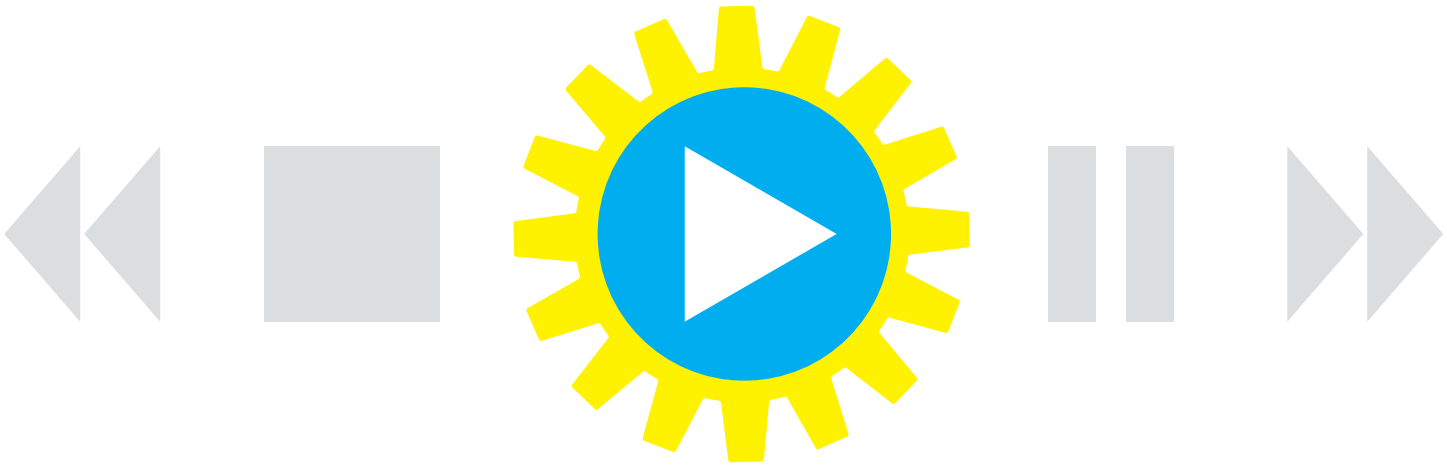
Systems Thinking Toolkit

Explore and play with the tools that systems thinkers use to tackle challenging problems.



Getting Started

The best way to learn something new is to jump right in....



After learning about systems thinking, it is difficult to immediately jump into teaching systems thinking. Some of us think systemically without realizing it. But to teach systems thinking requires naming this type of thinking and teaching others to use systems thinking tools. When students gain systems thinking habits of mind and tools, they are able to develop more deliberate strategies to tackle complex problems.

After testing out several approaches to help teachers develop this mindset in order to support them in helping their students develop the same mindset, we discovered that the best entry point to systems thinking is by sharing and using a series of systems thinking tools. These tools help students build and strengthen the habits of mind associated with systems thinking (listed on p. 9).

In the next sections, we will introduce the systems thinking tools, field-tested in both Quest classroom lessons and professional development sessions, and their direct link to building specific habits of mind for systems thinking.

When Quest teachers were given time to play with and practice using the systems thinking tools, and supported in implementing the tools into their teaching, we found:

- Teachers were more apt to use the tools in their classrooms because they spent time understanding their value and becoming comfortable with them;
- Teachers saw how these tools can be used across content areas; and
- Systems thinking became more prevalent in the school with more students engaged in using systems thinking tools in many of their classes.

THE TOOLKIT

Four systems thinking tools are in this design pack—behavior over time graph, collect and cluster, feedback loop, and causal map.
Each tool section includes:

- a description of its use
- user directions
- sample answers to key questions
- topic integration ideas
- an exercise for you to practice using the tool

It is important to note that we did not create any of these tools, but adapted them for our use from Peter Senge, the Waters Foundation and Creative Learning Exchange.

Advice for Teaching

To enable students to successfully use systems thinking tools, keep in mind these effective teaching techniques seen in all great classrooms.

Always have exemplars of finished products to show students.

Model using a tool by thinking aloud as you use the tool in an example.

Circulate and check-in with students as they work.

Establish norms and expectations around small and whole group discussions.

Provide opportunities for students to see each others' work.

TEACHING TIP

When planning with systems thinking tools, always remember to answer these three questions:

1. What are the learning goals for your students?

2. How will using systems thinking tools help them reach the goals?

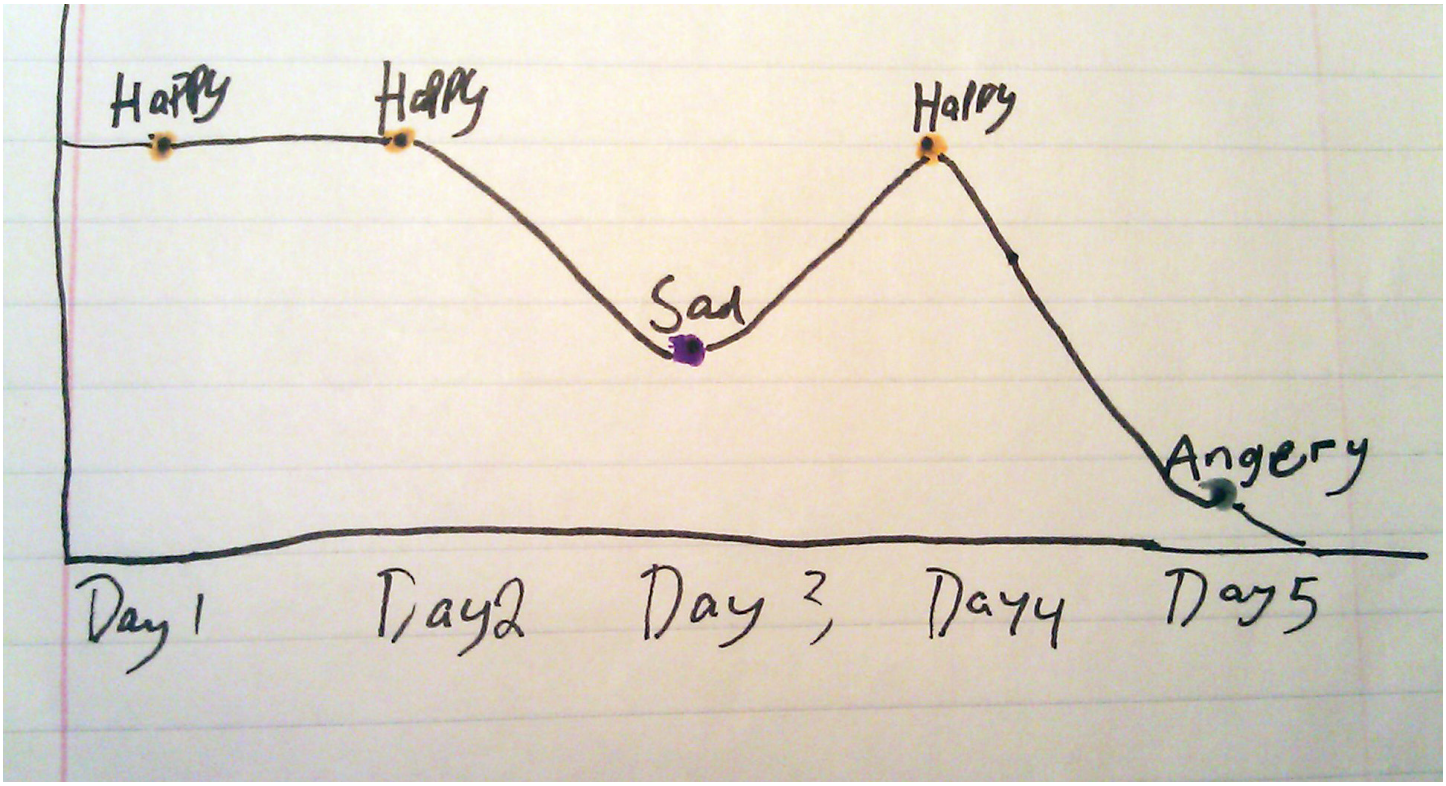
3. How will you know they reached the goals? (What are the student outcomes?)

A teacher always asks the same key questions so that students begin to always ask the questions of themselves and each other when using each tool.

The tool is only a powerful learning tool if students are asked to answer the questions, too. Repeated use of the same questions in all different classes creates a consistent culture of use around the systems thinking tools in a school.

Behavior Over Time Graph (BOTG)

A simple graph with horizontal (time) and vertical (changing factor) axes showing change over time.



A student graphed his emotions during the past five days.

Habits of Mind

- **Seeking to understand the big picture**
- **Seeing patterns/trends in systems**
- **Surfacing and testing assumptions**

Students, working in pairs, carefully drew two axes of a graph. "Now, decide if you are graphing your stress level over one day or three days or a week. Label your x axis based on what you decide," instructed the teacher. A hum in the room grew and grew as students drew their stress level graphs and began to share their lives with each other. After seven minutes, the teacher said, "Time's up! Let's hang up our graphs on the walls and get ready to have a gallery walk to look at everyone's. These look great, guys." Students hung up their graphs and slowly began to walk around the room to look at their peers' work. After three minutes, students sat down and the teacher asked, "Okay, did you see any patterns in our stress levels over the course of a day, three days or a week?" 26 hands shot up immediately.

Lesson Outcome: In Wellness class, students will write short analyses of BOTGs (their own and a peer's) with a specific focus on highlighting patterns.

Behavior Over Time Graphs

Key Questions

- **What changed?**
- **How did it change?**
- **Why did it change?**
- **Why is this change important?**

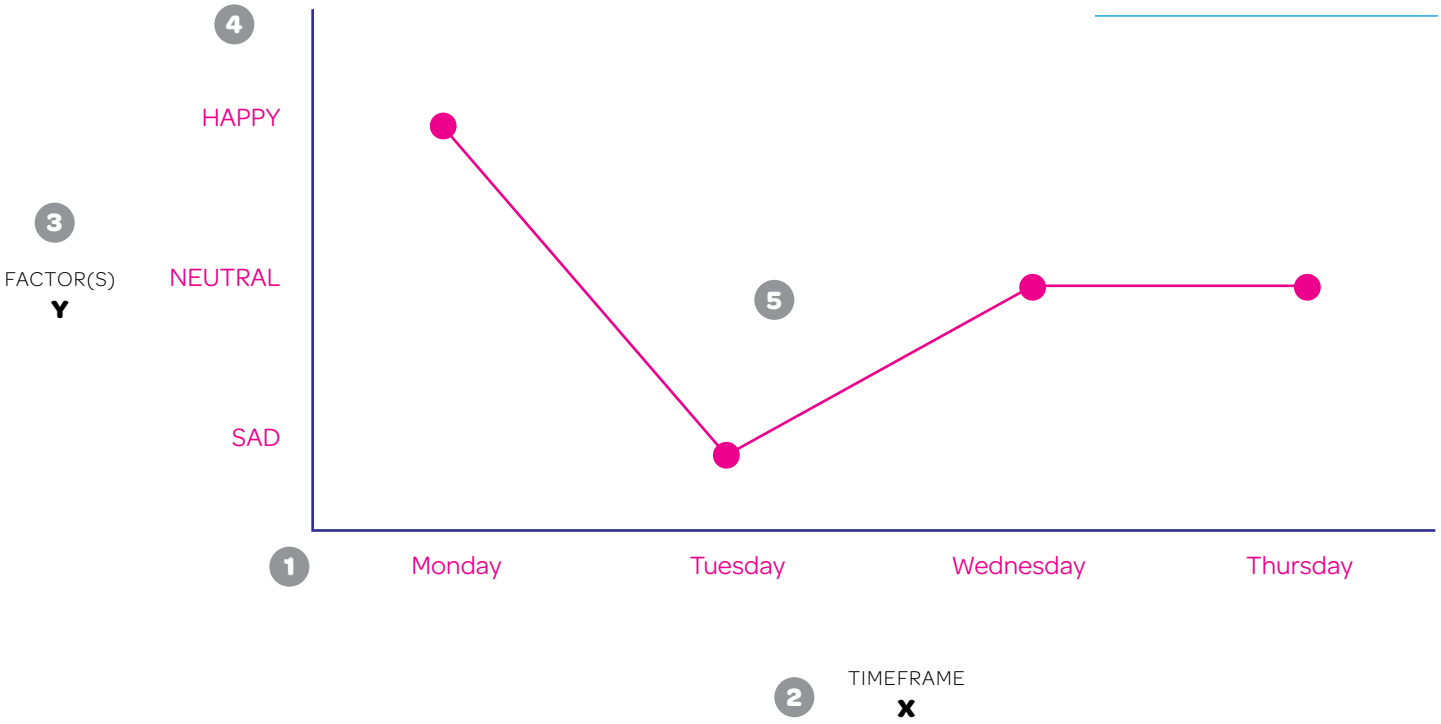
SAMPLE KEY QUESTION ANSWERS

What changed? My feelings changed.

How did it change? I was happy on days 1, 2, and 4. Then I was sad on day 3 and angry on day 5.

Why did it change? On day 3, I left my science homework at home and I got in trouble. On day 5, I left my homework at home again and because it happened again, I was angry.

Why is this change important? 'Cause I can see why I was sad and angry. I can try to remember my homework every day. Or I can write myself a note to make me remember.



1 **Draw x** and **y axes.**

2 **Label x in units of time.** The units of time that you choose will enable you to see different patterns, so be thoughtful about the units you choose.

3 **Label y as factor** being graphed.

4 **Create scale for y factor.** Does not have to be numerical. Could be "more"/"less", "hot"/"warm"/"cold."

5 **Create the graph.** If you don't have exact data, use estimation in creating the graph.

6 **Answer** the four key questions.

Topic Integration

SCIENCE
Is climate change happening?

MATH
What is the best way to save for college?

ELA AND FOREIGN LANGUAGE
How does the author affect your emotions as you read Harry Potter and the Deathly Hallows?

HISTORY
Has war always been a part of human civilization since the beginning?

WELLNESS
How does what you eat impact how you feel?

CLASSROOM MANAGEMENT
How do I make my lessons more engaging?

EXTENSION

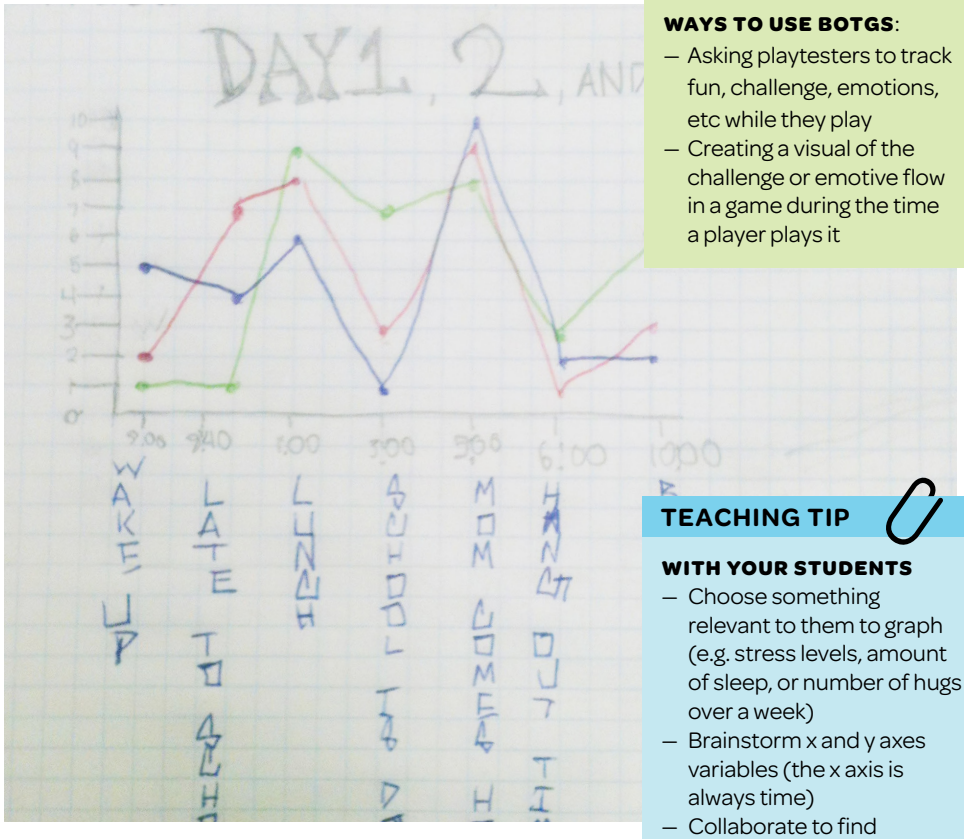
Use BOTG by asking students to include two or more factors in their BOTG.

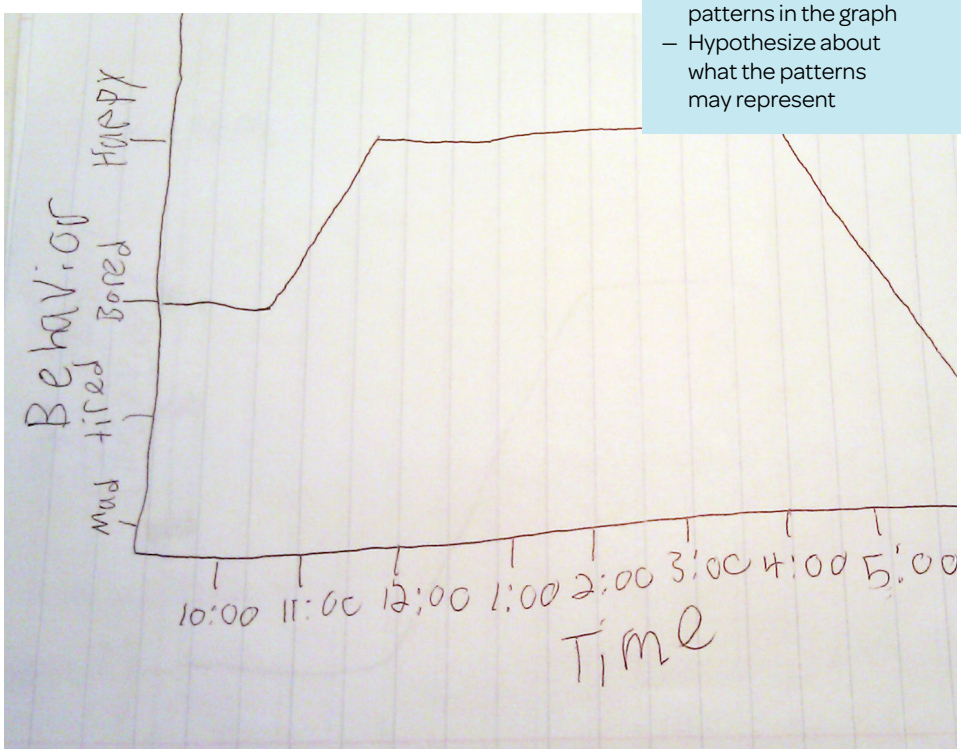
GAME DESIGNER HINT

WAYS TO USE BOTGS:
- Asking playtesters to track fun, challenge, emotions, etc while they play
- Creating a visual of the challenge or emotive flow in a game during the time a player plays it

TEACHING TIP

WITH YOUR STUDENTS
- Choose something relevant to them to graph (e.g. stress levels, amount of sleep, or number of hugs over a week)
- Brainstorm x and y axes variables (the x axis is always time)
- Collaborate to find patterns in the graph
- Hypothesize about what the patterns may represent





The two BOTGs above show different student representations of their emotions. Above: The BOTG shows a student's stress levels and how they varied over three days. Below: A student's BOTG shows changes in his feelings during one day.

NOW TRY IT

Use one of the personal/ professional problems that you identified on p.17 to create a BOTG.

Label the x and **y** axes.

Choose your time frame for the x axis carefully to help you identify any patterns or interesting data points.

Answer the 4 key questions.
What changed?
How did it change?
Why did it change?
Why is this change important?

Reflection Questions

What did you discover from your Behavior Over Time Graph?

How do you imagine you could use this tool in your classroom?

Collect and Cluster

An exercise to create a list of factors in a problem and then group them together to discover patterns.

In history class, an 8th grade student lists factors involvd with preventing war between the U.S. and Iran on Post-it notes.

Habits of Mind

- **Recognizing how a system's structure causes its behavior**
- **Surfacing and testing assumptions**

"Economic sanctions," yelled one 8th grade student while another said, "Send UN inspectors" One student in the group busily wrote the two ideas on two different Post-its. "What else?" asked the student. In the room, all students were engaged in generating a list of factors involved in preventing a war between the U.S. and Iran.

After five more minutes, the teacher said, "All eyes up here." She went on to explain she wanted each student group to put their Post-its, ranging in number from 15-18, on chart paper. Then, students were given the challenge of grouping the Post-its based on similarities that they established. A flurry of movement erupted with hands raising brightly colored Post-its and students discussing their reasons for why they were grouping different Post-its together.

Lesson Outcome: In History class, students will identify different types of factors/strategies involved in preventing wars.

Collect and Cluster
Key Questions

- **Why did you cluster your Post-its as you did?**
- **How did clustering the Post-its help you begin to explore the problem?**

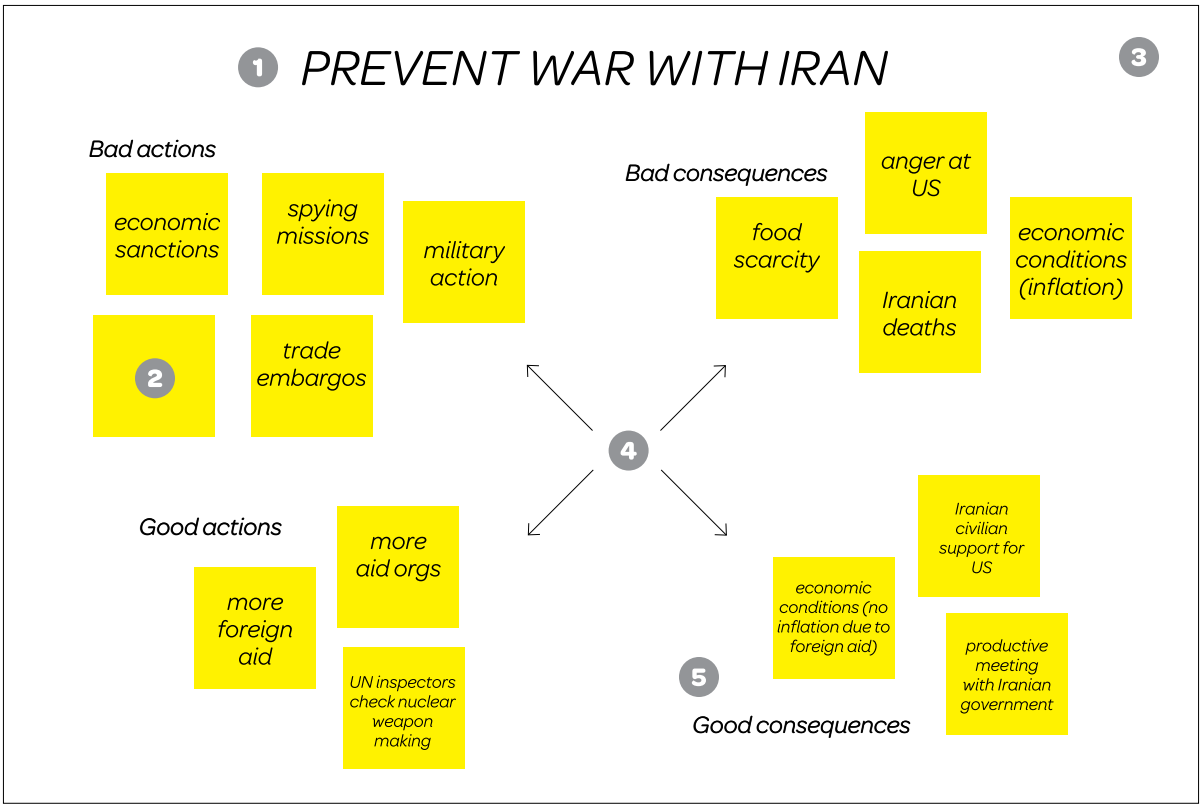
6

SAMPLE KEY QUESTION ANSWERS

Why did you cluster your post-its like you did? We clustered our post-its into good and bad groups.

How did the clustering help you to start to explore the problem? We wanted to look more at good actions, not bad ones for the people in Iran, that could prevent the war. Now we can focus on those ones in our work

What are the factors and cluster titles you came up with? We named our groups of Post-its: Bad and good actions and bad and good consequences. You can see on our poster (see graphic below) all the factors that we put in each group.



1 **Identify problem**.

2 **Using Post-its, list all factors** that may affect the problem on separate Post-its.

3 **Put post-its on a wall** or table.

4 **Cluster similar Post-its** together.

5 **Try to title each cluster** of Post-its to indicate commonality.

6 **Answer the two key questions.**

Topic Integration Ideas

SCIENCE
Why doesn't the pond near our school have any fish in it?

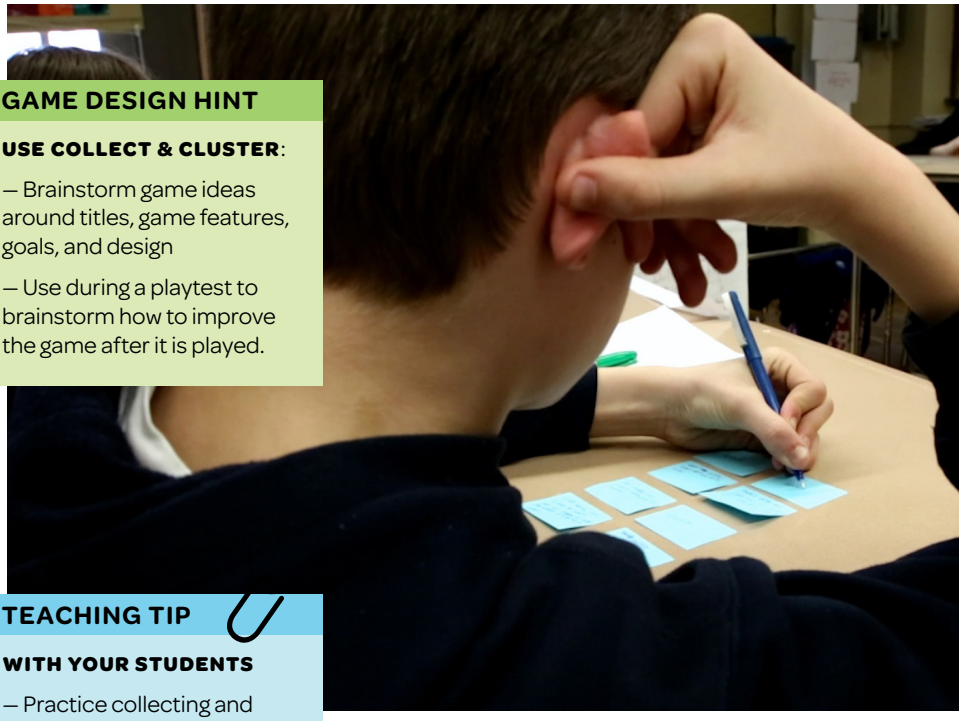
MATH
How are the money saving patterns similar or different between low-income, middle class, and the wealthy?

ELA AND FOREIGN LANGUAGE
How are Shakespeare's characters similar or different from some of your favorite movie/TV/book characters?

HISTORY
How do governments monitor their citizens in today's society?
What about in the past?

WELLNESS
How do food companies convince you to buy their food?

CLASSROOM MANAGEMENT
What influences student engagement in my classroom?



GAME DESIGN HINT

USE COLLECT & CLUSTER:

— Brainstorm game ideas around titles, game features, goals, and design

— Use during a playtest to brainstorm how to improve the game after it is played.

TEACHING TIP

WITH YOUR STUDENTS

— Practice collecting and clustering with an easy exercise (e.g. everyone throws a shoe in the center of the classroom and student groups classify the shoes)

— Identify 1-2 most popular categories from all student groupings

— Encourage students to write as many of their ideas on Post-its as possible

Above: An 8th grade student writes down factors that he thinks are involved in preventing a war with Iran. Below: Then, in groups, students clustered their factors according to similarities and explained their groupings to their teacher.

NOW TRY IT

Take the problem that you used to create a BOTG.

Write the problem on big sheet of paper.

Write out parts/factors of that problem on Post-its

Cluster similar parts/factors.

Answer these two questions:

1) Why did you cluster your Post-its as you did?

2) How did clustering the Post-its help you begin to solve the problem?

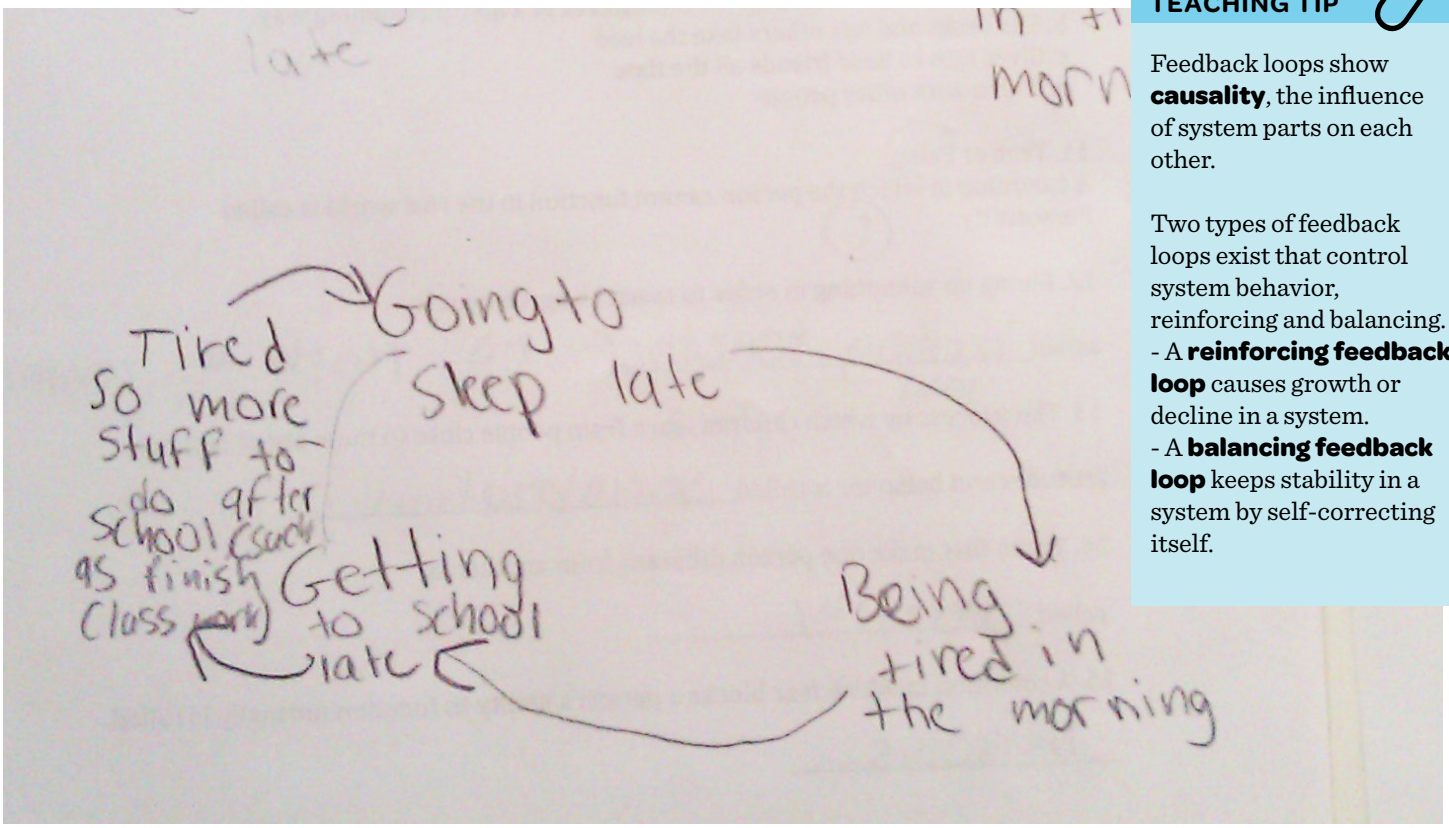
Reflection Questions

What did you discover from your Collect and Cluster exercise?

How do you imagine you could use this tool in your classroom?

Feedback Loop

A diagram showing how at least two factors relate to each other in a circular fashion.



A student's feedback loop showing how a total of four factors work together, in a circular fashion, to cause her to be tired in the mornings.

TEACHING TIP

Feedback loops show **causality**, the influence of system parts on each other.

Two types of feedback loops exist that control system behavior, reinforcing and balancing.
- A **reinforcing feedback loop** causes growth or decline in a system.
- A **balancing feedback loop** keeps stability in a system by self-correcting itself.

Habits of Mind

- **Identifying cause and effect relationships**
- **Surfacing and testing assumptions**
- **Finding leverage points to change a system**

When the Wellness teacher crouched down next to her, the 7th grade student said, "My problem is that I'm tired all the time." "Why do you think you are tired all the time," asked the teacher. She talked about going to bed late because of lots of work. She went on to say, "Because I'm late for school sometimes, I miss class so I have more make-up work to do at night." When she finished talking, the teacher said, "Okay, so you talked about a bunch of factors that might be related... could you make a diagram like a feedback loop showing those relationships?" By looking at the feedback loop, they could visualize the problem so they could talk about leverage points—factors to change—and get her to school on time.

Lesson Outcome: In Wellness class, students will make a change in their personal lives based on their feedback loops and will reflect on the effects of the change after a week.

Feedback Loops
Key Questions

- **When one factor changes (increases or decreases), how does it impact another related factor?** (Repeat this question for all factors in loop.)

SAMPLE KEY QUESTION ANSWER

When one factor increases, how does another factor change? When I go to sleep later, I am more tired in the morning. When I'm more tired, I get to school late because I sleep past my alarm. When I get to school late, I get tired and have more to do after school that I didn't do in class. When I have more to do after school, I have to do it at home and I stay up late.

TEACHING TIP

To determine if loops are reinforcing or balancing:

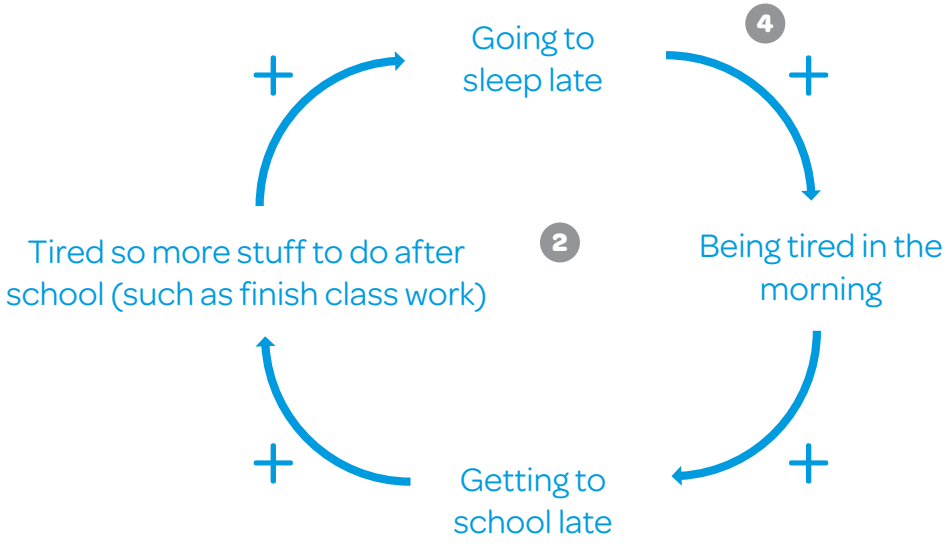
If both factors decrease or increase at the same time, put a "**+**" along the arrow connecting the factors. A "**+**" means the relationship is reinforcing—it will either amplify or reduce indefinitely.

If when one factor increases, and the other factor decreases or vice versa, put a "**-**" along the arrow connecting the factors. A "**-**" means the relationship is balancing—it will try and maintain equilibrium or stability.

If the relationships all show "**+**"s or "**-**"s, the feedback loop is reinforcing. If the relationships show an equal number of "**+**"s and "**-**"s, the feedback loop is balancing.

1

Problem:
Why am I tired all the time?



1 Like with collect and cluster, **identify a problem** and list factors/parts involved.

2 **Choose two or more dynamic (changing over time) factors that you think are related** and draw arrows to connect the factors.

3 **Check and see if you can answer the key question** to figure out if there is a relationship between the factors. If so, then you have discovered a feedback loop.

When one factor changes (increases or decreases), how does it impact another related factor? (Repeat this question for all factors in loop.)

4 If you cannot answer the key question, choose two other factors.

Topic Integration Ideas

SCIENCE
What is your impact on the environment?

MATH
How did a company figure out the price for a favorite item of yours?

ELA AND FOREIGN LANGUAGE
How do characters' actions impact the plot?

HISTORY/SOCIAL STUDIES
What are effects of poverty in the U.S?

WELLNESS
Why is obesity a problem in the U.S.?

CLASSROOM MANAGEMENT
How do my relationships with students impact their learning?

EXTENSION

If students start with two factors in a feedback loop, ask them to create a feedback loop with more than two factors.

TEACHING TIP

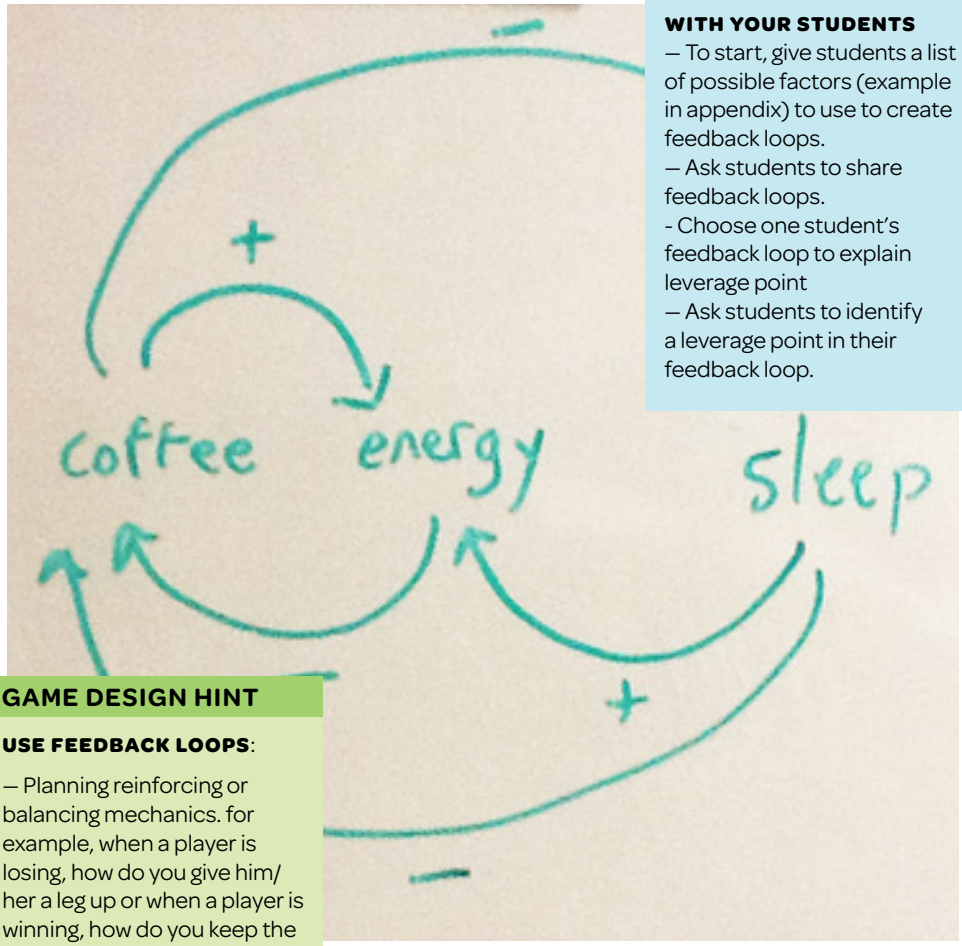
WITH YOUR STUDENTS
– To start, give students a list of possible factors (example in appendix) to use to create feedback loops.
– Ask students to share feedback loops.
- Choose one student's feedback loop to explain leverage point
– Ask students to identify a leverage point in their feedback loop.

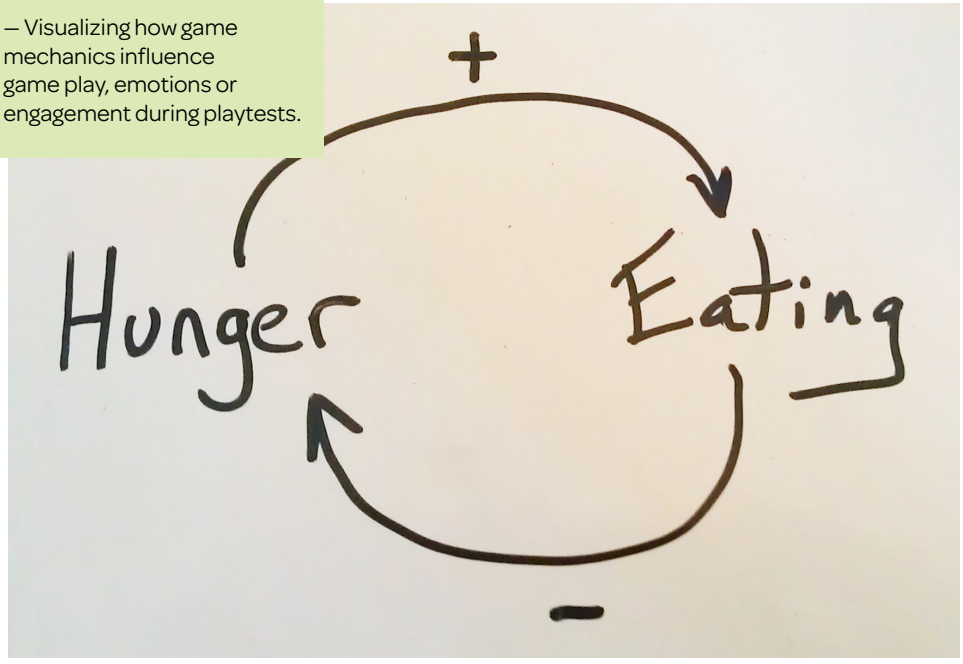
GAME DESIGN HINT

USE FEEDBACK LOOPS:

– Planning reinforcing or balancing mechanics. for example, when a player is losing, how do you give him/her a leg up or when a player is winning, how do you keep the game challenge for him/her?

– Visualizing how game mechanics influence game play, emotions or engagement during playtests.





A Quest teacher created a feedback loop to examine the relationship between sleep and coffee in his life.

NOW TRY IT

Take the problem that you used with Collect and Cluster to make a feedback loop.

Play with template factors to practice feedback loops (in appendix).

Use parts of that problem from the Collect and Cluster tool to try and find factors with back-and-forth relationships.

Answer key question. When one factor changes (increases or decreases), how does it impact another related factor?

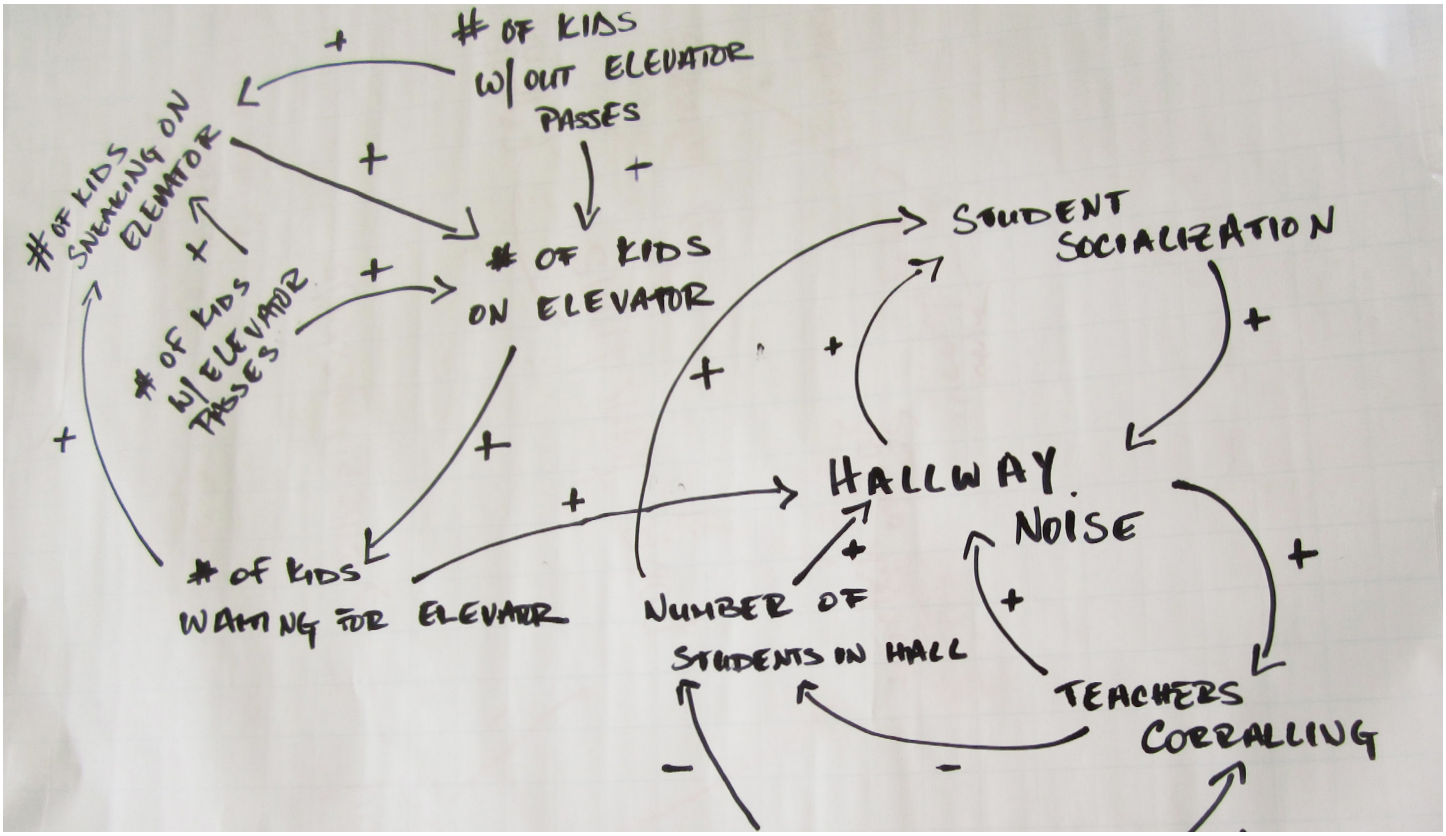
Reflection Questions

What did you discover about your problem from the feedback loop(s)?

How do you imagine you could use this tool in your classroom?

Causal Maps with return to FEEDBACK LOOPS

A causal map shows multiple relationships within a system. Or, in other words, it shows relationships between actions and effects in a system.



Quest teachers' causal map created to examine the problem of excessive hallway noise in between class periods.

Habits of Mind

All other habits of mind, plus:

- Finding where unintended consequence might arise
- Resisting making quick conclusions

All of a sudden, voices erupted in the classroom as teachers worked in groups to create causal maps about the widespread school problem of excessive hallway noise. "The elevator, the elevator," said one teacher. "What about the elevator?" asked another teacher. They went on to map out how the elevator was a factor involved in too much hallway noise.

Another group of teachers talked about supervision of the hallway during passing periods. They busily wrote and drew arrows all over a piece of chart paper.

After 15 minutes, the principal said, "Now, let's figure out what to do. Where are the feedback loops and potential leverage points in your maps?" She grabbed a marker and began to write on a whiteboard as groups of teachers shared their leverage points.

Session Outcomes: Teachers will identify leverage points to address the problem of hallway noise.

Causal Maps

Key Questions

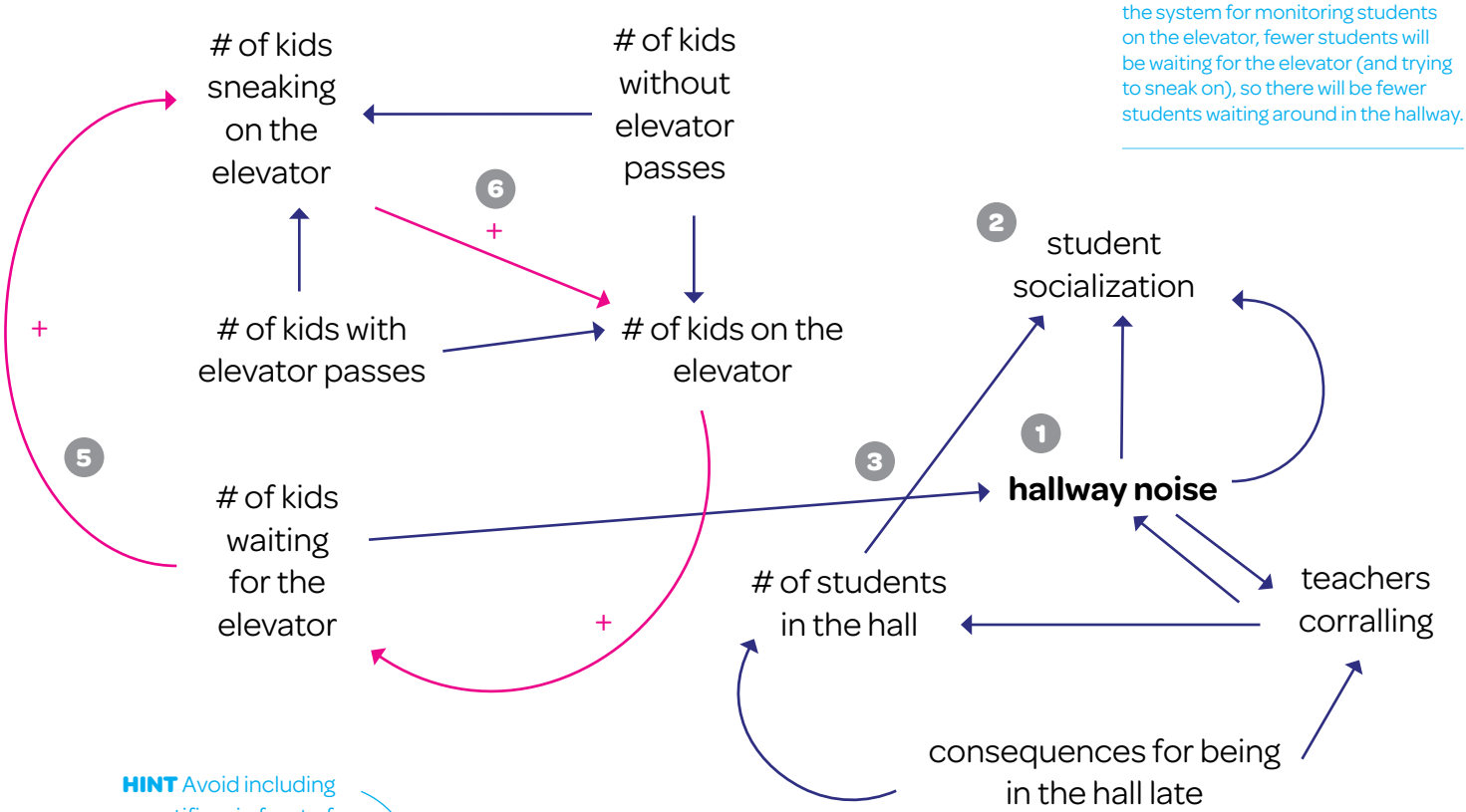
- **What relationships do you see in your causal map?**
- **Do you see any feedback loops in your causal map? (Remember to check yourself by making sure both factors affect each other.)**
- **What is a possible leverage point in your causal map?**

SAMPLE KEY QUESTION ANSWERS

What relationships do you see in your causal map? We found relationships between number of students in the hall and hallway noise, student socialization and hallway noise, and teachers corralling and hallway noise.

Do you see any feedback loops in your causal map? Yes, the number of students waiting for the elevator increases the number of students sneaking on the elevator and that increases the number of students getting on the elevator. Then more students wait for the elevator to sneak onto it.

What is a possible leverage points in your causal map? If we improve the system for monitoring students on the elevator, fewer students will be waiting for the elevator (and trying to sneak on), so there will be fewer students waiting around in the hallway.



HINT Avoid including quantifiers in front of effects. For example, more, less, lack, etc.

1. **Identify a problem and** put it in the center of a piece of paper.
2. **List all factors** that are involved in the problem around the center of the piece of paper. Leave space.
3. **Draw arrows between factors** that seem related.
4. **Ask the key questions** whenever you think you have found a feedback loop.
5. **Highlight** any feedback loops that you find.
6. **Add** "**-**" and "**+**" to show relationships between factors.

Topic Integration Ideas

SCIENCE
How might the building of a new skyscraper affect downtown Manhattan in New York City?

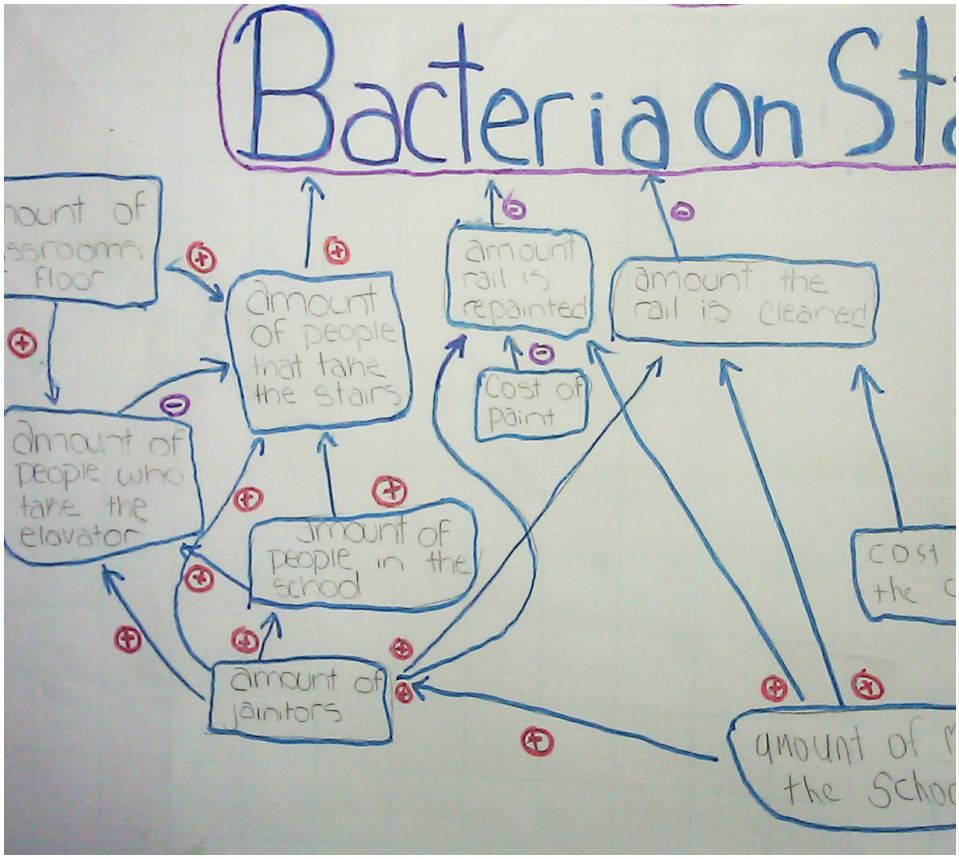
MATH
How do money saving methods impact people's lives?

ELA AND FOREIGN LANGUAGE
How do authors write novels that readers cannot put down?

HISTORY/SOCIAL STUDIES
How might oppression, power, and rebellion be factors in causing revolutions to happen?

WELLNESS
How does the government impact what we eat?

CLASSROOM MANAGEMENT
How does a class build trust and respect?



7th grade students created this causal map to better understand how bad bacteria spreads through the school.

EXTENSION

Feel free to expand your causal map by **adding a next level of factors (secondary factors)**. For example, the factors involved with the elevator on the hallway noise causal map are secondary factors.

TEACHING TIP

— Choose a topic that engages kids (i.e. tv watching)
— Ask students to choose a problem relevant to themselves and create causal maps in pairs or small groups
— Have students work collaboratively on causal maps because they will build on each other's ideas
— Give students time, individually and in groups, to look at causal maps and identify possible leverage points

GAME DESIGN HINT

— Managing large game communities
— Mapping out a game in terms of aesthetics, space, mechanics, rules, etc.
— Visualizing player experience based on choices made by the player in the game
— Determining reward systems
— Identifying leverage points to address problems like the game is too easy or challenging

TAKE NOTE

WATCH THE ARROWS!
Make sure to help students understand that the direction of arrows is important. The directions of arrows show which factor is directly impacting another.

NOT ALL CAUSAL MAPS HAVE FEEDBACK LOOPS
It is not unusual for causal maps to lack feedback loops, For example, the Bacteria on Stair Rail causal map does not have any feedback loops. If students cannot find any feedback loops, work with them to figure out if they missed a loop or whether additional factors might end up being part of a feedback loop.

NOW TRY IT

Take the problem that you used to create a feedback loop.

List every factor that you can think is related to the problem.

Create a causal map.

Answer this question: What relationships do you see in your causal map?

Now, answer these questions:

Do you see any feedback loops in your causal map? (Remember to check yourself by making sure both factors affect each other.)

What is a possible leverage points in your causal map?

Reflection Questions

What leverage points did you find in your causal map? What might you change to tackle your problem based on those leverage points?

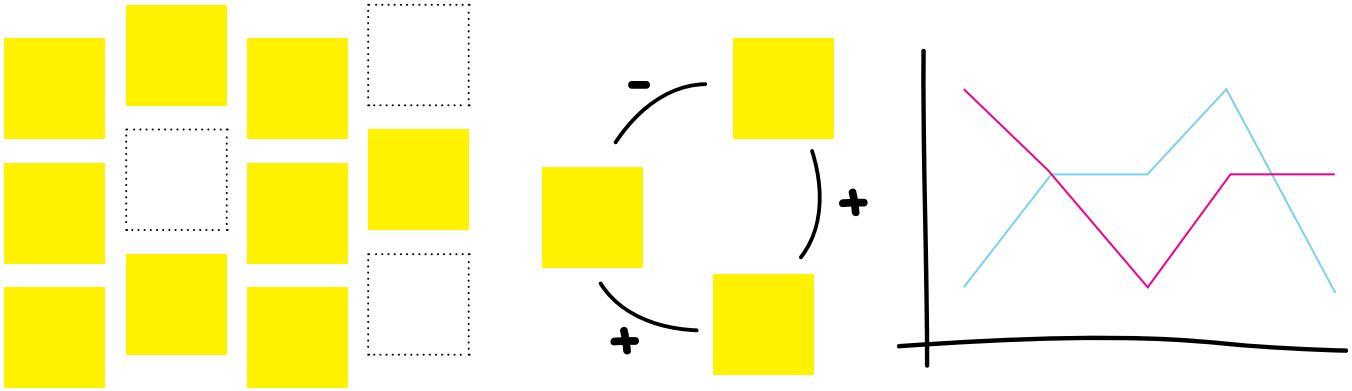
How do you imagine you could use this tool in your classroom?

After learning about the four tools, you can clearly use each tool individually, or you can use the tools in pairs, groups of three or all together to support students in building understanding over time.

Integrate Tools

The power of systems thinking tools is amplified when teachers use them in combination to help students tackle complex problems.

"I created a process of analysis by using all four tools. First the BOTG pinpointed stressful times of day. The three other tools helped us look at factors that led to that stressful time. Then students tried to change one factor from a feedback loop to help them reduce their stress."
—Quest Teacher



One example is from a project focused on stress management in our Quest Wellness program. The goal of the project was to help students decrease stress in their lives. To do the project, the teacher needed to help students identify stressors in their lives and then figure out ways to remove or lessen the impact of the stressor.

As a first step, the teacher asked students to graph their stress levels over one day, three days or a week on a **BOTG**. Then students used their BOTG to help them think of all the factors affecting their stress levels. They wrote those on post-its and classified them based on similarities using **collect and cluster**. Next, students created **causal maps** showing all the factors and relationships among factors. At that point, the teacher asked students to find as many **feedback loops** as they could in the causal map. Finally, after finding feedback loops, students identified feasible leverage points. They chose one leverage point to help them decide what change to make in their life to decrease stress. Three weeks later, students tested out the effectiveness of changes made based on identified leverage points. They graphed their stress levels using a BOTG, looked for changes in patterns, and wrote analyses of their findings.

This structured use of all systems thinking tools from this design pack shows how students used the tools to both solve a problem and build and strengthen different habits of mind concerning systems thinking.

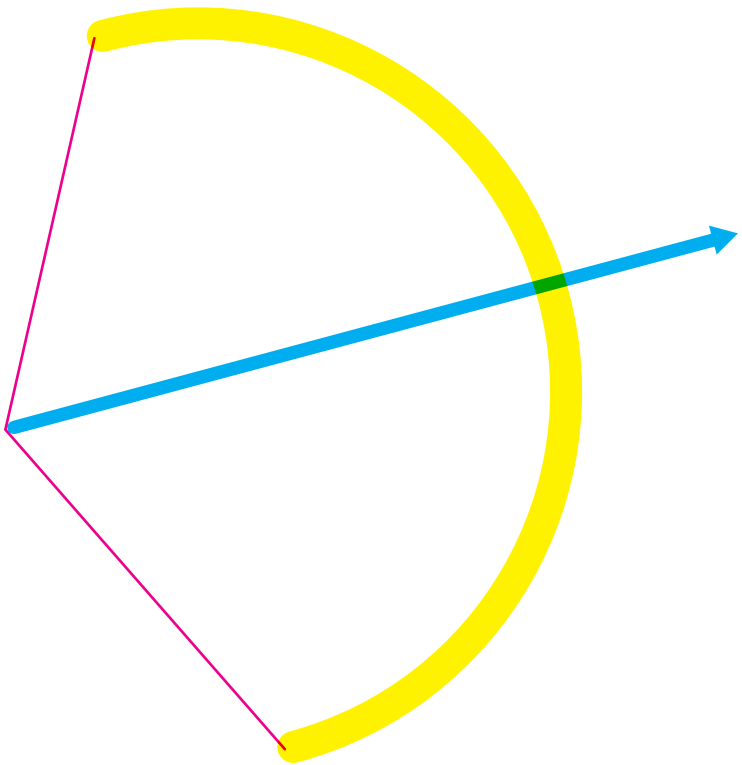
ALL TOGETHER

Within this one project, students directly:

- Strived to understand the big picture;
- Saw patterns/trends in systems;
- Recognized how a system's structure causes its behavior;
- Identified cause and effect relationships;
- Surfaced and tested assumptions;
- Found leverage points to change a system; and
- Resisted making quick conclusions.

Going Further!

Reflect on using systems thinking tools in your classroom and expand your systems thinking knowledge with additional resources.



Reflection

After you support your students in using a systems thinking tool in your classroom, come back to this page and reflect on your experience and how you would use the tool again.

Reflection Questions

Which tool did you try in your classroom?

What was a success from using this tool?

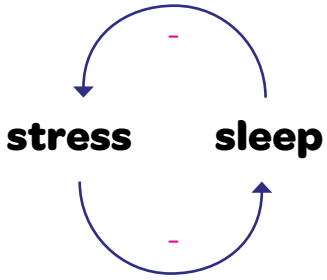
What was a challenge from using this tool?

If you plan to use the tool again, what would you do differently?

Which tool do you want to try next? Why?

Appendix: Feedback Loop Generator

Use this as a resource to teach about feedback loops. Pair two ideas together to see whether they create a feedback loop.



TEACHING TIP

This example of a feedback loop, using two terms from the Feedback Generator, shows a balancing loop. When stress increases, sleep decreases and when sleep increases, stress decreases.

stress
sleep
appetite
physical activity
happiness
productivity
energy
food intake
weight
interest
free time
engagement
homework
hands-on activities

challenges
distractions
collaboration
time with friends
rain
hugs
donuts
# of hobbies
temperature
game play
goal(s)
focus
strength
health

motivation
sunlight
comfort
sugar intake
organization
attention to detail
errors made
clarity
confusion
frustration
distance
fun
hot cocoa
coffee

Continued Learning

After exploring this design pack, we hope you are inspired to learn more about systems thinking and the Quest school model.

Below is additional information to support you in continuing to build and share your own learning.

We want to hear from you

We want to hear from you about your experience with this design pack.

Did it change your teaching?
How did your students respond?
Would you use this design pack again?

We welcome your stories about how you use systems thinking in your classroom.

Email your feedback and thoughts to:
info@instituteofplay.org

We want you to learn more

If you are interested in learning more, please visit these following websites:

Institute of Play
www.instituteofplay.org

Quest to Learn, NYC
www.q2l.org

CICS ChicagoQuest
www.chicagoquest.org

We also offer other Design Packs

Q Design Pack: School
This pack highlights ten innovative components of the Quest school model.

Q Design Pack: Curriculum
This pack provides tools and methods for you to use to design game-like curriculum.

Q Design Pack: Games and Learning
This pack describes our curriculum team model and includes tools and methods to help you begin to collaboratively design games.

We want you to share these resources

We want to thank our partners

This design pack is a result of collaborative work done over the past years between Institute of Play, Quest to Learn, and CICS ChicagoQuest. These resources are made possible through the generous support of The Bill and Melinda Gates Foundation, Carnegie Corporation of New York, and the John D. and Catherine T. MacArthur Foundation.

Additional Resources

Benson, T. et al. (2010). *Tracing connections: Voices of systems thinkers*. Acton, MA: The Creative Learning Exchange.

Senge, Peter M. (2006). *The fifth discpline: The art and practice of the learning organization*. New York: Doubleday Currency.

Senge, Peter M. et al (2012). *Schools that learn: A fifth discipline fieldbook for educators, parents, and everyone who cares about education*. New York: Doubleday Currency.

Sweeney, Linda Booth. (2001). *When a butterfly sneezes*. Westford, MA: Pegasus Communications.

The Creative Learning Exchange
www.clexchange.org

Waters Foundation
www.watersfoundation.org

About Institute of Play

We design experiences that make learning irresistible.

The Institute pioneers new models of learning and engagement. We are a not-for-profit design studio, founded in 2007 by a group of game designers in New York City. We are now home to an interdisciplinary team of designers, strategists and learning practitioners. Our first project was the design and implementation of an innovative New York City public school, called Quest to Learn.

At the core of the experiences we design are games, play and the principles that underlie them.

Using these principles, we have created institutions, games, programs, events, digital platforms and products. Our work unlocks the transformative power of people as seekers and solvers of complex problems, risk takers, inventors and visionaries. We work wherever people are: in communities, businesses, schools, cultural and civic institutions.

We empower people to thrive as active citizens in a connected world.

We are not preparing for a distant future. We are about meeting people where they are and igniting their potential now. We work with a diverse set of partners to make it happen, such as Electronic Arts, Intel, Educational Testing Service, the Mozilla Foundation, the Smithsonian, Parsons the New School for Design, Chicago International Charter Schools, DePaul University, E-Line Media and others.

A selection of our work

GlassLab

An unprecedented collaboration between leaders in the commercial games industry and experts in learning and assessment, GlassLab aims to leverage digital games as powerful, data-rich learning environments that improve the process of learning with formative assessments teachers can trust.

Play@ Your Org

With a hands-on exploration of games and design, Play@ Your Org workshops are designed to help businesses, cultural institutions and other organizations integrate the power of play-based learning in their work to maximize participation and engagement.

Playtime Online

A live hour-long webinar series, Playtime Online explores the work of leading organizations in the field of games and learning, the people who do it and why it matters in the world today. The series also offer a live forum to share learning within the Playtime community.

For more information, please visit **www.instituteofplay.org**