

APES: The Carbon Cycle Game

WHAT TO TURN IN (individually – 10 pts.):
Copy of playing board, colored according to procedure step 3
Discussion Questions # 1-7

PROCEDURE

- 1) Groups should have three students. Each student chooses a playing piece. This playing piece represents a carbon atom. Each group needs two coins and a playing board. Each person requires a question sheet and a copy of the playing board. The group needs some colored pencils.
- 2) Place your playing pieces on space #1. Flip the coins as instructed on the following pages. Flip your coins at the start of the turn following instructions as you go. Do not follow the sequence of the numbers, but follow the chance moves that the coins present. Two or more players can occupy the same place. When your carbon atom is returned to the atmosphere, you have completed one cycle. Continue playing until told to stop.
- 3) On your individual game board, use the colored pencils to keep track of your cycles with each color representing a single cycle. Label the cycles 1st, 2nd, etc. Everyone who travels through the cycle and understands the process is a “winner,” but it is interesting to note...
 - a) Who visited the most organisms?
 - b) Who completed the most cycles?
 - c) Who completed the longest cycle?... the shortest?
 - d) Who spends the most time in the atmosphere?
- 4) Have fun then answer the questions below.

DISCUSSION QUESTIONS

- 1) For the sake of time and space, some important pathways have been left out of the game. Note these pathways and describe how carbon atoms might enter into and cycle through these pathways. In particular note the aquatic and fossil fuel pathways.
- 2) In the course of the carbon cycle, are carbon atoms themselves ever created? Ever destroyed? Ever changed into other kinds of atoms? Ever changed into other compounds? Explain.
- 3) What changes do occur in the state of carbon atoms in the course of the cycle? Describe the organic and inorganic states of carbon and the changes that occur between these states.
- 4) Why are some carbon atoms from CO₂ not incorporated into sugar molecules in darkness? Start by answering: What is the potential energy of carbon dioxide? Of sugar? What is necessary for them to go to a higher phase?
- 5) Much of the food ingested into each organism is metabolized in cell respiration. Why is this so? What does the organism need and get out of this process and how does it get it?
- 6) What happens to carbon atoms as a result of respiration?
- 7) (SUMMARY) Why is a natural ecosystem not polluted by wastes from the various organisms? In chart form, discuss waste, from what organism and used by.



On to the game.....

THE CARBON CYCLE GAME

NOTE: H=heads T = Tails Flip two coins unless you are told otherwise
START AT NUMBER 1

1. Your carbon atom is now a molecule of CO₂ in the atmosphere.

Flip two coins

TT Not absorbed; your carbon atom remains in the atmosphere for another turn.

TH, HH Your carbon atom is absorbed into a leaf of a plant. Go to number 2

2. The molecule of CO₂ with your carbon atom is now in a leaf of a plant.

Flip two coins

TT NO SUNLIGHT! NO photosynthesis. The CO₂ molecule with your carbon atom returns to the atmosphere. Go back to #1

TH, HH SUNLIGHT! Photosynthesis. Your carbon atom is incorporated into a sugar molecule by photosynthesis. Go to #3.

3. Your carbon atom is now in a molecule of sugar in a plant

Flip two coins

TT The sugar molecule with your carbon atom is oxidized in cell respiration to provide energy for plant growth. Your carbon atom is released in a molecule of CO₂ Go back to #1.

TH, HH The sugar molecule with your carbon atom is incorporated into a molecule making up the tissue of a plant. Go to #4.

4. Your carbon atom is now in a molecule of sugar in a plant.

Flip two coins

TT The plant is eaten by an animal. Go to #5 and take another turn to determine what kind of animal.

TH, HH The plant part dies. Its organic matter is detritus. Go to #6.

5. The plant tissue with your carbon atom is eaten by a primary consumer.

Flip one coin twice.

T & T mammal herbivore. Go to 8A

T & H bird. Go to 8B

H & T insect. Go to 8C

H & H human, perhaps yourself. Go to 9

6. Your carbon atom is now in a molecule of dead organic matter or detritus.

Flip two coins

TT, TH Consumed by a detritus feeder or decomposer.

Go to 10 and take another turn to determine which one.

HH FIRE! Go to 7.

7. The molecule with your carbon atom is now being oxidized (burned) in a fire. Oxygen is combining with your carbon atom and it is being released in a molecule of carbon dioxide. Go immediately back to number 1 without taking a turn.

8. 8A, 8B and 8C The plant tissue with your carbon atom is now being ingested by a 1^o consumer as part of its food. Flip two coins

TT The molecule with your carbon atom is metabolized into a molecule making a tissue of the consumer's body. Go to 11P

TH CELL RESPIRATION! Go to 12.

HH The molecule with your carbon atom is not digested. It passes through the intestinal tract as waste. Go to 6.

- 9. The plant tissue with your carbon atom is now being ingested by a human, perhaps yourself, as a part of food.**
 Flip two coins
TT The molecule with your carbon atom is metabolized into a molecule making up a tissue in your body. Go to 11H
TH CELL RESPIRATION! Go to 12
HH The molecule with your carbon atom is not digested, It passes through the intestinal tract and out as fecal waste. Go to 6.
- 10. The molecule containing your carbon atom is now being ingested by a primary detritus feeder or decomposer.**
 Flip one coin twice.
TT earthworm. Go to 15E
TH decomposer fungus (mushroom). Go to 15F
HT decomposer bacteria. Go to 15B
HH insect. Go to 15I
- 11. H Your carbon atom is now in a molecule making up a tissue of your or another human's body.**
 Flip one coin
T The molecule is broken down and metabolized in cell respiration. Go to 12.
H When the human dies of injury and/or disease and if the body is cremated, the carbon atom will go to 7.
- 11. P Your carbon atom is now in a molecule making up a tissue of a primary consumer or herbivore.**
 Flip two coins
TT The molecule is broken down and metabolized in cell respiration, Go to 12.
TH The primary consumer is eaten by a secondary consumer. Go to 13
HH The primary consumer dies of injuries and/or disease. Go to 6.
- 11. S Your carbon atom is now in a molecule making up a tissue of a secondary consumer or a carnivore.**
 Flip two coins
TT The molecule is broken down and metabolized in cell respiration. Go to 12.
TH The secondary consumer is eaten by a third order consumer. Go to 14
HH The secondary consumer dies of injuries and/or disease. Go to 6.
- 11. T Your carbon atom is now in a molecule making up a tissue of a third order consumer or a carnivore.**
 Flip two coins
TT The molecule is broken down and metabolized in cell respiration. Go to 12.
TH The third order consumer is eaten by another third order consumer. Go to 14
HH The third order consumer dies of injuries and/or disease. Go to 6.
- 12. The molecule containing the carbon atom is now being broken down in cell respiration to provide energy for the consumer's movements and functions. In this process, your carbon atom is combined with oxygen atoms and is released back into the air as carbon dioxide. Go immediately back to #1 without taking another turn.**
- 13. The molecule with your carbon atom is now being ingested by a secondary consumer.**
 Flip two coins
TT The molecule is metabolized into a molecule making up tissues of the consumer's body. Go to 11 S.
TH CELL RESPIRATION! Go to 12.
HH The molecule with your carbon atom is not digested. It passes through the intestinal tract and out as fecal matter. Go to 6.

14. The molecule with your carbon atom is now being ingested by a cow - a consumer.

Flip two coins

TT The molecule is metabolized into a molecule making up tissues of the consumer's body. Go to 11 P.

TH CELL RESPIRATION! Go to 12.

HH The molecule with your carbon atom is not digested. It passes through the intestinal tract and out as fecal matter. Go to 6.

15. B The molecule with your carbon atom is now being absorbed by a bacterium.

Flip one coin

T It gets incorporated into a molecule of the bacteria: go to 16

H It gets broken down and metabolized in cell respiration: go to 12.

15. E The molecule with your carbon atom is now being ingested by an earthworm.

Flip two coins

TT It gets incorporated into a molecule of the worm's body. Go to 17.

TH It gets broken down and metabolized in cell respiration. Go to 12.

HH It is not digested; it passes through the intestinal tract and out as fecal matter. Go to 6.

15. F The molecule with your carbon atom is now being absorbed by a fungus (mushroom).

Flip one coin

T It gets incorporated into a molecule of the fungus.. Go to 18.

H It gets broken down and metabolized in cell respiration. Go to 12.

15. I The molecule with your carbon atom is now being ingested by an insect grub.

Flip two coins

TT It gets incorporated into a molecule of the insects body. Go to 19.

TH CELL RESPIRATION!. Go to 12.

HH It is not digested. it passes through the intestinal tract and out as fecal waste. Go back to 6

16. Your carbon molecule is now a molecule making up the bacterium's body.

Flip two coins

TT The molecule is broken down and metabolized in cell respiration. Go back to 12.

TH The bacterium is eaten by an earthworm. Go to 15E

HH The bacterium dies. Go to 6.

17. Your carbon molecule is now a molecule making up the earthworm's body.

Flip two coins

TT The molecule is broken down and metabolized in cell respiration. Go back to 12.

TH The worm is eaten by a bird. Go to 8B

HH The worm dies of injury or disease. Go to 6.

18. Your carbon molecule is now a molecule making up a mushroom.

Flip two coins

TT The molecule is broken down and metabolized in cell respiration. Go back to 12.

TH The mushroom is eaten by an insect. Go to 15I

HH The mushroom matures and dies. Go to 6.

19. Your carbon molecule is now a molecule making up the body of an insect.

Flip two coins

TT The molecule is broken down and metabolized in cell respiration. Go back to 12.

TH The insect is eaten by a small mammal. Go to 8A

HH The insect dies of injury or disease. Go to 6.