فیزیک جو

درس اول

صحرایی

گروه فیزیک دانشگاه رازی

http://www.razi.ac.ir/sahraei

References: منابع:

1. An Introduction to Atmospheric Physics, Fleagle & Businger
2. The Upper Atmosphere Meteorology and Physics, Craig.
3. Internet
4. هواشناسی عمومی – دکتر قائمی – سمت.
5. مبانی هواشناسی – دکتر قائمی.
6. هواشناسی فیزیکی – رتالاک – ترجمه صادقی

Assessment

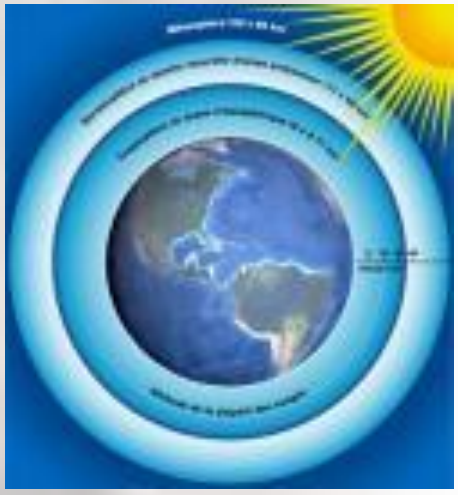
- **Mid semester exam (Sun. 6 Azzar.): 30%**
- **Final exam: 70%**


Research Topics
جو زمین
لایه بار الکتریکی
لایه ازن
برهمکنش باد خورشیدی و شهاب
توفان مغناطیسی زمین
شفق قطبی
تعیین چگالی اتمسفر
ماهواره مصنوعی
تخریب لایه ازن
اتمسفر
ترکیبات اتمسفر
شهاب سنگ
لایه هموسفر
تولید و اتلاف در یونسفر
ارتفاع سنجی
میدان الکتریکی یونسفر
جذب تابش در اتمسفر
اتمسفر
مسیر حرکت سیارات
جوسنج
پلاسماپوز
اصطلاحات رایج مکانیک سماوی
ترکیب مجدد در یونسفر
فروغ آسمانی
ساختار اتمسفر
انتقال و پخش در یونسفر
لایه یونسفر
منشا تابش سیاره ای
تونل باد
ضخامت نوری
لایه اگزوسفر
فیزیک جو
محفظه مغناطیسی پلاسماسفر
علم بالستیک
بارش شفق قطبی
سنجش دمای اتمسفر
لایه تروپوسفر
طوفان مغناطیسی
شار فوتونی
انتشار و جذب فروغ آسمانی
تعادل ترمودینامیکی
اتمسفر و تابش خورشیدی
بحران لایه ازن
قوانین کپلر
ماگنتوسفر و باد خورشیدی
میدان مغناطیسی زمین
لایه ماگنتوسفر
پلاسماسفر
باد خورشیدی
یونش فوتوالکترونی اتمسفر
جزیره مغناطیسی
کمربند تشعشعی زمین
پیکربندی شفق قطبی
انتقال و پخش یون در پلاسما
چگالی الکترونی یونسفر
جذب تابش در اتمسفر
سوراخ لایه ازن
تولید تابش در اتمسفر

Content فهرست

What is atmospheric physics?

Atmospheric physics is the application of physics to the study of the atmosphere.



- **all the bits of traditional physics that are needed to study the behaviour of the atmosphere**

What is the atmosphere?

It's a thin layer of gases surrounding our planet. The atmosphere is held to the planet by the force of gravity

Earth's Blanket

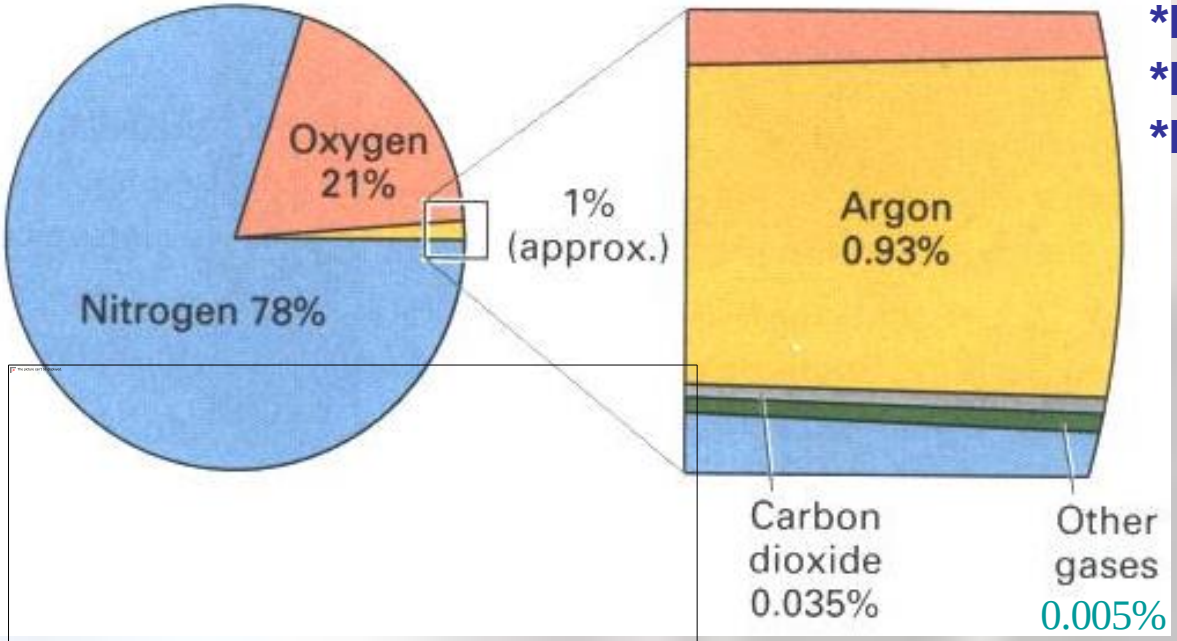
The atmosphere is the gaseous envelope that surrounds the earth and constitutes the transition between its surface and the vacuum of space.

The atmosphere is composed primarily of nitrogen (N_2) and oxygen (O_2) and is made up of many layers of air, each one identified by their thermal characteristics or temperature changes, chemical composition, movement and density.

Life on earth is supported by this atmosphere, solar energy, and our planet's magnetic fields.

Atmospheric Composition

Values show percentage by volume for dry air. Nitrogen and oxygen form 99 percent of our air, with other gases, principally argon and carbon dioxide, accounting for the final 1 percent.



***Neon----------0.002%**
***Helium----------0.0005%**
***Krypton----------0.0001%**
***Hydrogen--------0.00005%**

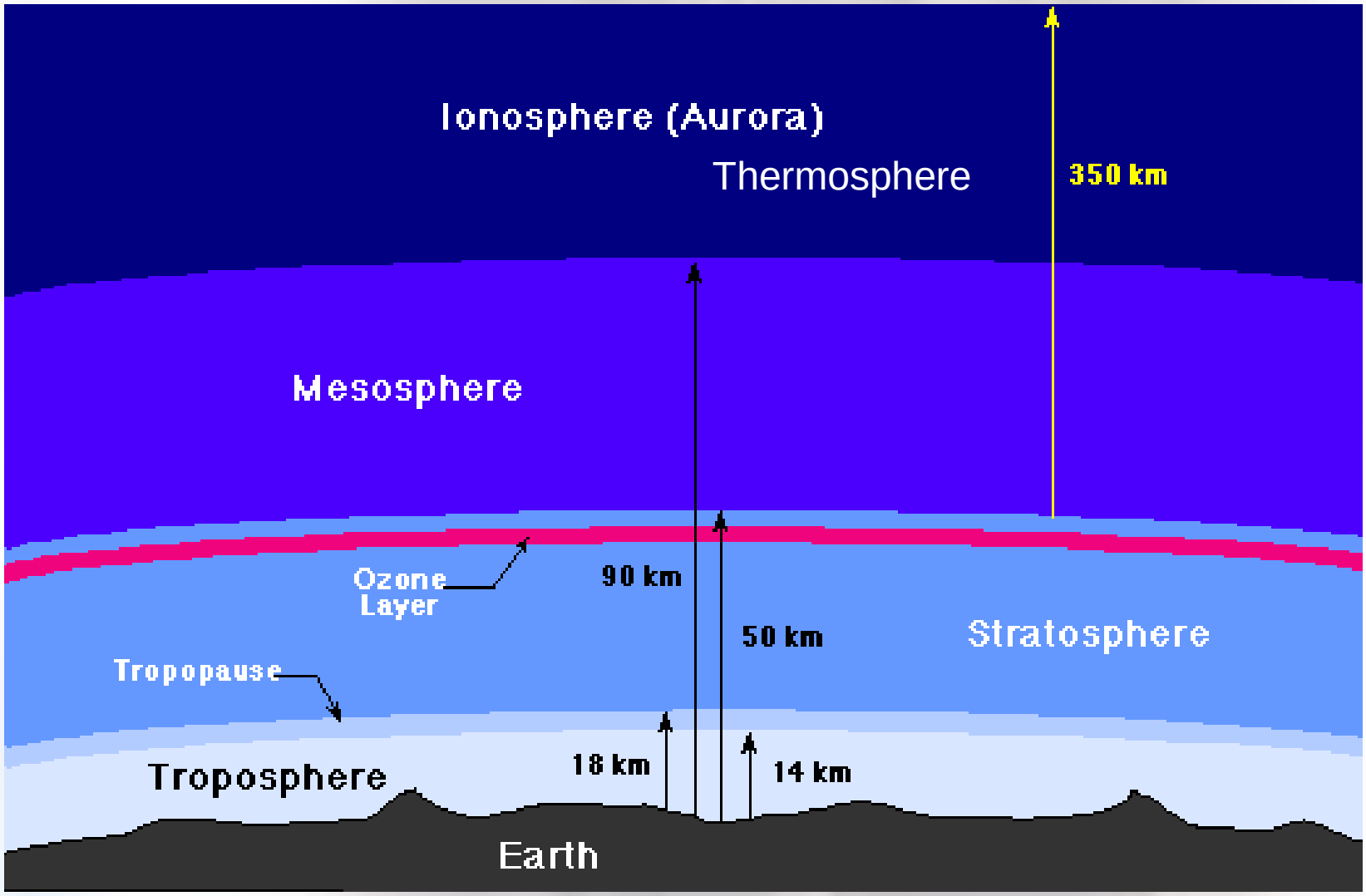
VARIABLE gases in the atmosphere and typical percentage values are:
***Water vapor-------0 to 4%**
***Carbon Dioxide----035%**
***Methane----------0.0002%**
***Ozone----------0.000004%**

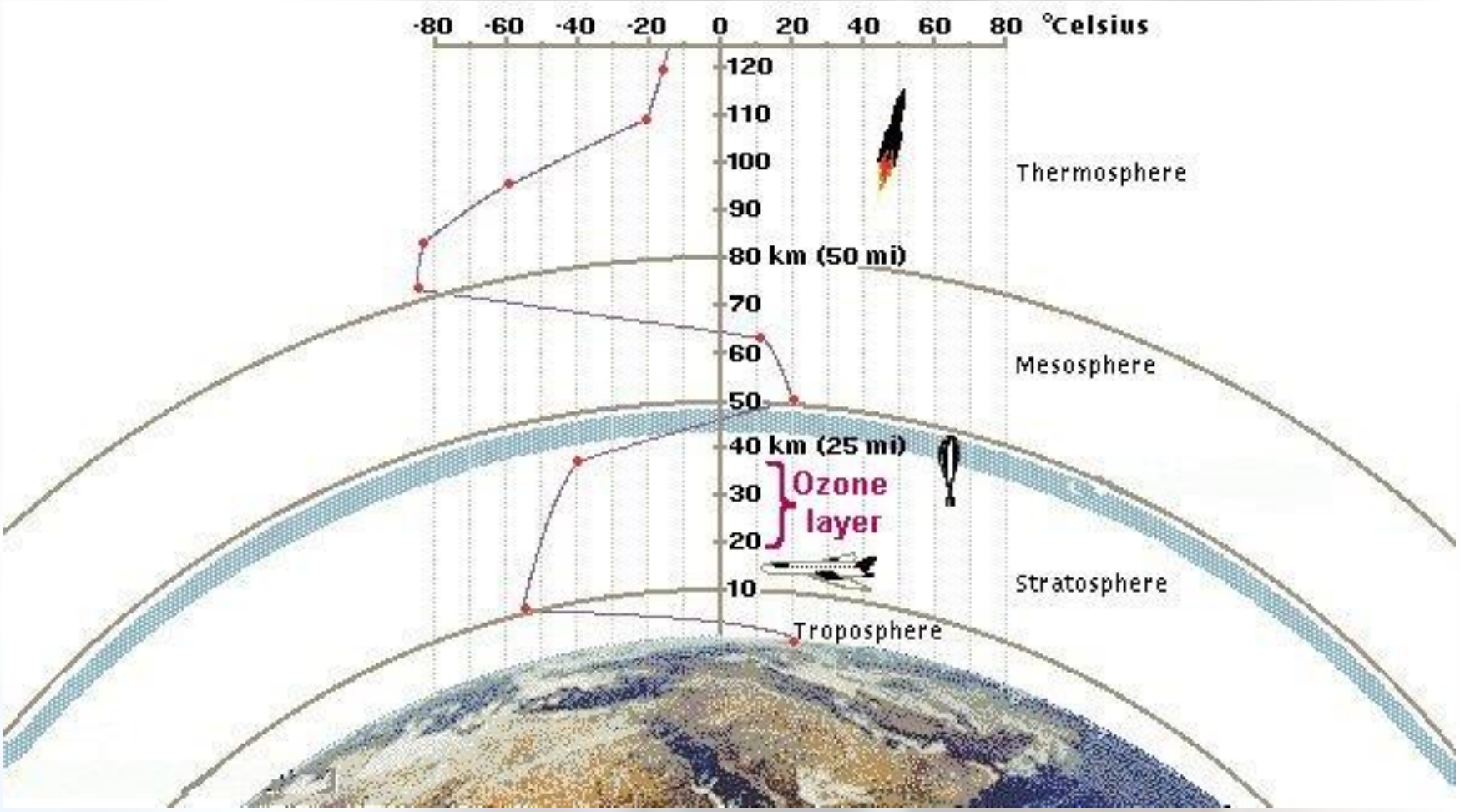
THERMAL STRUCTURE OF THE ATMOSPHERE

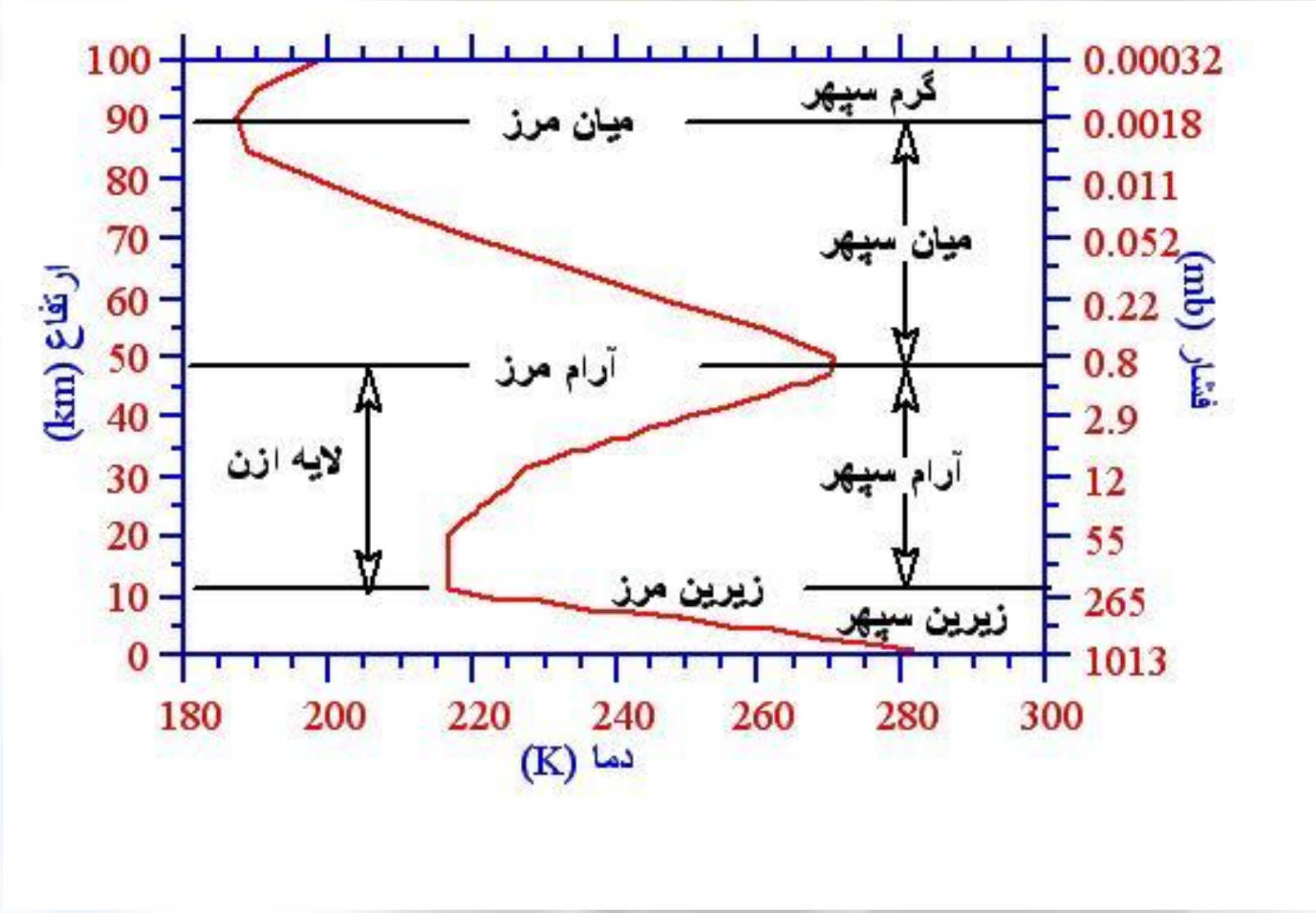
According to temperature, the atmosphere contains five different layers:

Troposphere	**زیرین کره**
Stratosphere	**آرام کره**
Mesosphere	**میان کره**
Thermosphere	**گرم کره**
Exosphere	**برونکره**

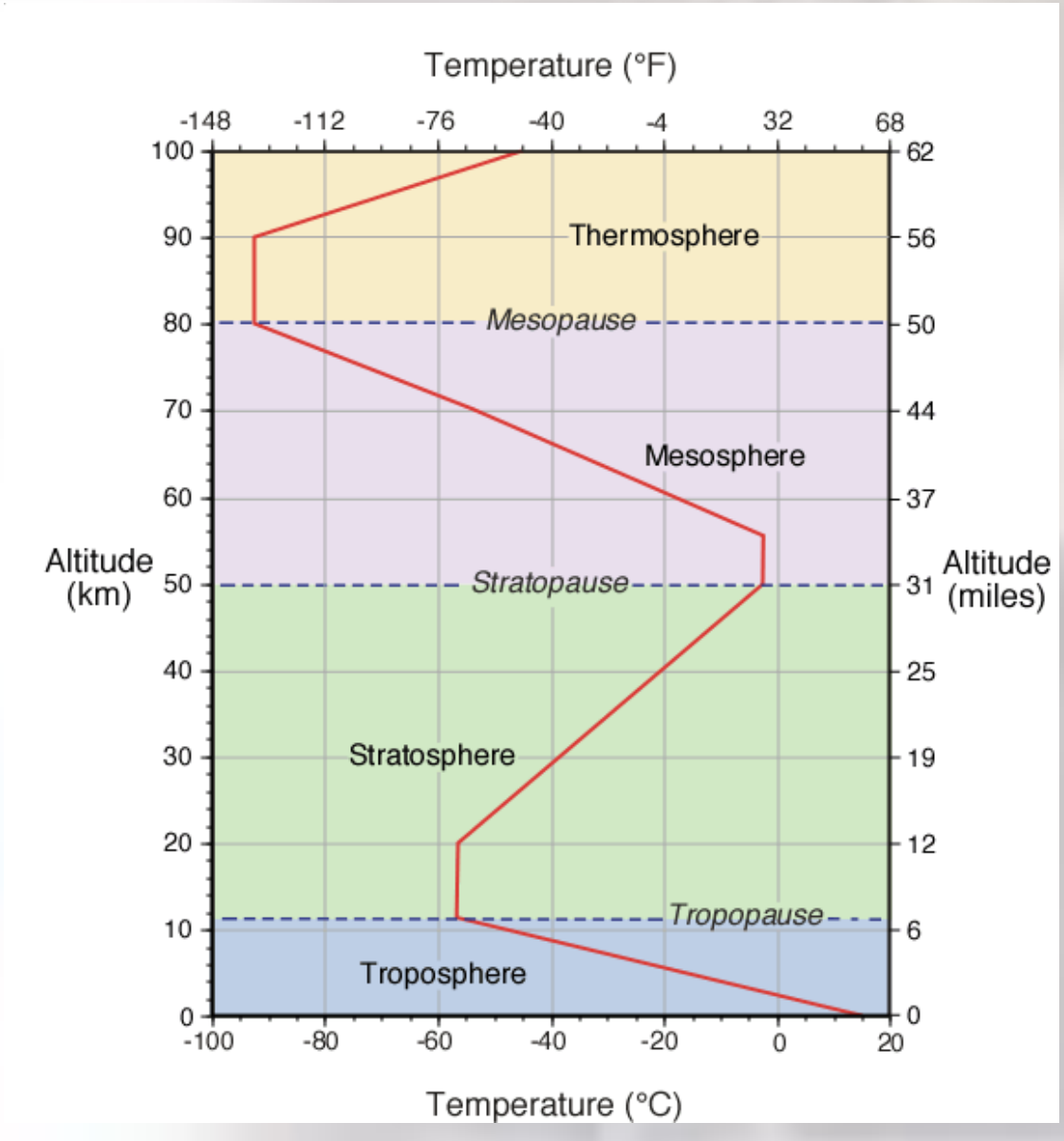
THERMAL STRUCTURE OF THE ATMOSPHERE




-80 -60 -40 -20 0 20 40 60 80 °Celsius
120
110
100
90
80 km (50 mi)
70
60
50
40 km (25 mi)
30
20
10
Thermosphere
Mesosphere
Ozone layer
Stratosphere
Troposphere


100
90
80
70
60
50
40
30
20
10
0
ارتفاع (km)
0.00032
0.0018
0.011
0.052
0.22
0.8
2.9
12
55
265
1013
فشار (mb)
گرم سپهر
میان مرز
میان سپهر
آرام مرز
لایه ازن
آرام سپهر
زیرین مرز
زیرین سپهر
180
200
220
240
260
280
300
دما (K)

THERMAL STRUCTURE OF THE ATMOSPHERE



Layer One (Troposphere)

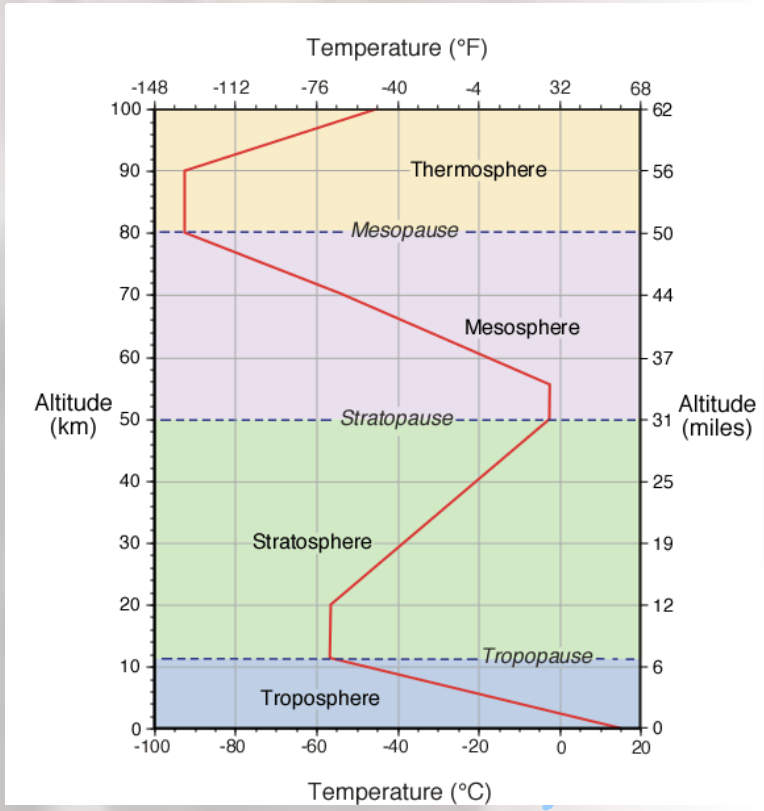
The layer closest to the Earth

Often referred to as "The Weather Layer"

Rain snow and wind stick to this layer.

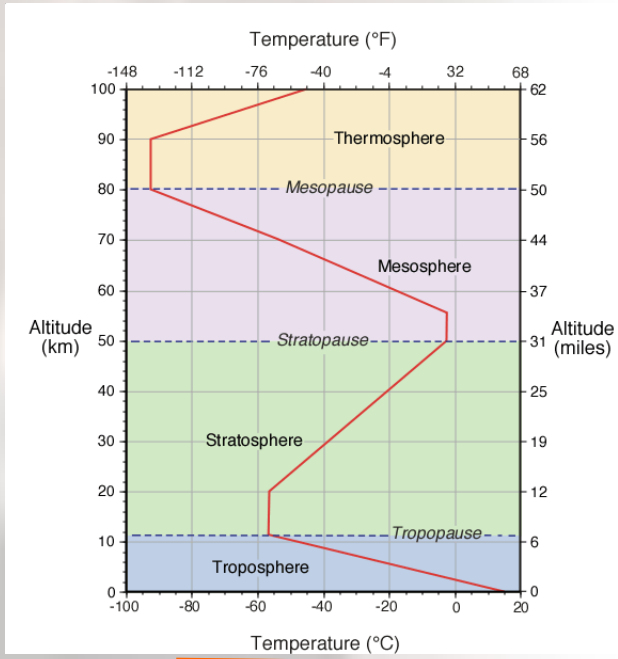
Planes fly in this layer

Below an altitude of 12 km the temperature decreases from 15 ºC to -55 ºC as altitude increases.



Layer Two (Stratosphere)

- In the stratosphere (12 km - 50 km) the temperature increases with altitude from -55 ºC to -2 ºC.



- Ozone layer found in the stratosphere

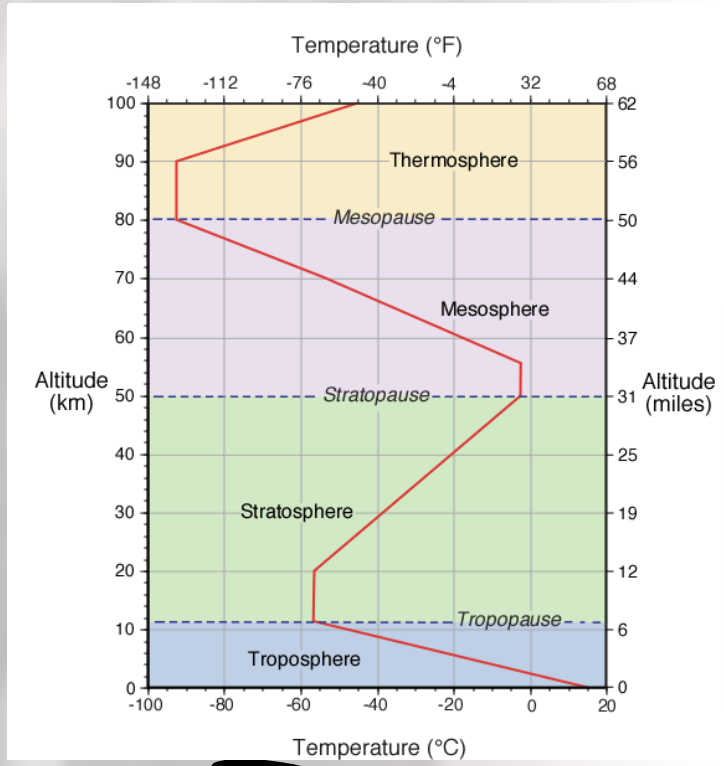
- Ozone is a gas that absorbs harmful UV rays and protects us from too much solar radiation. Pollution has created a hole in the Ozone layer over the South Pole.

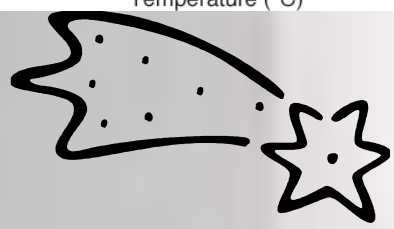
Layer Three (Mesosphere)

- In the mesosphere (50 km - 80 km) the temperature decreases (-2 ºC to -90 ºC) .

Atmosphere reaches it's coldest temperature of about -90° C.

A lot of meteors disintegrate in this layer from friction from entering the Earth's atmosphere.

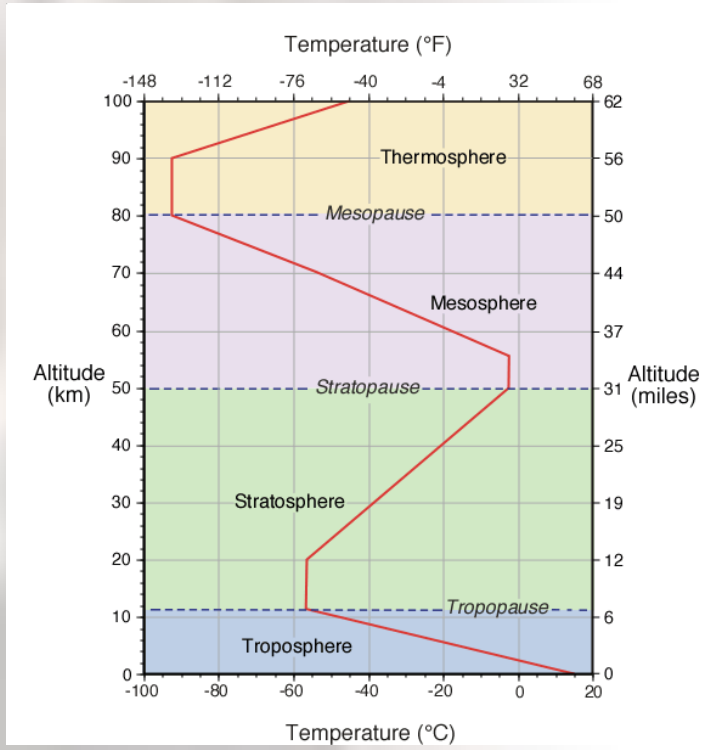




The stratosphere and mesosphere together are sometimes referred to as the *middle atmosphere*.

Layer Four (Thermosphere)

The thermosphere begins 80km above the earth.
Temperatures in the thermosphere go up when moving farther away from ground level due to the sun's energy.



- **Hottest of all layer, Temperatures in this layer can get as high as 1300-1800°C.**
- **Includes the Ionosphere, a region of the atmosphere, which is filled with charged particles.**

The thermosphere is the hottest layer in the atmosphere. In the thermosphere, gamma, X-ray, and specific wavelengths of ultraviolet radiation are absorbed by certain gases in the atmosphere. The absorbed radiation is then converted into heat energy.

The ionosphere is a region in the upper atmosphere that has a large concentration of ions and free electrons. Ions are atoms and that are electrically charged because they have either lost or gained one or more electrons. The ionosphere plays a major role in radio communications. The ionosphere reflects radio waves back to earth

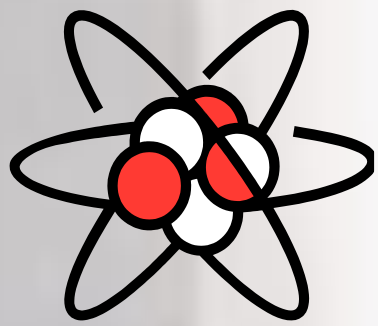
Layer Five (Exosphere)

At the top of the thermosphere, is the point at which the atmosphere thins and atoms and molecules begin to shoot off into space.

Not stable- gas molecules can escape into space

The exosphere is the highest layer of the atmosphere, 900 km above the Eart.

The thermosphere and the exosphere together make up the upper atmosphere.

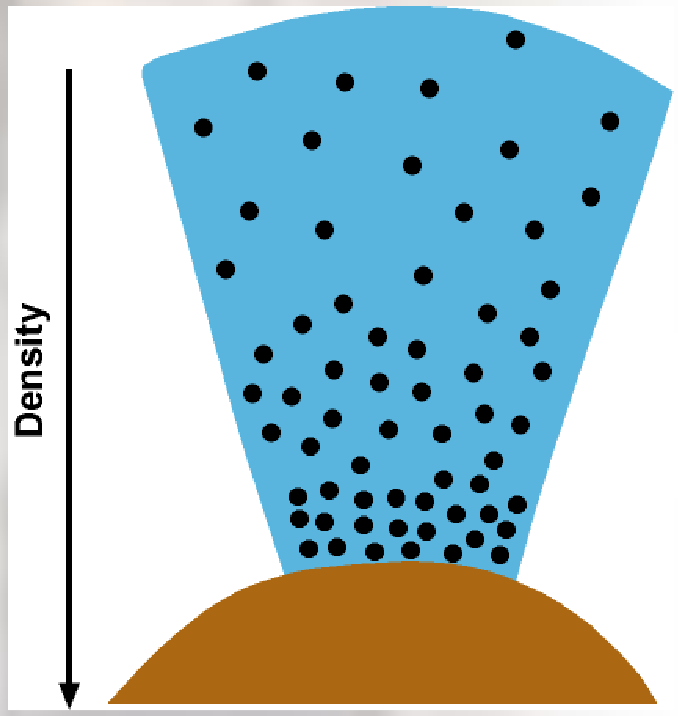


Density of Molecules

Gravity shapes and influences all atmospheric processes. It causes the **density** and **pressure** of air to decrease exponentially as one moves away from the surface of the Earth

About 97% of the atmosphere is within 30 km of the surface

75% is compressed below 10 km
which is to say, within the troposphere



The pressure vs temperature vs density relates like this:

Ht. (M)/Press.--------Temp (in K)---------- Density/kg m-3

0m, 1013.2mb-------288.2-------------------------1.23

5km, 540.5mb-------255.7-------------------------0.736

10km, 265.0mb-----223.2-------------------------0.414

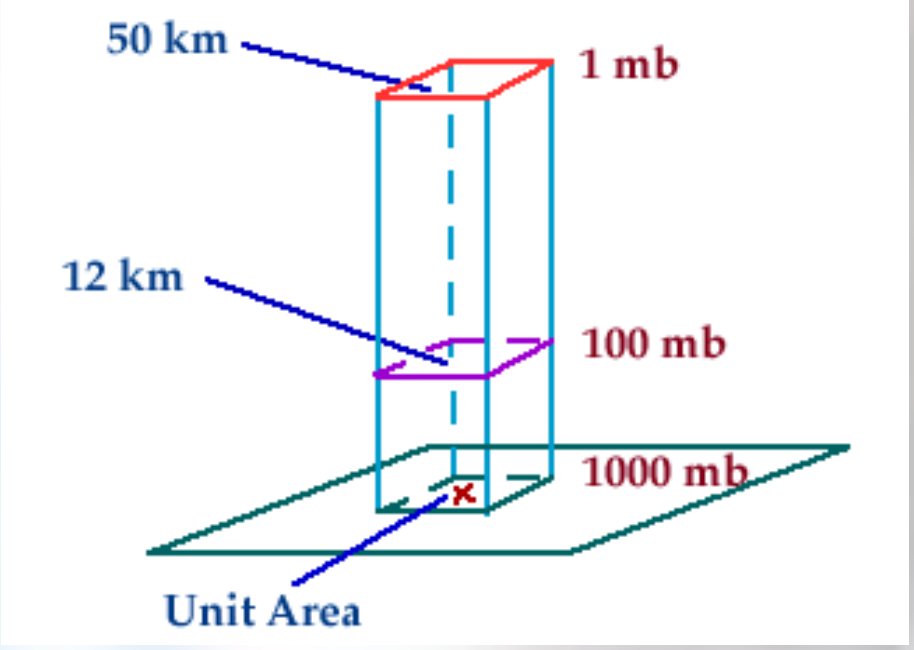
15km, 121.1mb-----216.7-------------------------0.195

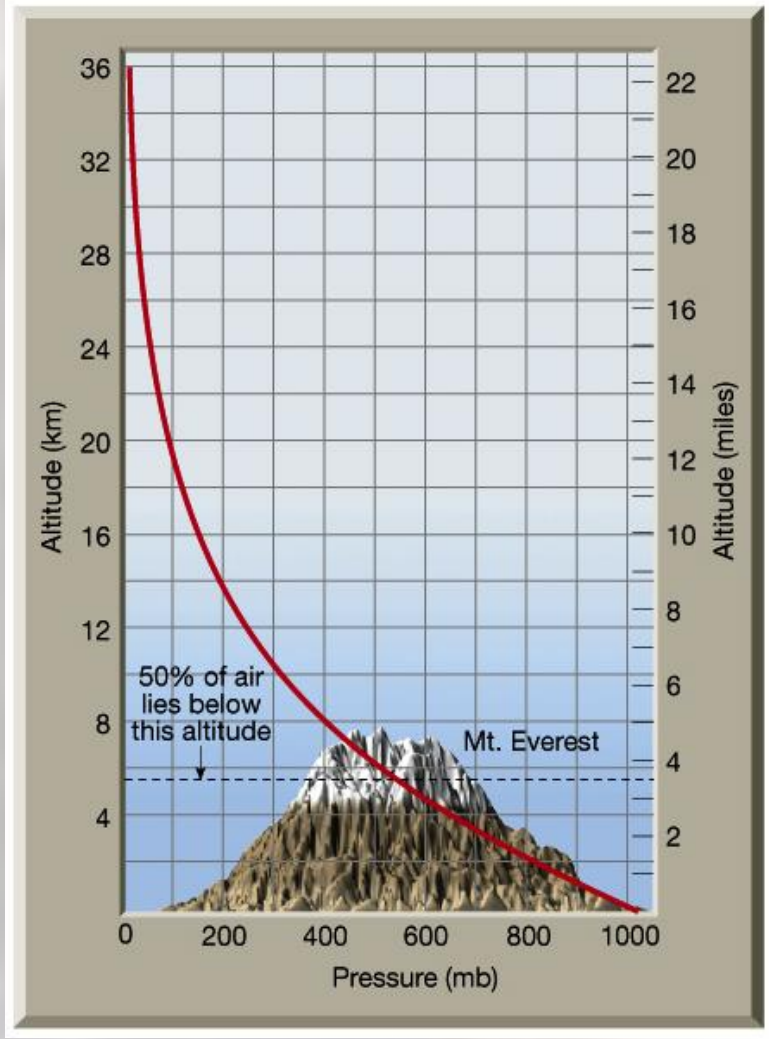
20km, 55.3mb-------216.7-------------------------0.0889

Pressure with Height

pressure decreases with increasing altitude

The number of air molecules above a surface changes as the height of the surface above the ground changes.



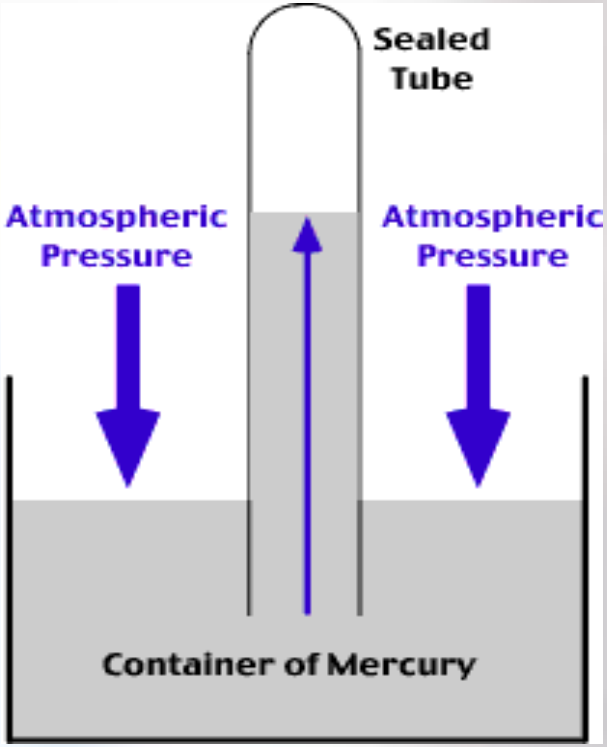


Pressure Measurement

Torricelli's Barometer

Weight of column of air above your head.

We can measure the density of the atmosphere by measuring the pressure it exerts.



standard sea-level pressure from Torricelli's experiment is 76.0 cm or 29.92 inches or 1013 millibars