

Carbon Cycle and



Climate Change

MATERIALS

Chemical cards, Sorting It Out page

DIRECTIONS

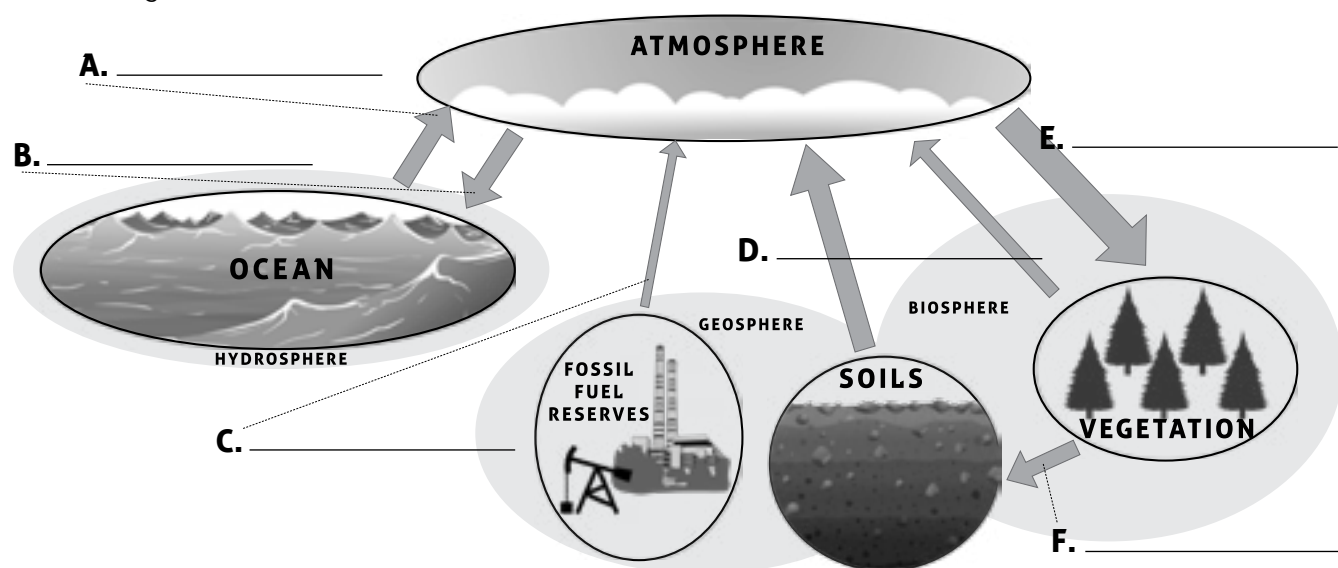
FOR EACH REACTION:

1. Look through the chemical cards and choose the chemicals you think are used as reactants and products. Place the cards in the correct boxes on the Sorting It Out page.
2. Write the chemical formulas for the reactants and products in Table 1 below.
3. Circle the reactant and product that contain carbon.
4. Put the chemical cards back into the stack.

Table 1. Reactants and Products

PHOTOSYNTHESIS		RESPIRATION		COMBUSTION	
Process used by plants to transform light energy into chemical energy		Process by which organisms use food molecules to produce energy (adenosine triphosphate, ATP) for their cells		Reaction that results in heat and light; in this case, the burning of coal, which is largely composed of carbon	
2 Reactants	2 Products	2 Reactants	2 Products	2 Reactants	1 Product
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

5. Label the blanks on the diagram below with the name of the process that moves carbon between the reservoirs by the arrows. Blank D is labeling two arrows pointing toward the Atmosphere, one from Soils and the other from Vegetation.



UP IN THE AIR MODEL

I. Label and Place the Cups

Materials: Five small cups, one set of cup labels, tape, scissors, and fluxing carbon pieces

In pencil, write the name of each the reservoirs in the box to the right onto one of each of the cup labels, based on the amount of carbon in the reservoir. Use what you know about how much carbon each of the reservoirs contains to determine which reservoir name to write on each cup label.

Cut out the cup labels and tape each of them to a cup. Place the correctly labeled cups onto the corresponding reservoirs on the model board.

RESERVOIR CHOICES:

Ocean
Soils
Fossil Fuel Reserves
Atmosphere
Vegetation

II. Place Fluxing Carbon Game Pieces

Use the table below to place the correct number of fluxing carbon pieces in each of the reservoir cups on the model board. Pieces represent fluxing carbon during the 1-year period of the game.

Important: each reservoir must contain at least ten 1 PgC pieces, except the fossil fuel reservoir.

Table 2. Amount of fluxing carbon in each reservoir during the 1-year period of the game

Reservoir	Approx. Fluxing Carbon (Pg)
Vegetation	44
Fossil fuel reserves	8
Ocean	80
Soils	75
Atmosphere	201

Data Sources: Ciais et al. (2013), IPCC and Ch. 6 Schlesinger and Andrews (2000)

III. Play the Game

Materials: One set of game cards

Follow the instructions below to play the game, and then answer the game questions.

- Shuffle the game cards and place them face down.
- The youngest player will go first.
- Player 1 draws the first card and moves fluxing carbon pieces from one reservoir to another based on the process listed on the card.
 - Determine which reservoirs to transfer carbon between based on the process listed on the card.
- Each player will **keep the game cards that they draw in a stack next to themselves.**
- Take turns drawing cards and moving fluxing carbon pieces until all cards have been used.
- Once you finish with the game cards, the game is over. **Keep each player's game cards next to them, and leave all of the fluxing carbon pieces in place on the game board.**

Game Questions

- Look at the game cards that you drew during the game, and **find the ones with the "A" in the top right corner.** These cards indicate carbon that you moved to the atmosphere.

Determine the amount of fluxing carbon that you **moved to the atmosphere** by adding up the amount of carbon on each of your game cards labeled "A."

Your fluxing atmospheric carbon: _____ Pg

7. Check with your partner(s). How much fluxing carbon **did your partner move to the atmosphere?**

Your partner's fluxing atmospheric carbon: _____ Pg

8. Who won? _____
Name of player who moved the **least** fluxing C to atmosphere

9. Find the total fluxing atmospheric carbon at the end of the game.

_____ Pg + _____ Pg = _____ Pg
Your fluxing atmospheric C Partner's fluxing atmospheric C Total fluxing atmospheric C

10. How much fluxing carbon was added to the atmosphere during the 1-year period of the game?

_____ Pg - _____ Pg = _____ Pg
Total fluxing atmospheric C Total fluxing atmospheric C Fluxing atmospheric C added
at end of game (question 9) at start of game (p. 2, sec. II) during 1-year period of game

How many blue whales could you use to represent the amount of carbon that is being added to the atmosphere every year? (1 PgC = approximately 6 million blue whales)

11. From which reservoirs is carbon fluxing **to** the atmosphere, but carbon is not fluxing **from** the atmosphere? In other words, on the game board, which reservoirs have an arrow pointing to the atmosphere but none pointing from the atmosphere back to the reservoir?

Of these reservoirs, which is a more recent source of carbon to the atmosphere?

12. Do you think the flux of carbon into the atmosphere from fossil fuels accounts for the increase in greenhouse gases, such as carbon dioxide, that are affecting Earth's climate? Why or why not?

13. Was carbon ever removed from or added to Earth during the game?

Can carbon be created or destroyed?

Conclusion

14. How are humans impacting the cycling of carbon on Earth?

What effects are these changes to the carbon cycle having on Earth's systems?

Extension: Critiquing the Model

15. Which parts of the game were effective at modeling the reservoirs and fluxing of carbon? Why?

16. Which parts of the game were not effective at modeling the reservoirs and fluxing of carbon? Why?