

## Lesson 8: Atmospheric Science Training Conclusion: Summarizing Learning

Students review characteristics of systems and the planetary temperature system and draw conclusions between the Earth's atmospheric gases and systems important to human survival. They then summarize their learning from this unit in a final project.



**Main Concept:** The atmosphere is an important part of the Earth's system, which is composed of several gases that interact with the astronomical, geological and biological characteristics of Earth's system through chemical reactions to maintain habitable conditions for humans.



**Scientific Question:** How is the Earth's atmosphere important to the Earth system, especially as it supports habitability to humans?

Objectives		Standards
<ul style="list-style-type: none"> <li>Students will draw and explain concept maps that show how the gases in the atmosphere interact with many different systems to support human habitability.</li> <li>Students will write a superhero comic book explaining how superheroes representing elements combine their powers to protect the Earth's habitability.</li> </ul>		<b>Addresses:</b> 2061: 4B (6-8) #2 2061: 11A (3-5) #1 2061: 11A (3-5) #2 2061: 11A (6-8) #2 2061: 11A (6-8) #3 NSES: D (5-8) #1.8
Assessment	Abstract of Lesson	
Concept maps and superhero comic books.	Students review the characteristics of systems and the planetary temperature system. They then draw concept maps that show the interaction of atmospheric gases with important systems that support human survival. Finally, students write a superhero comic book that shows how elements combine their powers to form properties that help maintain the habitability of Earth.	
Prerequisite Concepts		
<ul style="list-style-type: none"> <li>Systems consist of many parts that usually influence each other. A system may not work as well (or at all) if a part of it is missing, broken, worn out, mismatched or misconnected. Thinking about things as systems means looking for how every part relates to other parts. Any system is usually connected to other systems. (Astronomy Lesson 7)</li> <li>The type of star, the orbital distance of a planet and the mass of the planet are the major components of the planetary temperature system, which determines the surface temperature of the planet. (Astronomy Lessons 9 and 11)</li> <li>A large object, such as a Jupiter-size planet, orbiting near an Earth-size planet, could disrupt the planetary temperature system. (Astronomy Lesson 12)</li> <li>Humans need water, oxygen, food, gravity, a moderate temperature and protection from poisonous gases and high levels of radiation to survive. (Astronomy Lesson 1)</li> <li>The atoms of any element are alike but are different from atoms of other elements. Atoms may stick together in well-defined molecules. (Atmosphere Lesson 2)</li> <li>Carbon dioxide and water vapor are greenhouse gases that absorb energy radiated from Earth's surface and release some of it back towards the Earth, increasing the surface temperature. (Atmosphere Lesson 3)</li> <li>When substances interact and new substances are created, chemical change has occurred. Matter is neither created nor destroyed in this process. (Atmosphere Lesson 4)</li> <li>Oxygen is a highly reactive element involved in chemical reactions that release heat energy. Oxygen is important to humans because it helps to convert sugars into energy in the cells. (Atmosphere Lesson 5)</li> <li>The creation and destruction of ozone in the stratosphere protects life on Earth from harmful ultraviolet radiation. (Atmosphere Lesson 6)</li> <li>Nitrogen, like other substances, can have an effect on life because of its unique properties and because of the amount of it in the environment, which contributes to air pressure necessary for life functions. (Atmosphere Lesson 7)</li> </ul>		





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## Major Concepts

- The amount of gases in the atmosphere is determined by the mass of the planet (an astronomical characteristic) and is related to the amount of pressure, which is important to human habitability.
- The amount of greenhouse gases (carbon dioxide and water vapor) in the atmosphere plays a role in the planetary temperature system.
- Oxygen is breathed in through the respiratory system and is circulated to the cells through the circulatory system where it reacts with sugars brought in through the digestive system to provide us with energy.
- Nitrogen is brought into our bodies through the digestive system and provides us with necessary building blocks for proteins.
- Our star type determines the amount of harmful ultraviolet radiation put out by our star, much of which is absorbed by oxygen and ozone in the upper atmosphere.
- Chemical reactions are the means by which atmospheric gases change, helping us to survive because of such reactions as photosynthesis, aerobic respiration, and the formation and destruction of ozone.
- The properties of an element by itself are different from the properties of combined elements in molecules.



### Suggested Timeline (45-minute periods):

- Day 1 Engage and Explore Sections
- Day 2 Explain and Extend Sections
- Day 3 Evaluate Section



### Materials and Equipment:

- Chart paper for class concept maps and chart of the importance of each gas to humans
- Construction paper or blank white paper for students to draw their concept maps
- Different colored pens or colored pencils (for student concept maps)
- A class set of Final Atmosphere Project and System Concept Map
- 2-5 copies of the blank comic book pages for each student
- Crayons, colored pencils or markers (for comic books)

### Preparation:

- Prepare chart to record gases and their importance to humans.
- Gather materials.
- Duplicate Final Atmosphere Project, System Concept Map, and Atmosphere Comic Book pages.
- Prepare chart paper with the major concept of the lesson to post at the end of the lesson.

### Differentiation:

#### Accommodations

For students who may have special needs:

- Have them report orally to the teacher to explain their concept maps and comic books or have them act out their comic book with a partner.

#### Advanced Extensions

For students who have mastered this concept:

- Write a story describing how superheroes begin to make another planet in our solar system habitable to humans. Be sure to describe the current conditions of the planet and both the astronomical and atmospheric superheroes that will be necessary to transform the planet.





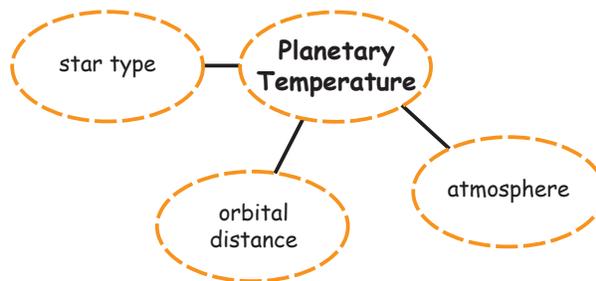
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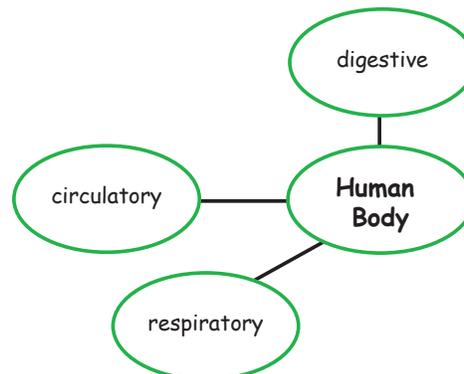
## Engage (approximately 25 minutes)

### 1. Review systems, the human body systems (Astronomy Lesson 7), and the planetary temperature system (Astronomy Lessons 9, 11, and 12).

- Question: What are the characteristics of a system?
- Answer: *Systems consist of many parts that usually influence each other. A system may not work as well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected. Thinking about things as systems means looking for how every part relates to other parts. Any system is usually connected to other systems.*
- Question: What system is largely based on the astronomical characteristics of our solar system? How is this system important to human survival?
- Answer: *The planetary temperature system is important to human survival because we need a moderate temperature that allows water to be a liquid.*
- Question: What are the parts of the planetary temperature system?
- Answer: *(As you discuss, begin to draw this as a concept map on the board.) The three main parts that determine the surface temperature of a planet are: star type, orbital distance, and the atmosphere.*



- Question: What are some of the important systems that make up the human body and help to keep us alive?
- Answer: *(As you discuss, begin to draw this as another concept map on the board.) Some of the systems that make up the human body are the respiratory system, the circulatory system, and the digestive system.*



- Question: What makes these systems?
- Answer: *They have parts that usually relate to each other or work together. If one part is missing or broken, the whole system can be affected. For example, if the star type is very hot, the planet will need to orbit at a further distance in order to maintain a temperature that is habitable.*





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**2. Bridge to this lesson and introduce the purpose and Scientific Question.**

- Say: The last characteristic of a system is that it is usually connected to other systems. Today, we are going to look at the gases that make up our atmosphere and how they connect to the parts of the astronomy system and the human body systems. The scientific question we will explore is:
  - How is the Earth's atmosphere important to the Earth system, especially as it supports habitability to humans?

**3. Review the atmospheric gases and the importance of each. (Atmosphere lessons 3, 5, 6, and 7)**

- Question: What are the gases that make up our atmosphere and how is each important to human survival?
- Answer: (You may want to record these on a chart as seen below.)

Gas	Importance to humans
Water vapor	Absorbs and reradiates heat to Earth's surface
Carbon dioxide	Absorbs and reradiates heat to Earth's surface
Oxygen	Highly reactive, allows us to get energy from sugars
Ozone	Absorbs harmful ultraviolet radiation and prevents it from reaching the Earth's surface
Nitrogen	Forms the building blocks of proteins and is inert allowing us to have a large amount necessary for air pressure

- Say: In the next activity, we'll explore how these gases interact with the planetary temperature system and human body systems to support human survival.



**Explore**

(approximately 20 minutes)

- 1. Have students draw concept maps and write explanations that show how the atmospheric gases interact with the two systems drawn on the board to support human survival. Go over System Concept Map directions and rubrics with students. Encourage students to look for ways to connect all parts to form one large concept map.**

**Students could start in several different ways:**

- Students might branch off from the atmosphere part of the planetary temperature chart and think about what factors determine the amount of atmosphere and what gases make up the atmosphere.
- Students might begin from the human body system and show which gases interact with which parts.
- Students may find connections between the planetary temperature system and the human body system.
- Some students may deviate from traditional concept maps, by showing cycles or flows that have sequences. As long as students are showing connections, this is fine.





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2. Encourage students to use different colors for the planetary temperature system, the human body system and the atmospheric gases. Also encourage students to look for ways to connect all parts to form one large concept map.
3. The following are some questions that may help to guide the thinking of those students who are having trouble making connections.
  - Draw and explain the parts of the system that play a role in the atmosphere's ability to absorb and reradiate heat to the planet's surface affecting the planetary temperature system.
  - How are our digestive, respiratory and circulatory systems all connected, and what role does our atmosphere play in this connection?
  - What are the parts of the system that protects us from ultraviolet radiation? How do the parts interact?



## Explain

(approximately 20 minutes)

1. Have students explain their concept maps, the connections they've made, and why to a partner.

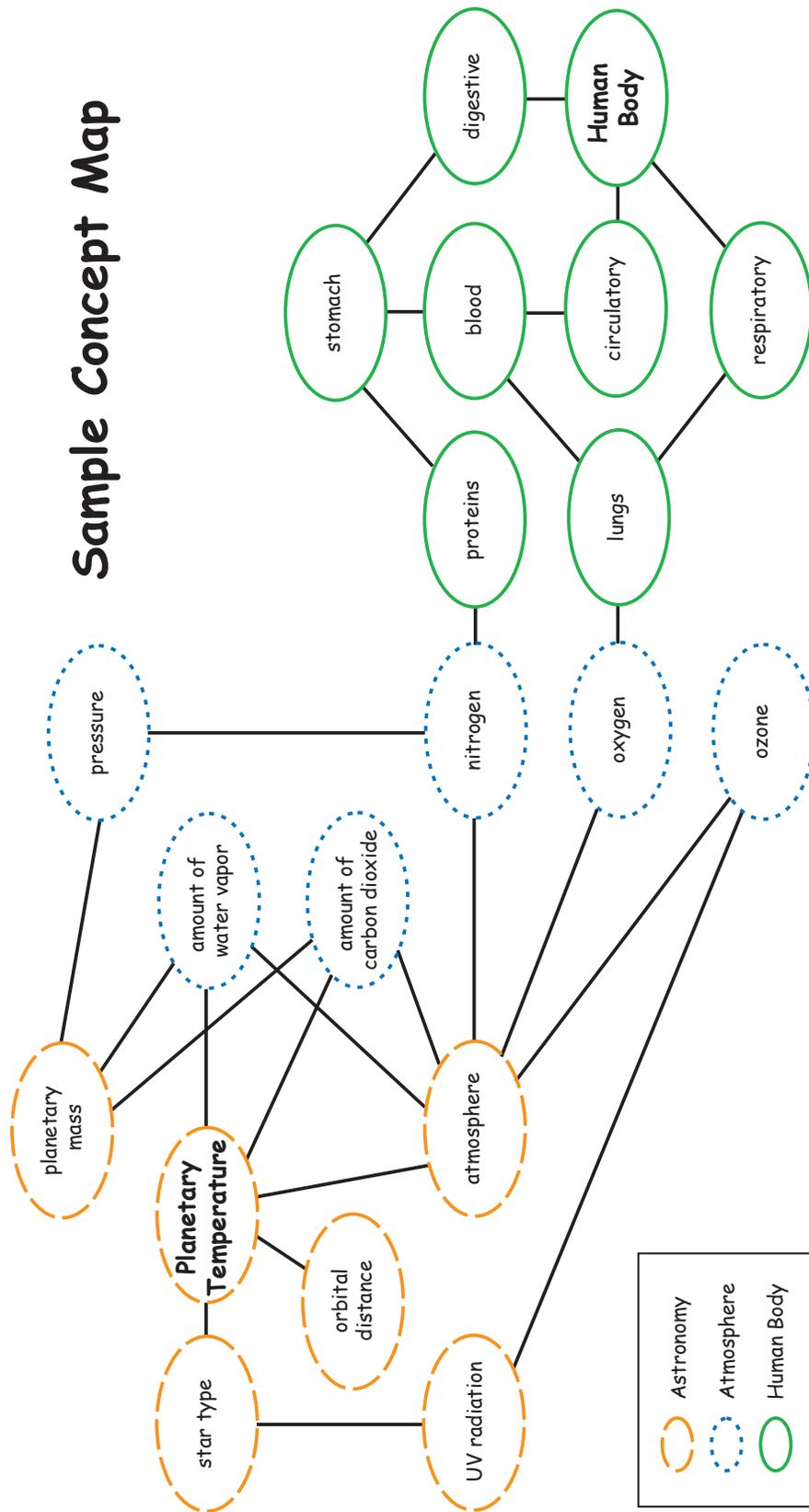
Note to Teacher: Every student will have a different way of thinking about concepts, and concept maps can be powerful for seeing how students are making connections. They may not all be identical and some may reveal faulty logic. This is an opportunity to probe how students are thinking about and connecting ideas and help them to correct any misunderstandings. The following is only one possible concept map.

2. The following types of questions may help students to see connections, they may not have made or made erroneously.
  - Question: How is the mass of a planet related to its atmosphere?
  - Answer: *The mass of a planet determines the amount of gravity a planet has and, thus, the amount of atmosphere it can hold onto.*
  - Question: How does this mass influence the surface temperature of a planet? How is this important for life?
  - Answer: *A planet's gravity influences the amount of greenhouse gases the planet may have in its atmosphere. Greenhouse gases, like carbon dioxide and water vapor, absorb radiation that bounces off the surface of a planet and reradiates some of it back to the planet's surface, raising its surface temperature. A moderate temperature that allows water to be a liquid at all times is essential for human survival. Greenhouse gases play an important role in determining whether a planet's surface temperature will be within an acceptable range for human survival.*
  - Question: How does the mass of a planet relate to the surface pressure, and how is this important to human survival?
  - Answer: *The mass of a planet determines the amount of gravity a planet has, how much atmosphere it can hold onto and thus, the amount of pressure on the planet's surface. We need a certain amount of pressure to keep gases inside our body and to keep water as a liquid on our surface.*





# Sample Concept Map





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- Question: Why is oxygen important to us, and how does it interact with our bodies?
- Answer: *Oxygen is highly reactive and reacts with sugars to give us energy. We breathe oxygen in through the respiratory system. It is circulated to the cells through the circulatory system, where it reacts with sugars that are brought in through the digestive system.*
- Question: How is nitrogen important to us, and how does it interact with our bodies?
- Answer: *Nitrogen is an inert gas that makes up the bulk of our atmosphere contributing to the necessary pressure we need. Nitrogen is also a building block of proteins, which make up important parts of our bodies. Nitrogen is brought into our bodies through the digestive system.*
- Question: How is ozone important to us, and how did you connect it to your system?
- Answer: *Ozone absorbs harmful ultraviolet radiation in the upper atmosphere and prevents much of it from reaching the Earth's surface where it can kill us. You could connect ozone to the atmosphere part of the Planetary Temperature System. You could also connect ultraviolet radiation to the star type of the planetary temperature system, since stars put out ultraviolet light.*
- Question: Looking at your system, where do chemical reactions take place that are important to survival? (You may want to have students mark these with another color.)
- Answer: *Chemical reactions that occur in the system may include: aerobic respiration when oxygen and sugars react; photosynthesis when carbon dioxide, water and the Sun's energy react to form sugar; the formation and destruction of ozone when ultraviolet radiation hits ozone or oxygen molecules; and the breaking down of food in our digestive system to obtain proteins, sugars or other nutrients.*



## Extend/Apply

Day 1 - (approximately 25 minutes)

### 1. Discuss the sub-systems of the atmospheric gases.

- Question: What are the sub-systems of the atmospheric gases?
- Answer: *Gases are made up of atoms from different elements.*
- Question: What is the key characteristic of atoms that allows them to interact with other systems?
- Answer: *Atoms form bonds with other atoms to form molecules. Molecules and atoms can have chemical reactions where two molecules bond together, two molecules exchange atoms, or a molecule splits into separate atoms. These changes allow gases to interact with other parts of the system.*
- Question: When molecules react with other molecules or atoms, do any atoms disappear or are any new atoms produced?
- Answer: *No, there is always the same number of atoms, they just change what substance they are a part of.*





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## 2. Introduce the final project that will summarize student learning from this unit.

- Go over the Final Atmosphere Project directions and rubric for the superhero comic book project.
- Draw students' attention to the properties of the five gases in Earth's atmosphere that were focused upon in this unit and the properties that each has that is important to human survival.
- You may want to brainstorm some of the types of catastrophes or villains that could be threatening Earth in ways that the superheroes could combine to combat them. Some examples might include: a villain who is trying to freeze the planet, who is draining energy from the planet, who is aiming a beam of ultraviolet radiation at the planet, or who is decreasing the pressure on the planet's surface.
- Allow students time to work on their final projects.

Note to Teacher: You may want to allow students to finish their comic books as homework. Otherwise, you may need to allow more class time for completion.



## Evaluate

(approximately 45 minutes)

### 1. Allow students to complete their comic books.

### 2. Have students share their comic books with a partner or group.

### 3. Discuss students' stories to ensure they have mastered the major concepts.

- Question: What could be done to combat the freezing of the Earth?  
• Answer: Carbon and oxygen could combine their powers to create carbon dioxide that absorbs heat from the Earth's surface and reradiates some of it back to the Earth. (Hydrogen and oxygen could combine their powers to form water vapor to do the same thing.)
- Question: What could be done to combat the draining of energy from animals?  
• Answer: Oxygen could help animals get energy from sugars.
- Question: What could be done to combat an increase of ultraviolet radiation to the Earth's surface?  
• Answer: Oxygen could join with other oxygen atoms to form ozone and absorb ultraviolet radiation.
- Question: What could be done, if the amount of surface pressure dropped significantly?  
• Answer: Nitrogen could come to the rescue, filling the space and increasing pressure without reacting.





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#### 4. Collect students' Final Atmosphere Projects and concept maps, and evaluate them to ensure that they have each mastered the major concepts:

- The amount of gases in the atmosphere is determined by the mass of the planet (an astronomical characteristic) and is related to the amount of pressure, which is important to human habitability.
- The amount of greenhouse gases (carbon dioxide and water vapor) in the atmosphere plays a role in the planetary temperature system.
- Oxygen is breathed in through the respiratory system and is circulated to the cells through the circulatory system where it reacts with sugars brought in through the digestive system to provide us with energy.
- Nitrogen is brought into our bodies through the digestive system and provides us with necessary building blocks for proteins.
- Our star type determines the amount of harmful ultraviolet radiation put out by our star, much of which is absorbed by oxygen and ozone in the upper atmosphere.
- Chemical reactions are the means by which atmospheric gases change, helping us to survive because of such reactions as photosynthesis, aerobic respiration, and the formation and destruction of ozone.
- The properties of an element by itself are different from the properties of combined elements in molecules.

#### 5. Bridge to next unit.

- **Question:** We've learned about the importance of the gases in our atmosphere for human habitability, and we've learned about the importance of astronomical characteristics of our solar system for human habitability. If a planet has these astronomical characteristics and atmospheric characteristics, is it habitable to humans?
- **Answer:** *Not necessarily. There are still geologic and biological characteristics that the planet must also have.*
- **Say:** In the next unit we will learn about the geological characteristics that are necessary for human survival.

Note to Teacher: After each lesson, consider posting the main concept of the lesson some place in your classroom. As you move through the unit, you and the students can refer to the "conceptual flow" and reflect on the progression of the learning. This may be logistically difficult, but it is a powerful tool for building understanding.





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## System Concept Map

Draw a concept map that shows how the atmospheric gases interact with the planetary temperature system and the human body system to support human survival. Use different colors for the planetary temperature system, the human body system and the atmospheric gases.

Include the following:

- The planetary temperature system and its three primary components
- The human body system and important sub-systems
- The five atmospheric gases explored in this unit: carbon dioxide, water vapor, oxygen, ozone, nitrogen
- An explanation of the connections you draw between the systems and the gases and why these connections are important to human survival

Your concept map will be evaluated using the following rubric:

<b>4</b>	<ul style="list-style-type: none"> <li>• The concept map clearly and accurately shows connections between the planetary temperature system, human body system, and the atmospheric gases and forms one large concept map. The description clearly and accurately describes all connections and their relevance to human survival.</li> <li>• The concept map has all required parts, and the design elements (circles, color, and lines) are exceptionally clear and easy to understand.</li> </ul>
<b>3</b>	<ul style="list-style-type: none"> <li>• The concept map clearly and accurately shows connections between the planetary temperature system, human body system and the atmospheric gases, but may be in two separate concept maps. The description clearly and accurately describes the connections and their relevance to human survival.</li> <li>• The concept map has all required parts, and the design elements (circles, color, and lines) are clear and easy to understand.</li> </ul>
<b>2</b>	<ul style="list-style-type: none"> <li>• The concept map is not completely clear or accurate in showing connections between some of the atmospheric gases, the planetary temperature system, and the human body system. The description is not completely clear or accurate in describing the connections and their relevance to human survival.</li> <li>• The concept map has most required parts, and the design elements (circles, color, and lines) are a little difficult to read.</li> </ul>
<b>1</b>	<ul style="list-style-type: none"> <li>• The concept map is not clear or accurate in showing connections between atmospheric gases, the planetary temperature system, and the human body system. The description is not clear or accurate in describing the connections and their relevance to human survival.</li> <li>• The concept map is missing several parts, and the design elements (circles, color, and lines) are difficult to read.</li> </ul>





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## Final Atmosphere Project

Create a superhero comic book with a superhero for each of the following elements:

- Carbon
- Oxygen
- Nitrogen
- Hydrogen

Include the following:

- Drawings, a descriptive narrative and dialogue of each superhero's superpowers based on the properties of the element they represent or on the properties brought about by combining their powers with other superheroes. For example, carbon and oxygen could combine to draw on the force of carbon dioxide.
- Drawings and a descriptive dialogue of **at least two** ways that the habitability of Earth is being threatened by villains.
- Drawings and a descriptive dialogue of **at least two** ways that your superhero team combines their powers to stop the villains.

Your comic book will be evaluated using the following rubric:

<b>4</b>	<ul style="list-style-type: none"> <li>- The comic book clearly and accurately describes three or more threats to human habitability and accurately describes the properties of three or more atmospheric gases and the importance of these properties to human habitation.</li> <li>- The comic book has all required parts, is creative, and has accurate and clear narration, dialogue, and illustrations that make the story exceptionally easy to understand.</li> </ul>
<b>3</b>	<ul style="list-style-type: none"> <li>- The comic book clearly and accurately describes two threats to human habitability and accurately describes the properties of two atmospheric gases and the importance of these properties to human habitation.</li> <li>- The comic book has all required parts, has accurate and clear narration, dialogue, and illustrations that make the story easy to understand.</li> </ul>
<b>2</b>	<ul style="list-style-type: none"> <li>- The comic book is not completely clear or accurate in describing two threats to human habitability or in describing the properties of two atmospheric gases and the importance of these properties to human habitation.</li> <li>- The comic book has most required parts. Narration, dialogue, and illustrations are a little difficult to understand.</li> </ul>
<b>1</b>	<ul style="list-style-type: none"> <li>- The comic book is not clear or accurate in describing threats to human habitability or in describing the properties of atmospheric gases and the importance of these properties to human habitation.</li> <li>- The comic book is missing several parts. Narration, dialogue, and illustrations are difficult to understand.</li> </ul>



# Atmosphere Comic Book