DeVaughn Croxton

Jane Kim

Team Name: Rayleigh’s StingRays

A45911208

PHY 482

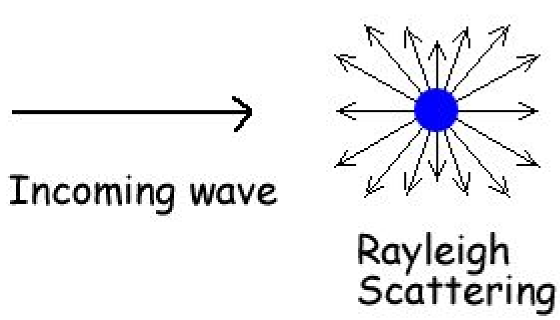
Homework 10 Question 3

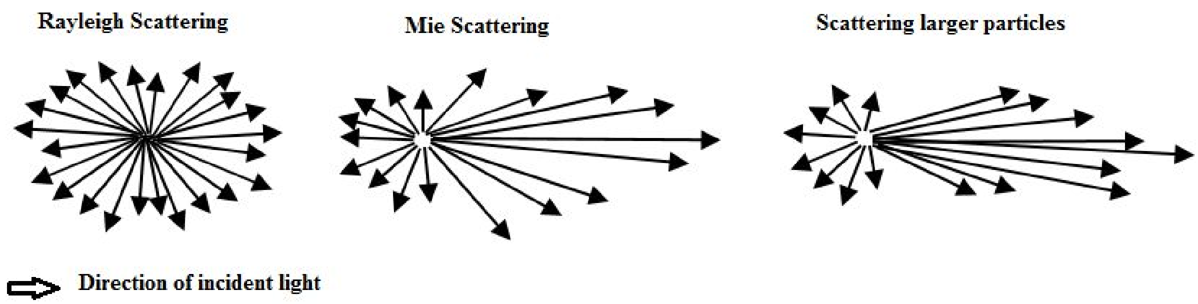
For our project we have 3 main aspects that we want to model for our viewers. We want to model what Rayleigh scattering looks like after particle collisions, how the size of the particle can affect the resulting wavelength in the form of a distribution diagram, and how these wavelengths separate and based on the perspective of the viewer, will create the blue color we see in the sky during the daytime and the red color that we see during sunset.

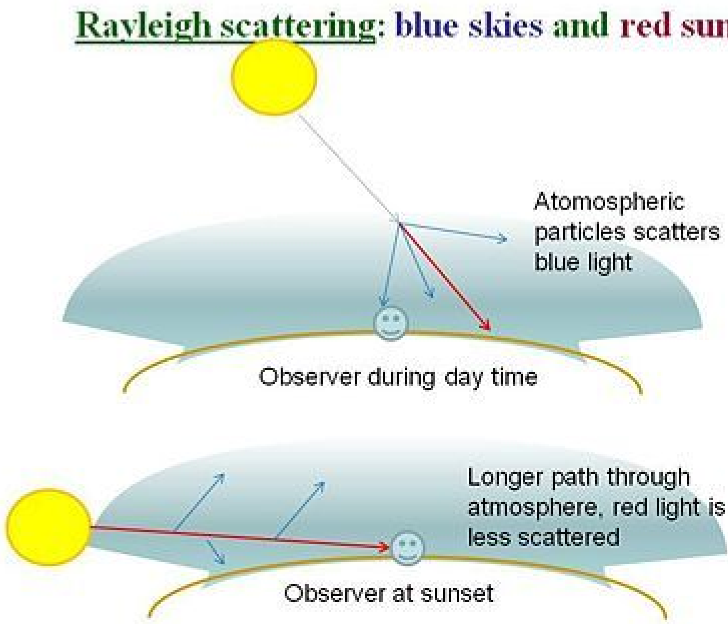
Now I will explain each of the models below in descending order. The first model you will see will be the general model for Rayleigh scattering when an incoming wave makes contact with a particle. This model is important to show how light is radially distributed amongst our atmosphere. After that you will observe three pictures from left to right showing the rayleigh scattering model again, the mie scattering model, and another mie scattering model but with larger particles. We thought this diagram would be nice to add because we hope to add a part to our project explaining how the contents of our atmosphere can alter how the light will scatter and that this scattering may be the root of why we have any color distortion in our skies. We will show an “ideal” case of how the scattering takes place and a more “complex” case that takes into account things like pollution or excess of carbon or nitrogen in our atmosphere. Our hope is that this will bring environmental awareness to our viewers.

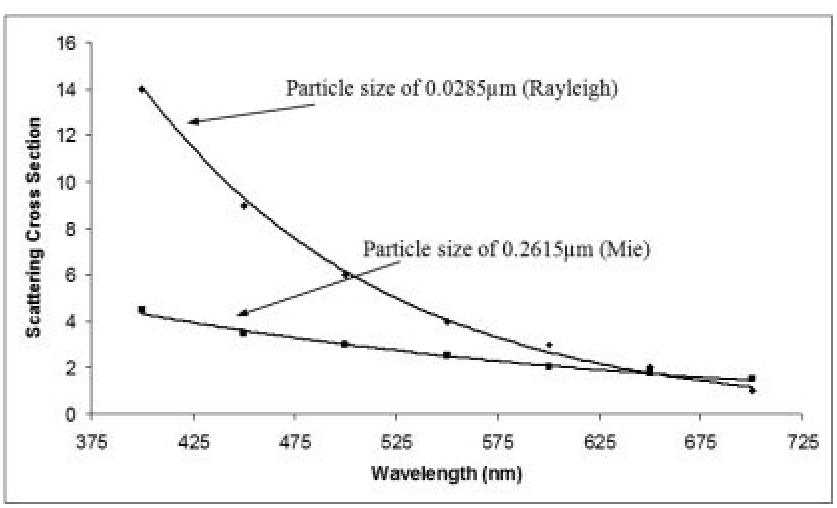
The next following model is a model of how light waves split from the perspective of a person on earth looking towards the sun. This will help show how the angle of the angle combined with the respective wavelength will show a certain color at a certain time. Following that you will observe a diagram comparing rayleigh scattering to mie scattering based upon particle size and how these sizes alter the wavelength. After that diagram we have another diagram that shows what percent of scattering occurs for each wavelength and how the percentage reflects why the color blue is the dominant color that we observe in the sky. The final model is something we believe we can use to shape our project as opposed to placing it on the poster but it shows the various components of the atmosphere and how these different particles react to the light colliding with them.

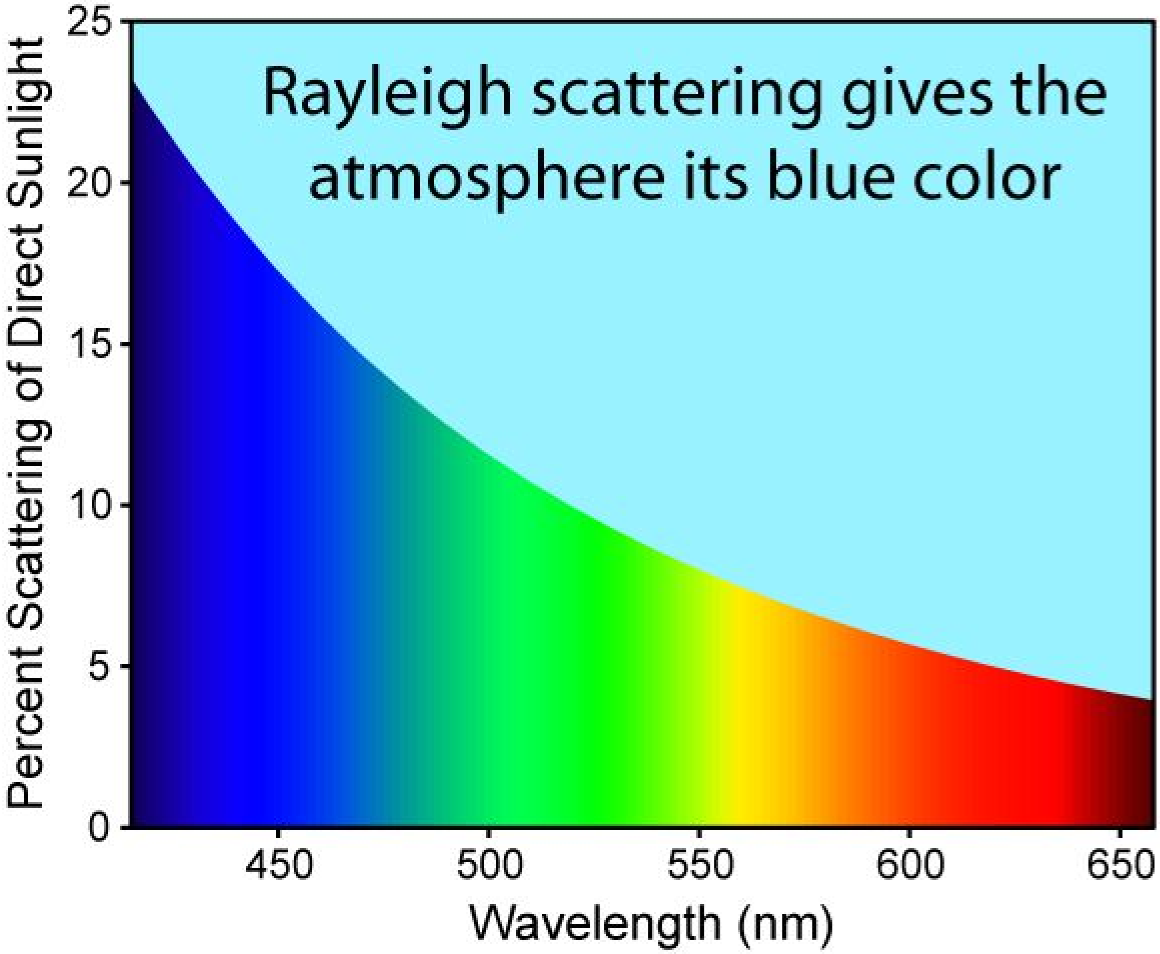
Moving forward DeVaughn will focus his efforts on analyzing what components affect our atmosphere on a daily basis and how these components may alter our desired scattering patterns. Jane will focus her efforts on optimizing the computer program we have that will output various distributions based upon what components are detected in the atmosphere. With the combination of our work we hope that our program will output diagrams similar to the “ideal” ones shown below and also show the complexities that occur based upon our current environment. A copy of our program will also be placed into our repository.

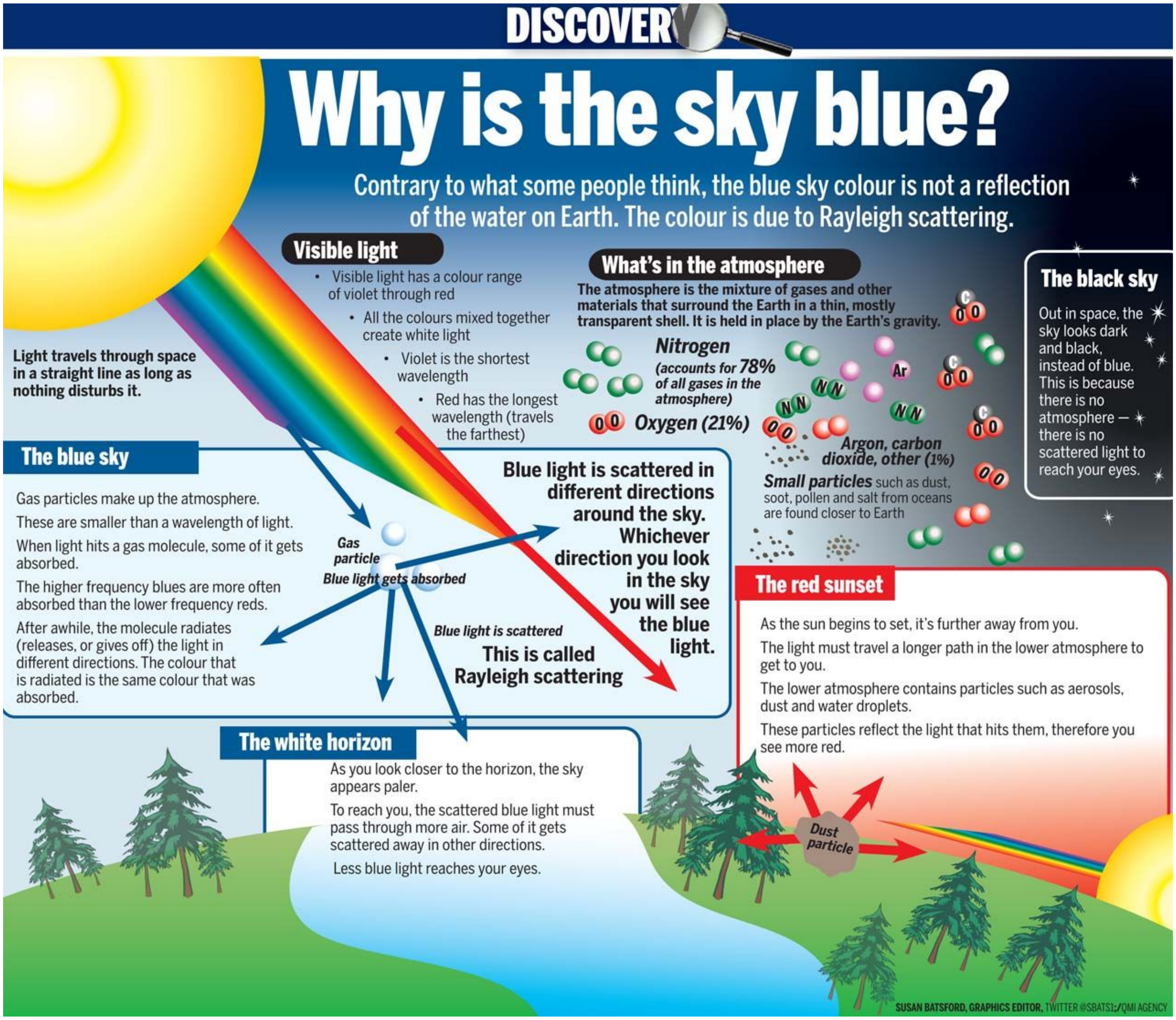



Rayleigh Scattering
Mie Scattering
Scattering larger particles
Direction of incident light


Rayleigh scattering: blue skies and red sunsets
Atomospheric particles scatters blue light
Observer during day time
Longer path through atmosphere, red light is less scattered
Observer at sunset


Particle size of 0.0285µm (Rayleigh)
Particle size of 0.2615µm (Mie)
Scattering Cross Section
Wavelength (nm)
16
14
12
10
8
6
4
2
0
375
425
475
525
575
625
675
725


Rayleigh scattering gives the atmosphere its blue color
Percent Scattering of Direct Sunlight
25
20
15
10
5
0
450
500
550
600
650
Wavelength (nm)


DISCOVERY
Why is the sky blue?
Contrary to what some people think, the blue sky colour is not a reflection of the water on Earth. The colour is due to Rayleigh scattering.
Visible light
• Visible light has a colour range of violet through red
• All the colours mixed together create white light
• Violet is the shortest wavelength
• Red has the longest wavelength (travels the farthest)
Light travels through space in a straight line as long as nothing disturbs it.
What's in the atmosphere
The atmosphere is the mixture of gases and other materials that surround the Earth in a thin, mostly transparent shell. It is held in place by the Earth's gravity.
Nitrogen (accounts for 78% of all gases in the atmosphere)
Oxygen (21%)
Argon, carbon dioxide, other (1%)
Small particles such as dust, soot, pollen and salt from oceans are found closer to Earth
Ar
The black sky
Out in space, the sky looks dark and black, instead of blue. This is because there is no atmosphere — there is no scattered light to reach your eyes.
The blue sky
Gas particles make up the atmosphere.
These are smaller than a wavelength of light.
When light hits a gas molecule, some of it gets absorbed.
The higher frequency blues are more often absorbed than the lower frequency reds.
After awhile, the molecule radiates (releases, or gives off) the light in different directions. The colour that is radiated is the same colour that was absorbed.
Gas particle
Blue light gets absorbed
Blue light is scattered
This is called Rayleigh scattering
Blue light is scattered in different directions around the sky. Whichever direction you look in the sky you will see the blue light.
The white horizon
As you look closer to the horizon, the sky appears paler.
To reach you, the scattered blue light must pass through more air. Some of it gets scattered away in other directions.
Less blue light reaches your eyes.
The red sunset
As the sun begins to set, it's further away from you.
The light must travel a longer path in the lower atmosphere to get to you.
The lower atmosphere contains particles such as aerosols, dust and water droplets.
These particles reflect the light that hits them, therefore you see more red.
Dust particle
SUSAN BATSFORD, GRAPHICS EDITOR, TWITTER @SBATS1 /QMI AGENCY