HANDBOOK

Carbon Cycle Game

Handbook

Table of Contents

Carbon Cycle Game

Overview

The Carbon Cycle game is an interactive tool which allows students to simulate the movement of carbon molecules within the carbon cycle. The students are going to experience the carbon cycle as carbon molecules or as stored carbon which travel the path of various carbon sources (atmosphere, plants, animals, soil, ocean and fossil fuels) in their journey over time. The game aims to help students understand the different carbon transfer processes and their relational impacts along the carbon cycle as well as explore the concept of feedback processes in the cycle through further discussion and teamwork.
The first part of the game is demonstrating the cycle in "pre-history" before human interaction, however in the second part, students are challenged to explore how human interaction impacts the carbon cycle.

Age:
High School 16-18 years old

Time:
- Pre-test 10 minutes
- Simulation one class session per game, expected around 35-45 minutes

Materials:
- Access to individual devices and internet
- Teachers supervision
- Simulations are available on iseesystems.com

Game1:
https://exchange.iseesystems.com/public/vir011/carbon-cycle-game

Game 2:
https://exchange.iseesystems.com/public/vir011/carbon-cycle-and-human-interaction

Learning Objectives

Carbon Cycle game 1- without human interaction

- Introducing the main elements of the system.
- Familiarizing students with graphs and reading graphical data.
- Learning about how increasing and/or decreasing different carbon source/sinks affects the system's behavior.
- Assisting students to predict the general direction and magnitude of changes in the system due to specific changes to the system.
- Learning about climate feedback and balancing feedback loop definition.

Carbon Cycle game 2- with human interaction

- Introducing human-interaction to the carbon cycle.
- Learning about climate feedbacks and comparing climate feedbacks with and without human impact.
- Practice decision-making and group discussion to reason the impact of the decision.
- Expanding system-oriented learning concept to their day-to- day life.

Preparation

The simulations are designed for high school students. They expected to have a general knowledge about carbon cycle concept as part of the school biology curriculum. The two simulations are complementary and it's very important to be played in order.

Following check list would make the experiment easier both, for the students and teachers.

The experiment contains different documents and simulations. They are all published and available online as given in the first page of this handbook and listed here as well. Check that all links are working.

Following the next order:

1st	Pre-test	
2nd	Game 1	Journal 1
3rd	Game 2	Journal 2

Pre-test https://drive.google.com/file/d/1AlCMb7tGeHQUPpV9dfH7_xvFHdoWUqXS/view?usp=sharing
Game 1 https://exchange.iseesystems.com/public/vir011/carbon-cycle-game
Game 2 https://exchange.iseesystems.com/public/vir011/carbon-cycle-and-human-interaction
Journal 1 https://drive.google.com/file/d/17gWbvGFsK8i21c-FAmJiac5999CoSWye/view?usp=sharing
Journal 2 https://drive.google.com/file/d/1RbhoSr_ctoEYfv8ypfriBEkX52BKOitY/view?usp=sharing

Before to start, give students their ID number for the game, and it's important that students use the same ID for the pre-test and both games.

Pre-test

Provide Pre-test form, for students to complete before start Game 1, *AppendixIII*

Generic check before each game:

- Double check the access link for the online simulations.
- Make sure all students have their device up and running and have access to the simulation link.
- Make sure the journal google form is shared with all participants and they have access to record their answers along the game. They should sign their journals with their given ID numbers.
- Encourage them to ask questions if they need extra help and information.

More instruction is available in facilitations guide section.

Facilitation Guide

The carbon cycle games are highly recommended for physical classroom experiments under teacher supervision.
Suggested answers for all questions listed in the journals and are available in *Appendix I* and *II*. The answers are not absolute, they stand to clarify the expected keywords.

General facilitation

- Make sure students have their journals open parallel to relevant game and they are following the guidelines to change different variables along the game.
- Following chapters of this handbook, give more detail information about the game design and learning objectives, that can help the facilitators (teachers) to understand the intention behind different questions in the journals. *Appendix I* and *II.*

Action	Explanation	Time (min)
Assign students with the ID numbers	Ask students to register their ID number on their journals and first page of the simulations.	5

Pre-test

Students have to do a pre-test. In order to be able to evaluate their understanding and performance progress about carbon cycle along the games.

Pre-test	Individual class activities	10

Game 1

This game is individual (single player), Students are going to interact with the online simulation game parallel to their individual journals. the summery of actions are listed in the table below.

Game 1	**Individual activity in the class, exploring the interactive online simulation and writing their answers for each challenge in their personal journal 1.**	**35**
Game 1 Page 1-6	Exploring the carbon pools, fluxes and animation simulator and answer the relevant challenges in the journal 1.	15
Game 1 Page 7-11	Experiment 1-2 and answer the relevant challenges in the journal 1.	10
Game 1 Page 12-15	Feedback concept through an example from carbon cycle system and answer the relevant challenges in the journal 1.	10
Game 1 Page 16-17	Individual activity, student can complete this section as fun and creative homework. If they have extra time, it can be also done in the class. Homework: https://drive.google.com/file/d/1V1NSsHgW4XnHQo7JwIjAaFh8le5XMeTW/view?usp=sharing	---

Game 2

The second game has some parts that will be played individually and some team-based parts, where students are going to play them as a team.
Before starting the second game, it's recommended to divide students into teams of two. It is a matter of saving time, student will follow the game's activities in following order, playing some of them individually and others working, developing, and discussing with their partners.

1st Activities pages 1-4, students will play TEAM.
2nd Activities pages 5-7, students will play in TEAM.
3rd Activities pages 8-11, students will play TEAM.
4th Activities pages 12-14, students will play INDIVIDUAL at home or classroom according to time limitation.

Some details on team-base activities:

- Team members should be located next to each other, as they are going to share the same computer for the team-base activities.
- They should complete the sections as a team, together.
- Each team share one computer and they assign their decision in one device, however, is **important** that each student work in their own individual journal (Journal 2), even for the team-based activities.
- Depends on students' performances and the time they spend for the pre-decision-making discussion, the teacher can decide on whether they should complete both scenarios/only one.

More information and detail available in the journal.

Game 2	**This game has some parts for individual activity and a section for teamwork**	**40**
Game 2 Page 1-4	**Team activities** Exploring different human actions and their impacts on the carbon cycle and answering the relevant challenges in the journal.	15
Game 2 Page 5-7	**Team activities** The experiment contains two decision-making scenarios. Students in each team have different roles and making decision according to the role (Page 3-4 in Journal 2).	15
Game 2 Page 8-11	**Team activities** Exploring climate feedback under human interaction and answering the relevant challenges in the journal.	10
Game 2 Page 12-14	**Individual activities** Individual activity, student can complete this section as fun and creative homework. If they have extra time, it can be also done in the class. Homework: https://drive.google.com/file/d/1N-wJ5b8_JD8WXJ18hvoNC1-vCSOwS2Lz/view?usp=sharing	---

Carbon Cycle Game 1- Without Human Interaction

The Carbon Cycle Game is an interactive tool which allows students to simulate the movement of carbon molecules within the carbon cycle. The students are going to experience the carbon cycle as carbon molecules or as stored carbon which travel the path of various carbon sources (atmosphere, plants, animals, soil, ocean and fossil fuels) in their journey over time. The game aims to help students understand the different carbon transfer processes and their relational impacts along the carbon cycle as well as explore the concept of feedback processes in the cycle through further discussion and teamwork.

The first part of the game is demonstrating the cycle in "pre-history" before human interaction, however in the second part, students are challenged to explore how human interaction impacts the carbon cycle.

Carbon Reservoirs (pool)

In this page, the short animation introducing the main carbon reservoirs (stocks). They can also review the baseline graphs for all the reservoirs by click on the "Graphical Data" button.

Figure 1. Carbon Reservoirs

Learning outcome of the page

- Recognition of different stocks in the carbon cycle
- Learning the baseline graphs for the stocks and capacity of carbon storage in each stock

Carbon Cards (flux)

As they already got introduced to the carbon stocks, the next page is illustrating all the carbon fluxes. We call them carbon cards due to their function in the system, each flux is represented as a card that needs to be played in order to create change in the cycle. The carbon cards are categorized and assigned to different colors. The colors are based on the direction and destination of carbon particle movement. Such as, direct carbon removal from the atmosphere, direct carbon emission to the atmosphere, land sink and ocean uptake.

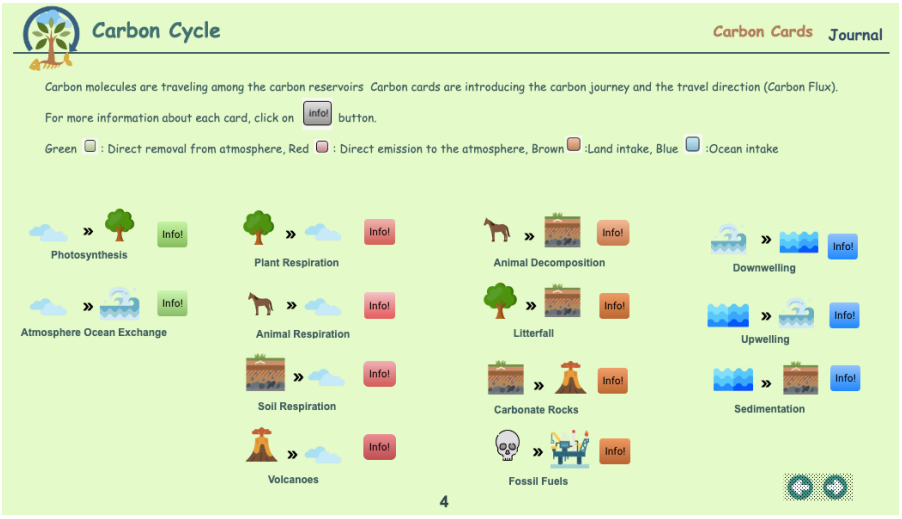


Figure2. Carbon Cards

Learning outcome of the page

- Recognition of the carbon cards and their functions
- Learning about the concept of emission, removal, land sink and ocean sink

Main Simulator

This page is the interactive animated simulator, which allows student to explore the cycle by controlling different cards and observe the impact of the changes primarily on the atmospheric carbon and followed by few given challenges in their journal (Appendix I). They are expected to learn about the relations between different parts of the carbon cycle. Also, the expand graph button is opening the window of the graphical data of different carbon stocks and flows where they can see the dynamic of impacts over time.

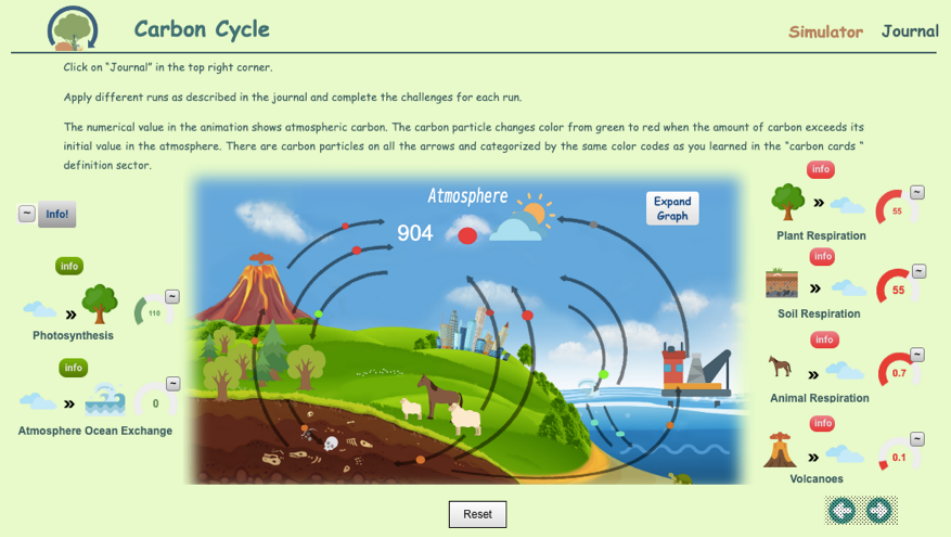


Figure3. Main Simulator

Learning outcome of the page

- Learning the systematic relations between different variables
- Reading graphical data over time
- Ability to describe why different changes impact the system the way they do
- Determine the most and least dominant carbon cards (flows/fluxes)

Experiments

In this section students will be challenged to make changes in certain variables and to predict graphically the impact of the change on atmospheric carbon, after they are going to apply the change and simulate. They will have access to the comparison data from their prediction and the simulation result. They can evaluate their prediction and describe why it was easy or difficult to predict.
After second experiment students will be introduced to climate feedback concept before they move on to the 3rd experiment.

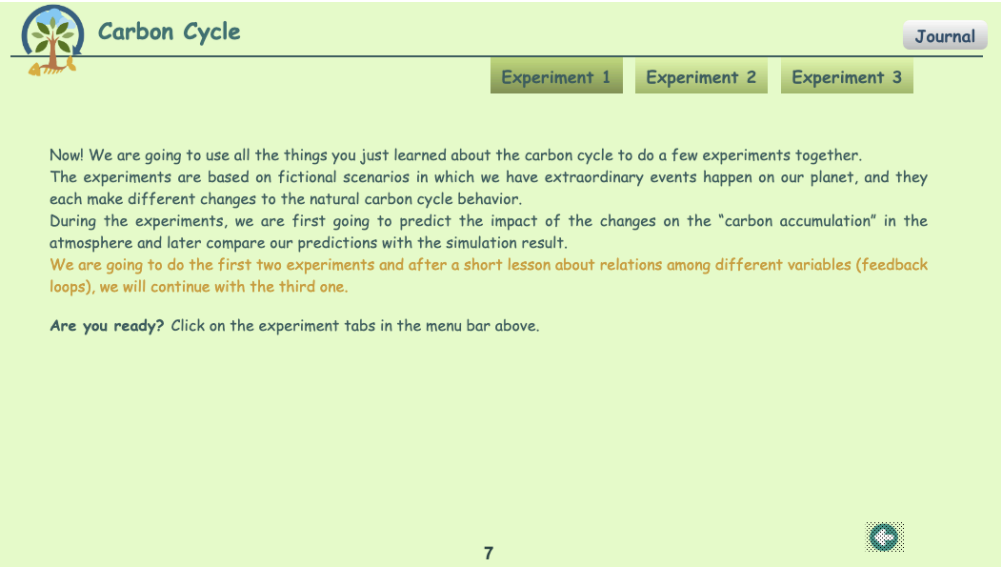


Figure4. Experiment

Learning outcome of the page

- To prepare students for learning feedback loop concept in the next step by graphical prediction challenge
- To emphasize diverse impact of different carbon cards (flows) in the cycle

Feedback Process

This section is trying to build up on the previous challenge and teach students about feedback loop concept through a step change in the photosynthesis process and reviewing the graphical data after the change.

Figure5. Feedback Process

Learning outcome of the page

- Feedback concept
- Climate feedback
- Behavior over longer period of time

Experiment3

The last experiment is a final challenge for the first carbon cycle game! Students are asked to create their own story where impact carbon cycle. They are asked to identify the relation between happening in their story and available carbon cards in the game. Then, they need to propose solutions to stabilized atmospheric carbon around its initial value (750 GT)
This task allows students to apply all the lesson learned from the game. (depends on time limit and the teacher preferences, the experiment can be, do in class and homework)
It's recommended as homework, which students have more time to process and reflect on the learning outcomes and can be also more creative with the story telling part.

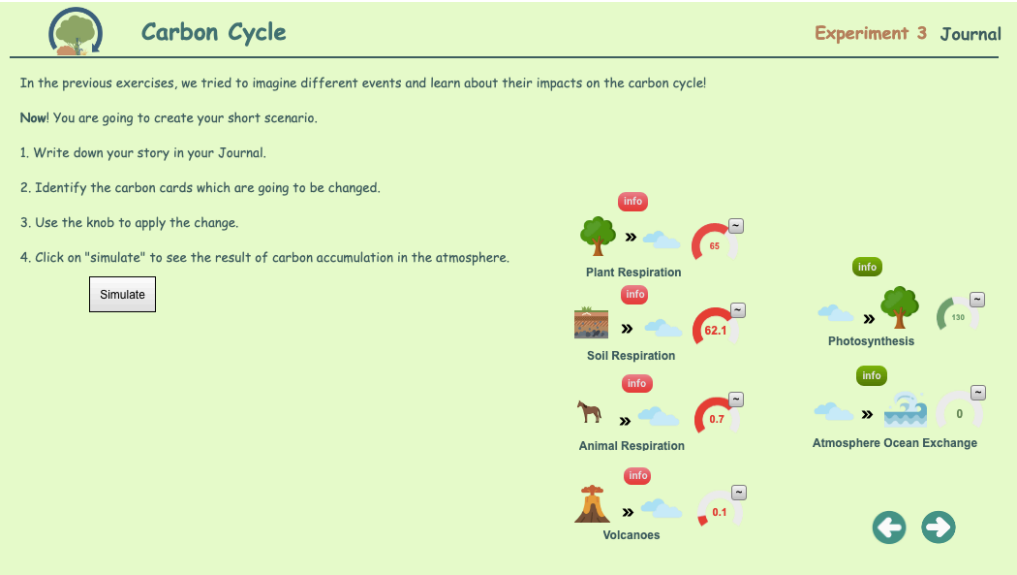


Figure6. Experiment 3

Carbon Cycle Game 2- With Human Interaction

The carbon cycle involves the movement of carbon between the atmosphere, biosphere, oceans and geosphere. Since the Industrial Revolution approximately 150 years ago, human activities such as the burning of fossil fuels and deforestation have begun to have an effect on the carbon cycle and the rise of carbon dioxide in the atmosphere. Human activities affect the carbon cycle through emissions of carbon dioxide (sources) and removal of carbon dioxide (sinks). The carbon cycle can be affected when carbon dioxide is either released into the atmosphere or removed from the atmosphere.
The game aims to help students understand, how human actions impact the carbon cycle. They will be introduced to some basic human activities which are affecting the carbon cycle, and the game allows them to take different decision-making roles and discus in groups, how their decisions impact the carbon cycle.

Briefing

Describe the objectives of the game and introduce the list of human impact which is within the boundary of this carbon cycle simulation, also the main simulator. If possible, the briefing recommended being done together with the teacher as a class.

Figure7. Briefing

Learning outcomes of the page

- Familiarizing with human interaction variables
- Learning about the definition and the impact
- Human interaction impact on atmospheric carbon and global temperature

Simulator

This page is the interactive animated simulator, which allows student to explore the impact of different human interaction on the cycle by controlling different variables and observing the animation respond and well as graphical data over time. The graphs are accessible by clicking on “Graph Expand” button.

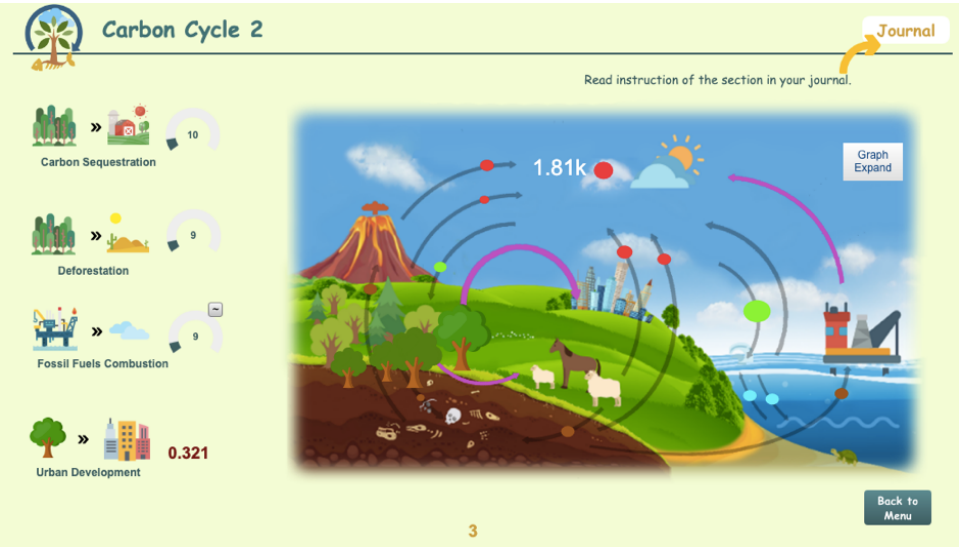


Figure8. Simulator

Learning outcome of the page

- Learning the systematic relations between different variables
- Reading graphical data over time
- Ability to describe why different changes impact the system the way they do
- Determine the most and least dominant human practice on the cycle.

Experiment

In this section students are given different scenarios about human interaction and they are challenged to make decisions every 50 years. The goal is, to avoid dramatic atmospheric carbon increasing. The students are playing the role of the minister of energy and human right representative. They should finalize their decision in a dialog before they apply it to the system, based on the system outcome they will make decide for the next 50 year.
They should be encouraged for realistic decisions based on given scenario, for example: if they decide to stop oil and gas combustion, they should propose the alternative energy source in their journal.

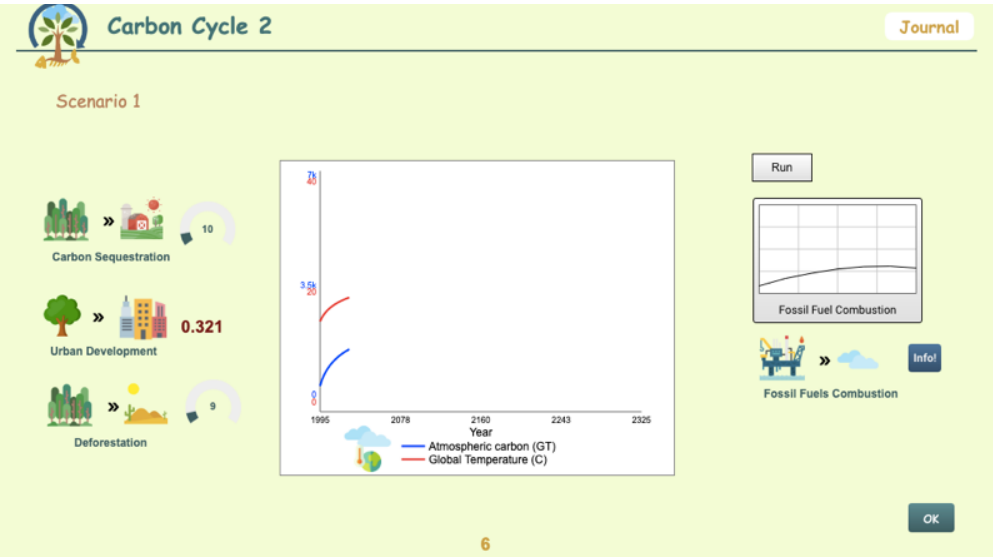


Figure8. Experiment

Learning outcomes of the page

- Responsible decision-making and follow-up discussion
- Climate feedback and human impact

Debriefing

This section is dedicated to more general definition of system and summarized the concept in relation with carbon cycle system.
Debriefing also includes an example of photosynthesis feedback loop with and without fossil fuel combustion.

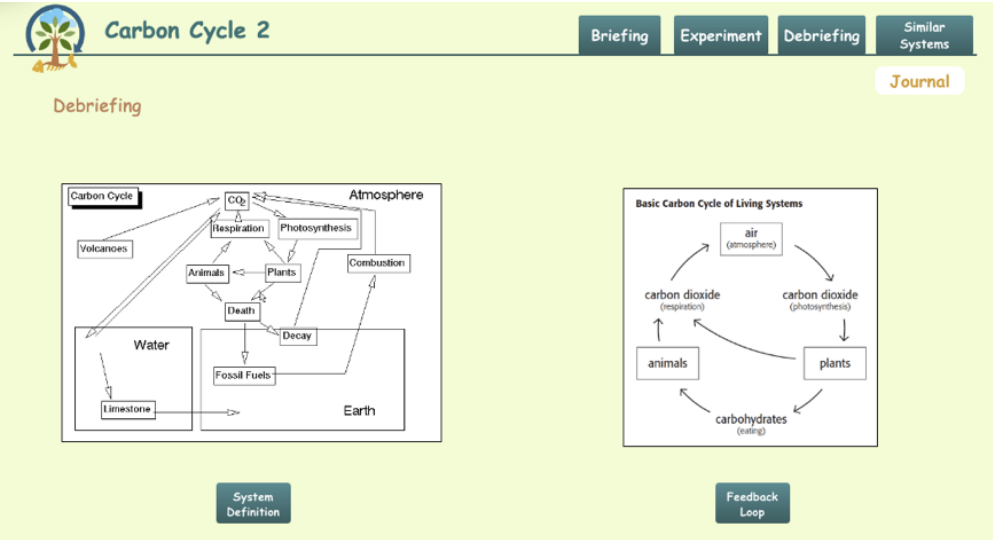


Figure9. Debriefing

Learning outcomes of the page

- Impact of human interaction on the feedback loops
- General definition of system, understanding feedback loops as a system principle

Similar Systems

Students are asked to relate their learning outcomes about system thinking and feedback loop processes to the day-to-day life. They are given couple of examples of feedback loops which made based on personal experience, challenged to modify them to their own real-life experience. The purpose is to let the student connect their system understanding to their daily life and practice system thinking.
It's also important for us to be able to evaluate, if the game serve to the purpose of teaching a generic concept through a narrative subject.

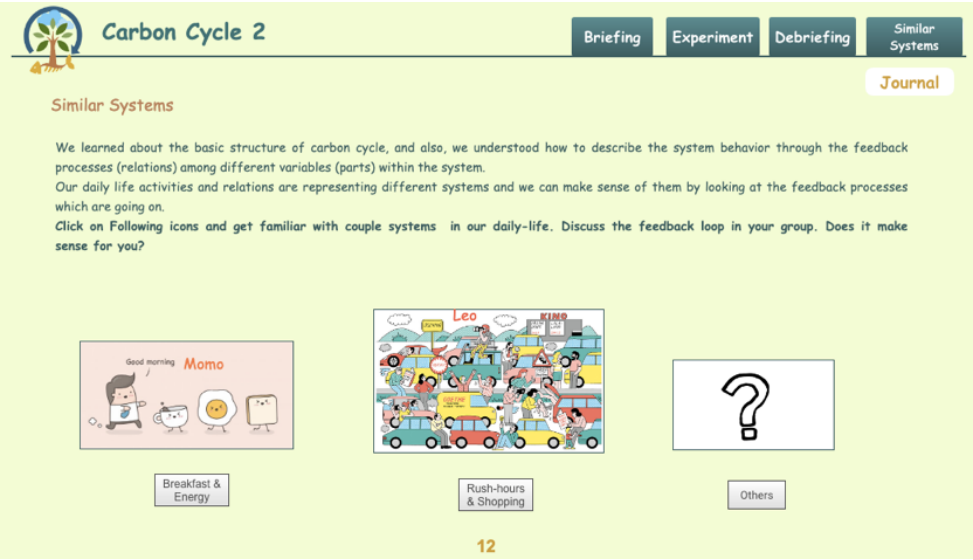


Figure10. Similar System

Learning outcomes of the page

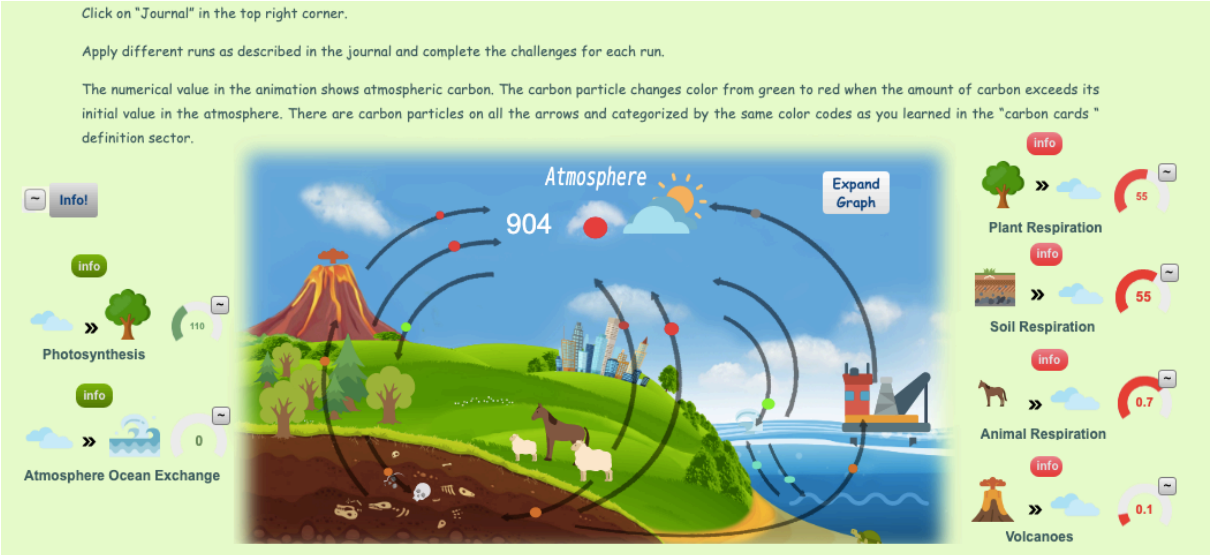
- Practicing system thinking
- Develop system understanding
- To be able zoom out from the subject and scale their understanding of feedback loops

Player number 1 Date 11.4.21

You will find "journal" button on top right corner of every page of the game. Try to keep this journal Window open parallel to the game to avoid many windows closings and opening during the game. Each question in this journal refers to a page number which is at the bottom in the middle of each page.

Feel free to raise your hand and ask questions during the game.

Simulator (Page 5&6)



Run 1 (Page 5-6)

1. Change the carbon cards value, one by one, and observe the impact.
2. After each change, click on "Graph Expand" to view the graphs of carbon accumulation in the atmosphere and carbon flux over time.
3. Click on the "reset" button to reset the simulation to the original values before applying new changes.
4. Have you noticed how different variables impact atmospheric carbon differently? Briefly describe your observation.

YES

Photosynthesis, lower value strong impact on increasing atmospheric carbon and higher value leads to very fast and noticeable carbon reduction.

Atmosphere ocean exchange, lower value of exchange means carbon in the ocean and the atmosphere are in balance and this state illustrates the baseline atmospheric carbon, and in higher values shows carbon reduction over time.

Plant respiration, since it's in direct emission category has a direct relation with atmospheric carbon.

Soil respiration, has similar impact as and relation to atmospheric carbon.

Animal respiration, direct relation but very little impact.

Volcanoes, direct relation and very small impact.

Generally, if students are able to categorize the fluxes and their impact based on removal and emission direction is good enough.

5. Name variables with the most and the least impact?

Most impact: Photosynthesis and Atmosphere Ocean exchange
Least impact: Volcanoes and Animal respiration

Run2 (Page 5-6)

1. Reset the simulation.
2. Increase photosynthesis to the maximum value.
3. Change the "atmosphere-ocean exchange" between its minimum and maximum values.
4. Describe the impact of "atmosphere-ocean exchange" on atmospheric carbon while photosynthesis is maximum.

Very little impact

5. Why did this happen?

Maximum photosynthesis decreases the atmospheric carbon to very low levels, and in that case, there will be no extra carbon in the atmosphere to be absorbed by the ocean.

Run3 (Page 5-6)

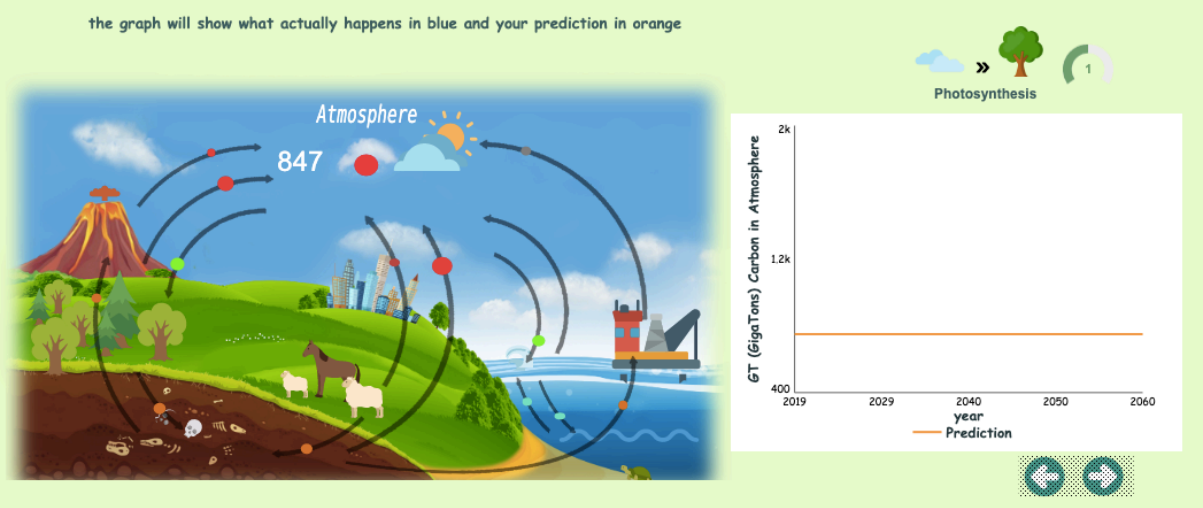
1. Reset the simulation.
2. Increase the volcano to the maximum value.
3. Observe the simulation and the graphs.
4. Which variables are affected by an increase in volcano eruptions?

Volcano, Atmospheric carbon

5. Why did this happen?

Volcano impact on atmospheric carbon is not very large, and it didn't lead to big change in Atmosphere-ocean exchange and other variables.
If they answer in detail: AtmOC exchange, soil resp, plant resp, photosynthesis

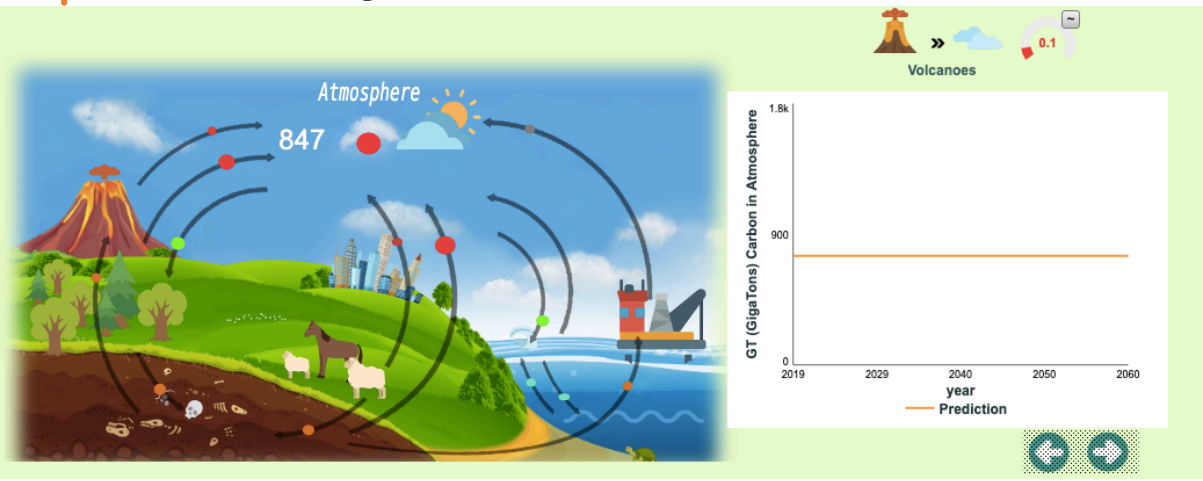
Experiment 1 (Page 8-9)



Can you describe why it was hard to predict atmospheric carbon behavior?

Based on their personal experiences

Experiment 2 (Page 10-11)



Can you describe why it was hard to predict atmospheric carbon behavior?

Based on their personal experiences

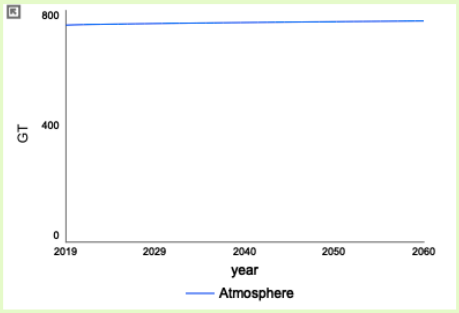
Feedback loop processes example (Page 14)

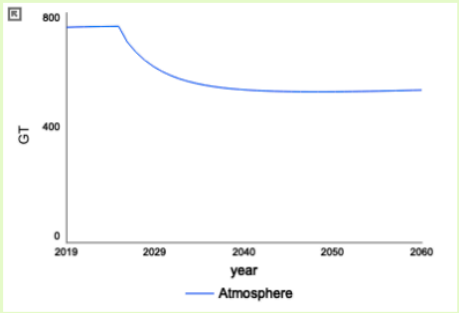
Look at the two graphs below, the graph on the left is the baseline graph for carbon accumulation in atmosphere. The graph on the right results when only photosynthesis is increased in a step around year 2025. Notice what happened to carbon accumulation in atmosphere in comparison to the baseline graph.

Answer following questions briefly before click next

Why might an increase in photosynthesis decrease carbon in atmosphere?

based on the balancing feedback process, what do you think will happen to carbon in atmosphere if the simulation runs over longer time?





Why might an increase in photosynthesis decrease carbon in the atmosphere?

As per photosynthesis definition, plants uptake carbon from atmosphere to their body mass carbon storage.

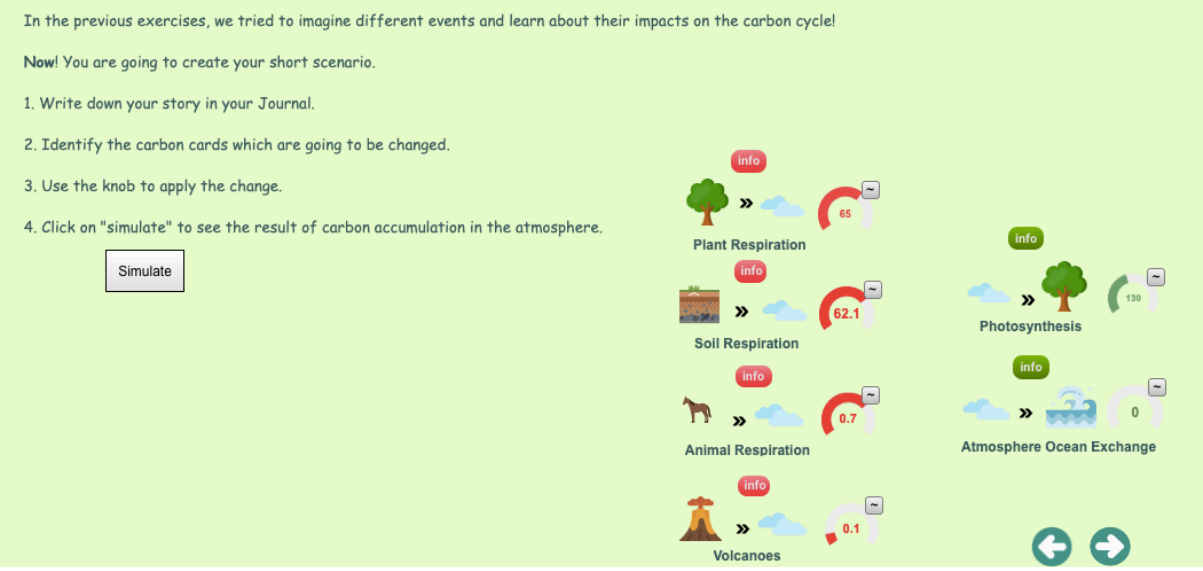
Based on the balancing feedback loop, what do you think will happen to carbon in the atmosphere if the simulation runs over a longer time?

It will fall towards its initial value.

Experiment 3 (Page 16-17)

If you have time, complete this section in class otherwise to be done as homework!

Part 1 (Page 16)



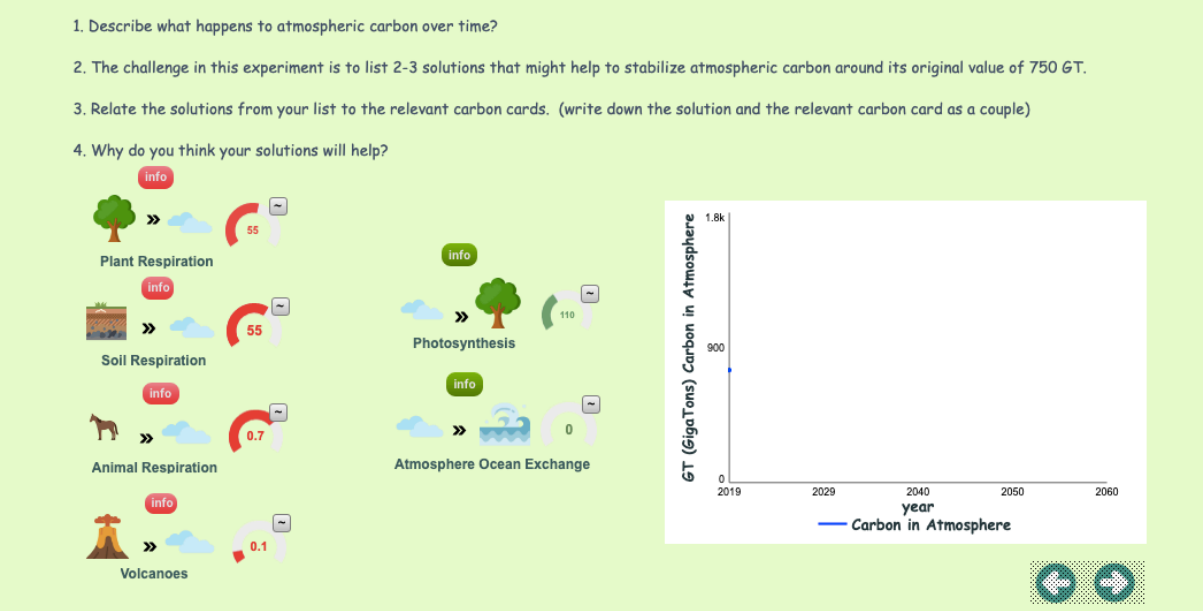
1. Write down your story, be creative and have fun with your story writing. Doesn't need to be long ☺

Looking for systems story around carbon cycle

2. Identify the carbon cards which are going to be changed.

If they can relate any event to the relevant variable

Part 2 (Page 17)



1. Describe what happens to atmospheric carbon over time?

Graph Reading

2. List 2-3 solutions that might help to stabilize atmospheric carbon around its original value of 750 GT.

For example Forest regeneration

Systems based soultuion

3. Relate the solutions from your list to the relevant carbon cards.

For example Forest regeneration – Photosynthesis

Relate the solutions to its relevant variable

4. Why do you think your solutions will help?

Looking for reasoning capacity about the carbon cycle system

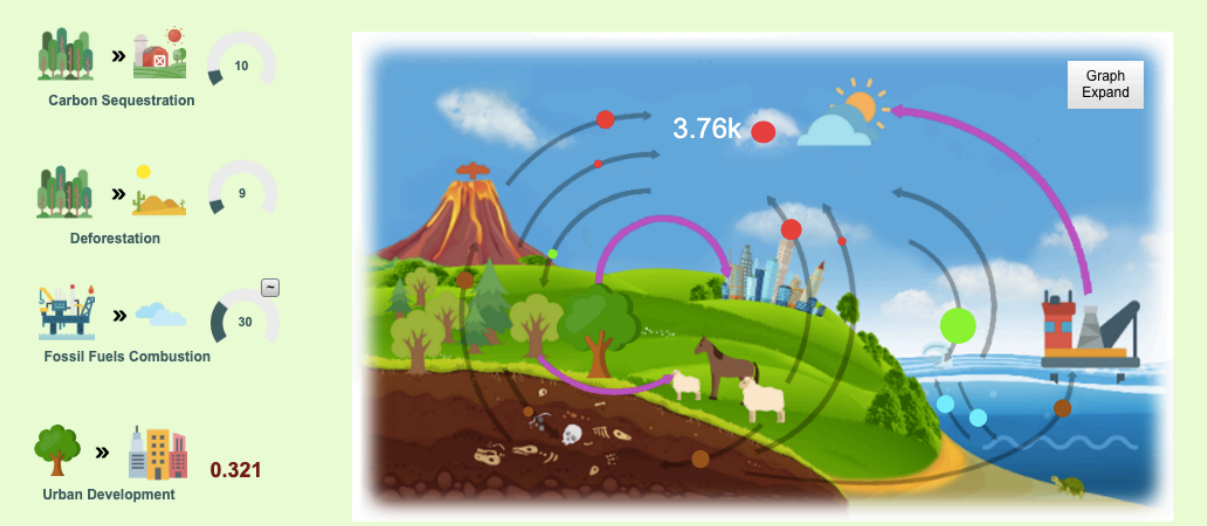
Player number 1 Date 11.4.21

Player number 2

You will find "journal" button on top right corner of every page of the game. Try to keep this journal Window open parallel to the game to avoid many windows closings and opening during the game. Each question in this journal refers to a page number which is at the bottom in the middle of each page.

Feel free to raise your hand and ask questions during the game.

Briefing-Simulator (Page 3&4)



1. Change the human interaction variables, one by one, and observe the impact.
2. After each change, click on "Graph Expand" to view the graphs of carbon accumulation sources, the green area (forest), photosynthesis, and global temperature
3. you can continue exploring the simulation by continuously shifting between the simulator page and the graphical illustration page.
4. Click on the  to reset the simulation to the original values.
5. Have you noticed how different variables impact atmospheric carbon and global temperature differently? Describe your observation?

Yes
Fossil Fuel, increasing fossil fuel combustion leads to an increase in atmospheric carbon and global temperature, after year 2200 a sharp decrease can be seen in both atmospheric carbon and global temperature due to, fossil fuel collapse.
Farming impact, increasing farmlands has a negative impact on photosynthesis process and decreasing photosynthesis will lead to increase carbon in the atmosphere and global temperature.
Deforestation, cutting down forests significantly impact photosynthesis reduction, which leads to increase atmospheric carbon and global temperature.
General expectation from students, if they can describe all three variables have negative relation with atmospheric carbon and global temperature.

And state the fossil fuel impact follows different process than the other two variables.
Fossil fuel impact is directly to the atmospheric carbon whereas, the other two impact the cycle through photosynthesis.

6. What has a stronger impact on global temperature: deforestation or Fossil Fuel combustion?

Fossil Fuel

Experiment (Page 5,6&7)

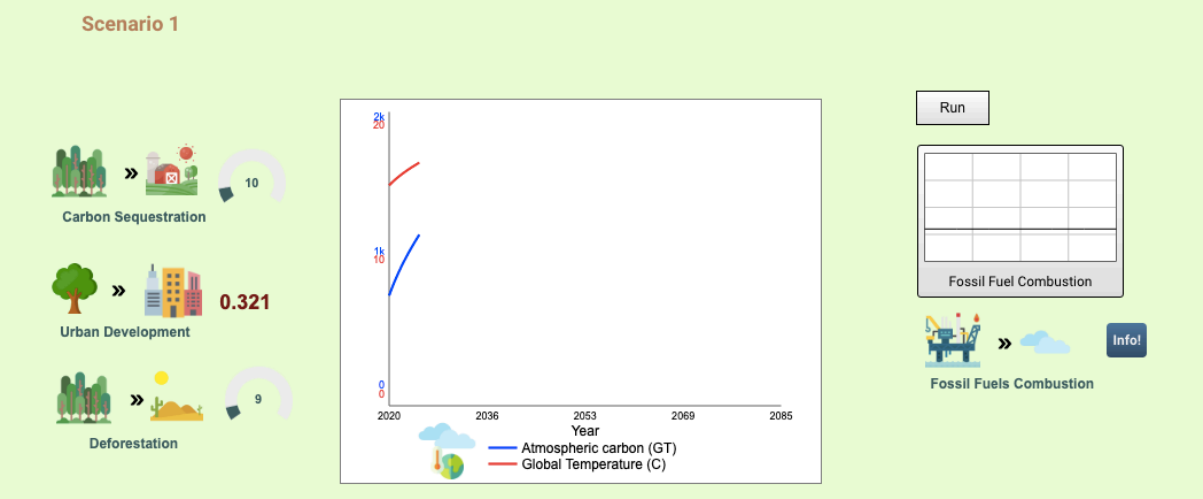
This part of the game is a multiplayer group work, you are challenged to make decision together with your teammate based on the given scene below. The experiment is divided in two sections: Scenario 1 and 2. Both scenarios are following the same goal and story, only difference is, their initial values.

The scene: The Earth's population is increasing, and with it the need for food production, and land development. As we are living in the technology age, all of this leads to an increase in energy demand.

The Goal: Minimizing CO2 emission from human actions.

The roles:
MINISTER OF ENERGY: considering the energy shortage and balancing the supply and demand for energy. (Fossil Fuel Combustion)
MINISTER OF HUMAN RIGHTS: making sure everyone has access to basic human needs such as accommodation and food. (Farming and Deforestation)
Assumptions: global scale decision making

Scenario 1 (Page 6)



Initial values:

1. Carbon from Fossil Fuel combustion is constant and stabilized on **30 GT/year** (Oil and gas resources will be available to explore maximum to year 2200).
2. Agriculture farming impact on photosynthesis (Farming) is **10%/ year.**
3. Deforestation (which you should assume is largely derived from urban development) is **9%/ year.**

You are team of two people, choose one of the following roles. You are going to shift the role for the second scenario. Don't worry! You both have chance to experience the different roles.

Player 1: **Minister of Energy (in charge of "fossil fuel combustion")**
Player 2: **Minister of Human Rights (in charge of "carbon sequestration" & "Deforestation" for urban development)**

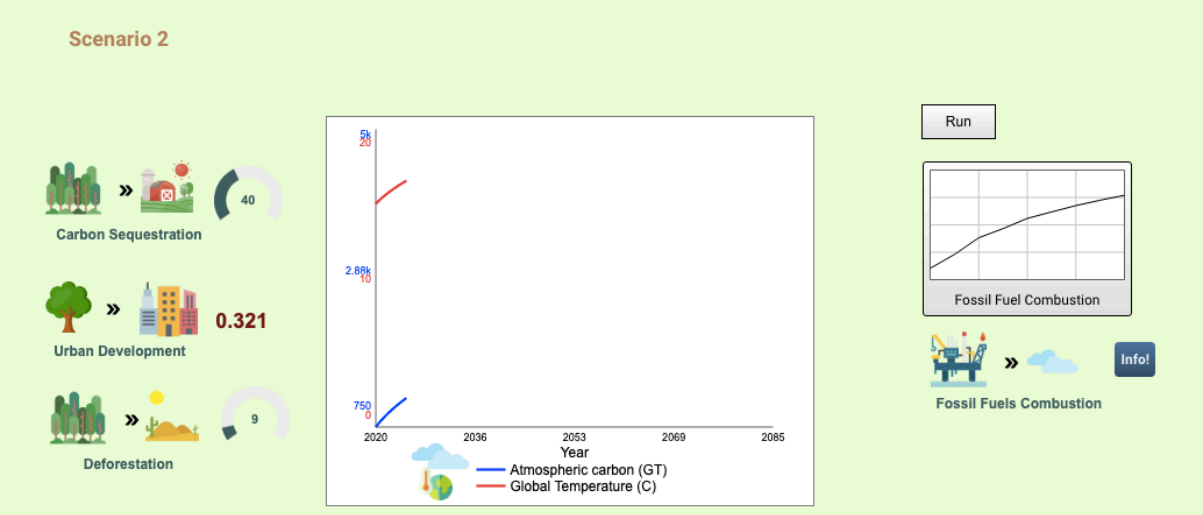
Now you are attending a ministry meeting and discuss how to change your duty variables every 50 years for 6 rounds (2025-2325) to minimize the emission to the atmosphere.

1. Discuss your decision with your group.
2. Apply your decision to the system.
3. Click on "Run"
4. Now you are ready for the second round of your decision-making process.

Did you manage to avoid increasing atmospheric carbon? What was your strategy? If not, can you describe why?

No, check the impact of my change after each run and if it was increasing the atmospheric carbon tried to reduce the variable for the next run.
I think one reason can be the late appearance of the impact of my change, I felt I am always behind the system to make decision.
Or Can be yes, …. I learned from the simulator how different human interaction impact the atmospheric carbon and I tried to make my decisions in a way to avoid the over shooting carbon in atmosphere.

Scenario 2 (Page 7)



Initial values:

4. Carbon from Fossil Fuel combustion initialized as a graphical function **GT/year.** as you can see in the game (Oil and gas resources will be available to explore maximum to year 2200).
5. Agriculture farming impact on photosynthesis (Farming) is **40 %/ year.**
6. Deforestation(which you should assume is largely derived from urban development) is **9%/ year.**

Remember to switch your roles

Player 2: Minister of Energy (in charge of "Fossil Fuel Combustion")
Player 1: Minister of Human Rights (in charge of "Carbon Sequestration" & "Deforestation" for urban development)

Now you are attending a ministry meeting and discuss how to change your duty variables every 50 years for 6 rounds (2025-2325) to minimize the emission to the atmosphere.

1. Discuss your decision with your group.
2. Apply your decision to the system.
3. Click on "Run"
4. Now you are ready for the second round of your decision-making process.
Did you manage to avoid increasing atmospheric carbon? What was your strategy?
If not, can you describe why?

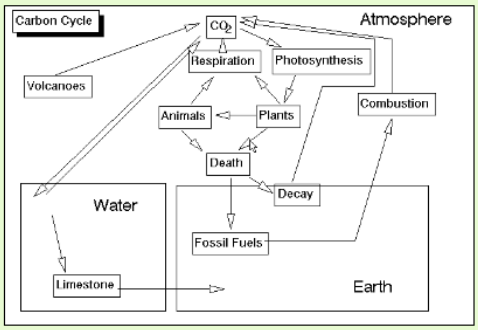
No, check the impact of my change after each run and if it was increasing the atmospheric carbon tried to reduce the variable for the next run.
I think one reason can be the late appearance of the impact of my change,
I felt I am always behind the system to make decision.
Or Can be yes, …. I learned from the simulator how different human interaction impact the atmospheric carbon and I tried to make my decisions in a way to avoid the over shooting carbon in atmosphere.

5. How did you experience your new role?

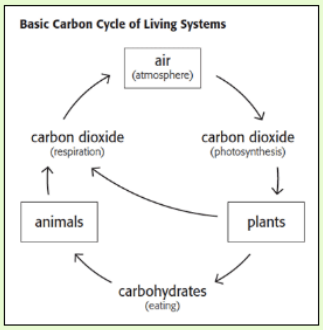
For example, I found easier to be minister of energy, I was focusing only on one duty, plus the fossil fuel resources finished earlier than the simulation, even if I made bad choices that cause increasing the atmospheric carbon but still after 2200, I could see the decreasing trend.

Journal

Debriefing



System Definition



Feedback Loop

Debriefing-System Definition (Page 9)

Do you know of any similar systems? List couple of them.

1. Water Cycle
2. Nitrogen Cycle

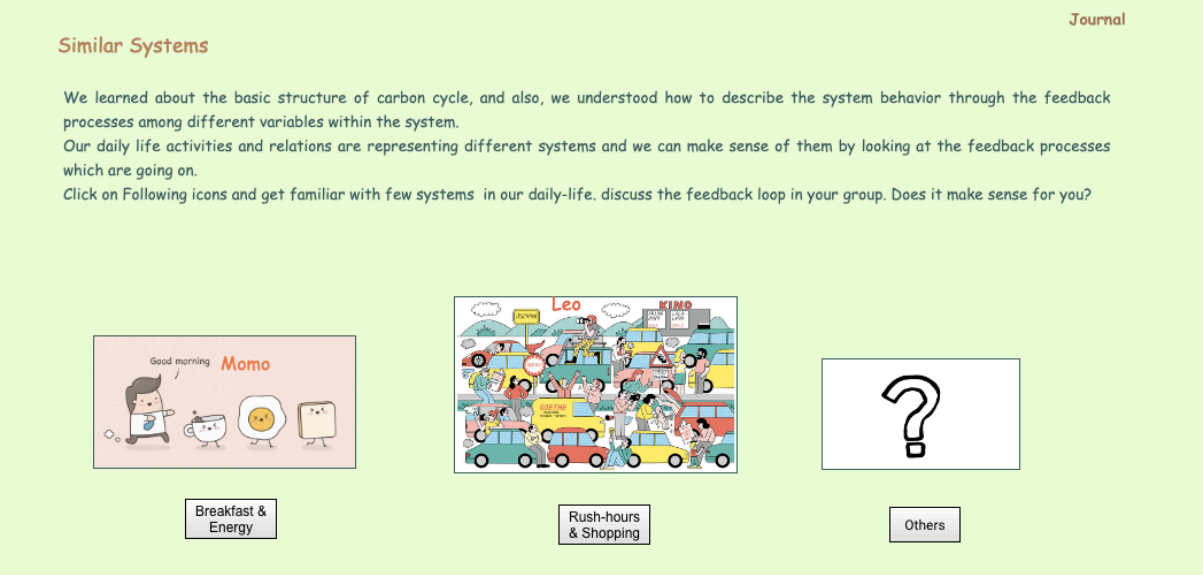
Debriefing-Feedback Loop (Page 10&11)

Describe the difference of the two different behaviors based on the final values. (Remember the impact of fossil fuel COMBUSTION on photosynthesis)
Can you explain why this happened?

In Both graphs atmospheric carbon is increasing to a pick and starts falling. Both behaviors are matching the balancing feedback loop concept.
Left: Atmospheric carbon increasing for longer period of time and to higher values- fossil fuel combustion is releasing lots of co2 and also decrease the photosynthesis carbon removal from the sky-combination ends the co2 in higher values
Right: Atmospheric carbon increasing for shorter period of time and to lower values- only a step decrease in the photosynthesis and balancing loop is self-correcting the behavior in few next time steps.

Similar Systems (Page 12)

If you have time complete this section in class, otherwise to be done as homework!



Momo´s breakfast & energy feedback loop (Page 13)

Does Momo´s breakfast cycle accurately depict you? If not, modify the cycle to your personal system. You don't need to draw the cycle, modify the story. (Text from the arrows in the game).

Personal experience, still expected to be able to modify to their own experience

Leo´s Rush hours shopping decision feedback loop (Page 14)

Does Leo's rush hour shopping cycle make sense to you? If not, modify the cycle to your experience.

Personal experience, still expected to be able to modify to their own experience

Illustrate one of your day-to-day life feedback loops

Over sleeping------ less energetic------- want to sleep------ change the biological clock------ tiredness-----sleeping more------oversleeping