


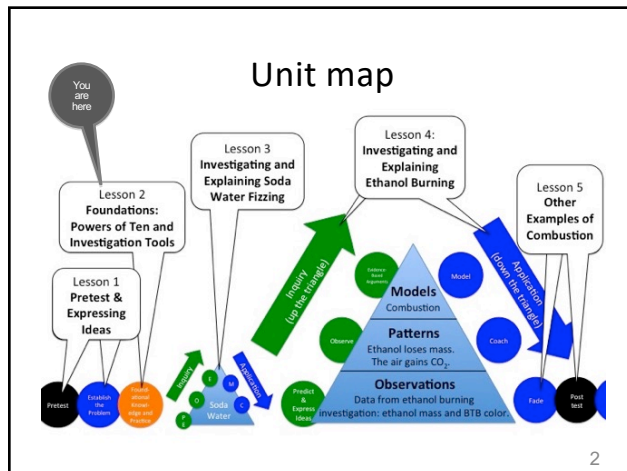
Carbon TIME Carbon: Transformations in Matter and Energy
Environmental Literacy Project
Michigan State University

Systems and Scale Unit


Activity 2.3 Zooming Into Air



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Does air have mass?




Is it empty?
OR
Is it full?

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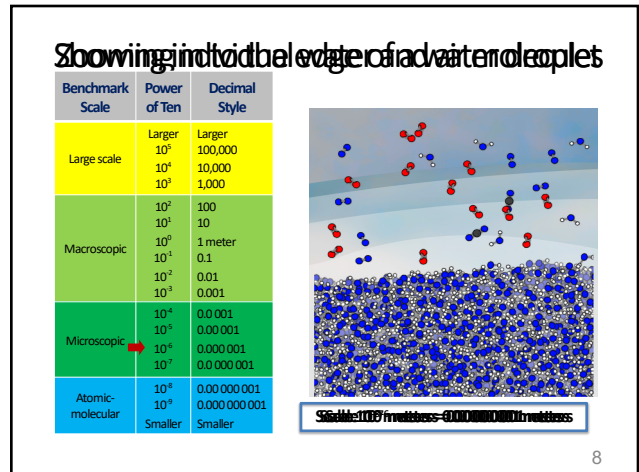
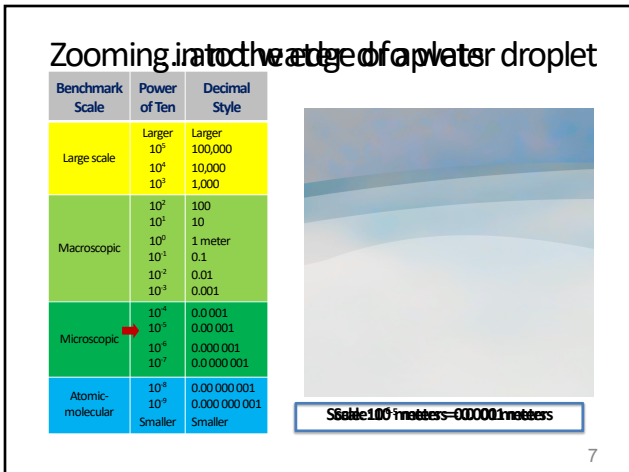
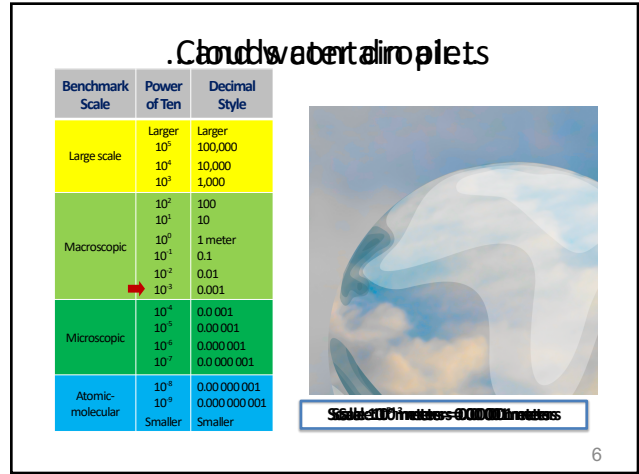
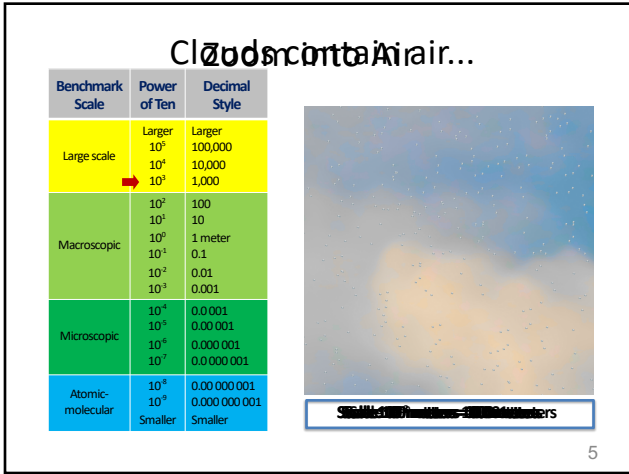
Zoom into Air

Benchmark Scale	Power of Ten	Decimal Style
Large scale	Larger	Larger
	10^5	100,000
	10^3	10,000 1,000
Macroscopic	10^2	100
	10^1	10
	10^0	1 meter
	10^{-1}	0.1
	10^{-2}	0.01 0.001
Microscopic	10^{-3}	0.001
	10^{-5}	0.00001
	10^{-7}	0.0000001
Atomic-molecular	10^{-9}	0.00000001
	10^{-8}	0.00000001
	Smaller	Smaller



Scale: 10^3 meters = 1000 meters

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Water individual water molecules

Benchmark Scale	Power of Ten	Decimal Style
Large scale	Larger	Larger
	10^2	100,000
	10^4	10,000
Macroscopic	10^2	100
	10^1	10
	10^0	1 meter
	10^{-1}	0.1
	10^{-2}	0.01
Microscopic	10^{-3}	0.001
	10^{-4}	0.0001
	10^{-5}	0.00001
Atomic-molecular	10^{-6}	0.000001
	10^{-9}	0.000000001

we still see water!

Scale: 10^9 meters = 0.000000001 meters

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Different kinds of molecules in air

Benchmark Scale	Power of Ten	Decimal Style
Large scale	Larger	Larger
	10^2	100,000
	10^4	10,000
Macroscopic	10^2	100
	10^1	10
	10^0	1 meter
	10^{-1}	0.1
	10^{-2}	0.01
Microscopic	10^{-3}	0.001
	10^{-4}	0.0001
	10^{-5}	0.00001
Atomic-molecular	10^{-6}	0.000001
	10^{-9}	0.000000001

Oxygen O_2

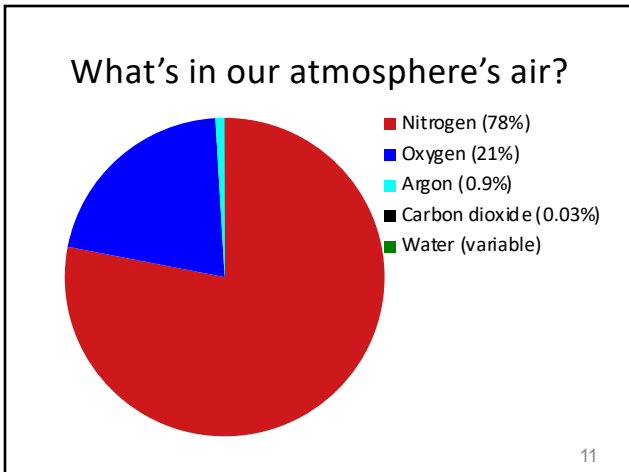
Water H_2O

Carbon dioxide CO_2

Nitrogen N_2

Atomic-molecular Scale

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What is the difference between an atom and a molecule?

1. Oxygen	2. Carbon dioxide	3. Argon
4. Nitrogen	5. Oxygen	6. Hydrogen
7. Carbon	8. Nitrogen	9. Water

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Atoms and Molecules in Air

- Oxygen molecules (O_2) are made of 2 oxygen atoms
- Nitrogen molecules (N_2) are made of 2 nitrogen atoms
- Water molecules (H_2O) are made of 2 hydrogen and 1 oxygen atom
- Carbon dioxide molecules (CO_2) are made of 1 carbon and 2 oxygen atoms

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Three Facts about Atoms

1. Atoms last forever (except in nuclear changes).
2. Atoms make up the mass of all materials.
3. Atoms are bonded to other atoms in molecules.

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Apply the Three Facts About Atoms to Air

1. Atoms last forever (except in nuclear changes).
 - a. **Will the carbon atoms that exist today in CO_2 still be carbon atoms in a million years?**
 - b. **Will the CO_2 molecules that exist today still be CO_2 molecules in a million years?**

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Apply the Three Facts About Atoms to Air

2. Atoms make up the mass of all materials.
 - a. **Does air have mass?**

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Apply the Three Facts About Atoms to Air

3. Atoms are bonded to other atoms in molecules.
 - a. **What are some important atoms in air?**
 - b. **What are some important molecules in air?**

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Check Your Understanding

- Do you think that **people** are made of atoms? Do the three facts about atoms apply to the atoms that we are made of?
- Do you think that **ethanol** is made of atoms? Do the three facts about atoms apply to the atoms that ethanol is made of?
- Do you think that **flames** contain atoms? Do the three facts about atoms apply to the atoms in flames?

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