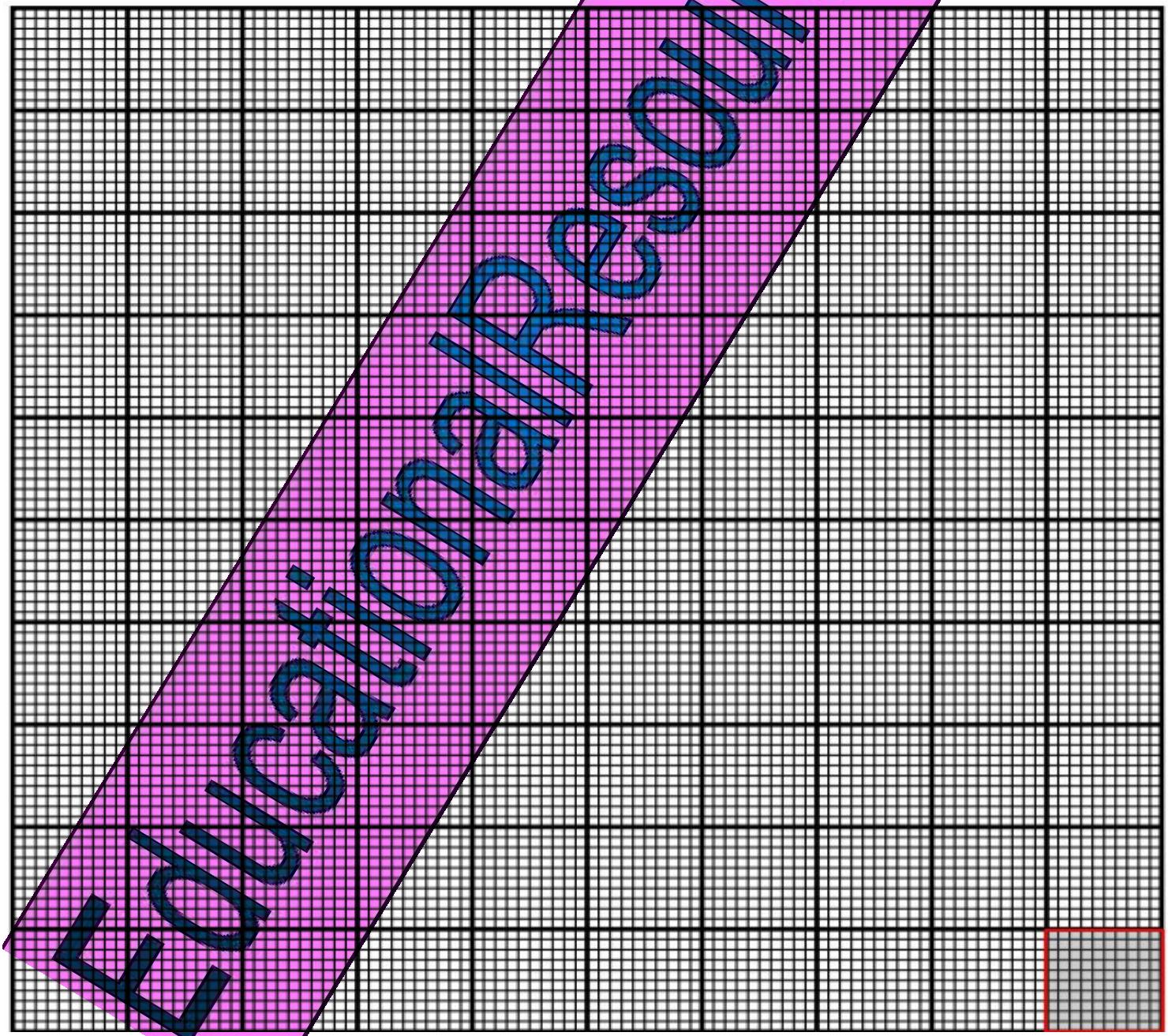
Name: _____

Atmospheric Composition Lab

The majority, **78.08%** of the Earth's atmosphere is made out of nitrogen. The atmosphere contains **20.95%** oxygen, **0.93%** argon, and that doesn't leave much room, **0.04%**, for all the other gases found in the atmosphere. We call these extra gases, **trace gases**. It is easy to use percents and just talk about them, but do you truly understand what these percents mean? Sometimes it helps to see percentages visually. Some trace gases are found in such small quantities, smaller than one percent, that scientists use another unit of measurement called **parts per million,** or **ppm** which is used to measure the concentration of a substance, either in liquids or in gases.

1. **Let's make sure you understand the math in percents of the graph paper below.**
    a. **How many large blocks are there altogether?**
    b. **What percent of the entire graph paper is each large block equal to?**
    c. **What percent would each small block be equal to?**
    d. **How many small blocks are there altogether?**
2. **Use colored pencils or markers to color in the grid according to the quantity of each gas found in the atmosphere. Color in the tiny squares in order. In other words, the last large square should have some oxygen, and all of the argon and trace gases in it. Create a color legend for the gases.**



Each large block in the graph paper could also be written as 1 part per 100.

3. **One small block could be written as 1 part per _____?**

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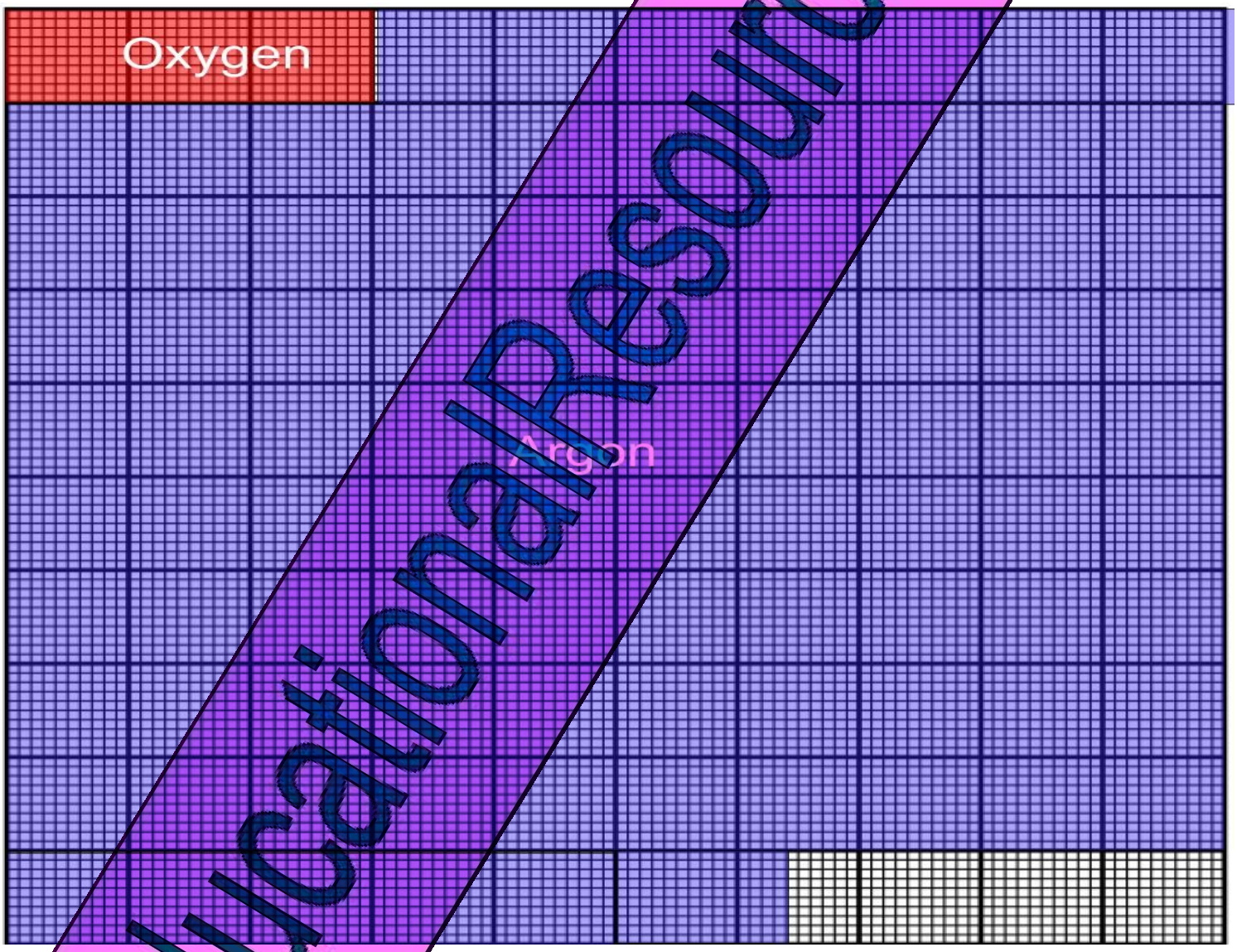
You should have fit some of the oxygen, all of the argon, and all of the trace gases fit into the last large square. There are many different trace gases. Even though they are in very small quantities, they are extremely important to the Earth's atmosphere. Some gases block out harmful radiation and some help plants grow. If these gases increase or decrease by too much, the balance of the Earth's atmosphere can be harmed. Each cell in the table below shows how much some gas in ppm the atmosphere contains. Oxygen and argon are already colored. Color in the rest of the grid based on ppm of these gases.

Argon = 9340 ppm	Carbon Dioxide = ~393 ppm	Neon = ~18 ppm	Helium = ~5 ppm
Methane = ~2 ppm	Krypton = ~1 ppm	Hydrogen = 0.5 ppm	Nitrous Oxide = 0.5 ppm
Carbon Monoxide = 0.1 ppm	Ozone = 0.07 ppm	Nitrogen Dioxide = 0.03 ppm	

In order to visualize how little these amounts are, imagine zooming in on the last block, which is shaded, on the first page and then imagine turning that block into another 10,000 little blocks. That is what the grid below represents.

4. **Each tiny block in the first grid was equal to 0.01% or 1 part per ten thousand. Now that we have zoomed in, what percent would each tiny block be now of the first grid? _____ which is equal to 1 ppm. Hint: We zoomed in on 100 tiny squares to create another 10,000.**

For the amounts above fill in the grid below. Oxygen and argon have already been filled in. Create a color legend.



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5. **Notice that it was not possible to color in all of the trace gases. There are many other trace gases including water vapor. What would we have to do, in order to visually represent these other trace gases?**

Using http://EarthScience.xyz/Atmosphere, Section 1, answer the following questions:

6. **What are the five greenhouse gases?**

7. **About how warm would the planet be if we didn't have greenhouse gases?**

8. **Are greenhouse gases naturally bad for the atmosphere? Explain.**

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Teacher Notes, Instructions and Reflection

1. In this lab, students will represent amounts of atmospheric gases on graph paper, using colored pencils.
2. This assignment is not easy for students who do not have an understanding of percents and decimal places. For this reason and because my students come from a wide academic background, I split my class into groups of 2 to 4 students, so that those that struggle with the assignment, have a partner in which they can get help. I do have all student complete their own paper, however. Before, it was one paper per partnership, but this allowed students without a paper to sit and vegetate while their partner did all the coloring. I do let them collaborate together to come up with the same answers.
3. Caution your students to make sure they count the squares correctly. You will have students who won't though. Every year I have students make multiple mistakes because they miscount.
4. This assignment is meant to be done with little to no teacher intervention except to ask clarifying questions.
5. The temptation is to color in the squares quickly and poorly. If students do this correctly, they will get a really good representation of the gas amounts. I provided an answer key with how it should be correctly colored. I use these images later when we discuss the work that they just accomplished.
6. This is a highly adapted idea of an activity found on the Environmental Literacy and Inquiry Working Group website.

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