**Warming Up with Greenhouse Gases**

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| Grade Level: | **5-8, 9-12** | Subject: | Carbon Cycling | Prepared By: | **Will West** |

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| Overview & Purpose Understanding of carbon cycling  Understanding of how humans impact carbon cycling | Education Standards Addressed What state/county education standards that this lesson satisfies? |

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|  | Teacher Guide | Student Guide |  |
| Objectives (Specify skills/information that will be learned.) | * Explain how carbon cycling can influence greenhouse gas emissions. * Explain that greenhouse gases warm the earth by trapping heat. * Follow up with video, or activity of climate warming (melting ice or warming with lights in incubation of greenhouse gases) | * Recognize that there is a finite amount of carbon on earth. * Model how carbon moves around in the environment, from one place to another. * Identify how humans influence the carbon cycle. | Materials Needed  * Marbles * Carbon Cycle Role-Play Cards (7 total, one per group) * Dice |
| Information (Give and/or demonstrate necessary information) | * Lecture showing examples of how humans change carbon balance * How humans change greenhouse gases. | * Carbon has a limited number of molecules * Carbon is transferred between many systems * Carbon can be a gas in some environments and drive climate change |
| Verification (Steps to check for student understanding) | * Ask students to think about examples of how we can reduce carbon use. * Ask students to think about other ways humans alter carbon balance. * Subsequently, for high school students, describe processes of carbon transfer more in detail. | * After the activity, ensure students can explain carbon transfer. * Ensure students understand how changing rates of carbon can influence carbon storage. * Have students draw the exchange of carbon between environments. | Other Resources (e.g. Web, books, etc.)   * EPA Climate Change * https://www3.epa.gov/climatechange/kids/ |
| Activity (Describe the independent activity to reinforce this lesson) |  | * Carbon Cycling Role Playing * Distribute 7 biosphere labelled cards amongst students. * Students will divide amongst groups and pass out marbles randomly. * Subsequently, students will change the rates of marble exchange based on upon a given rate (use dice). |
| Summary | * If you are working towards Performance Expectations regarding developing a model to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact, remember that elementary students only need to explain the interactions of two systems at a time. * The emphasis for middle school is on the geologic process of the rock cycle, * The emphasis in high school is on how biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), provide the foundation for living organisms. |  | Additional Notes |