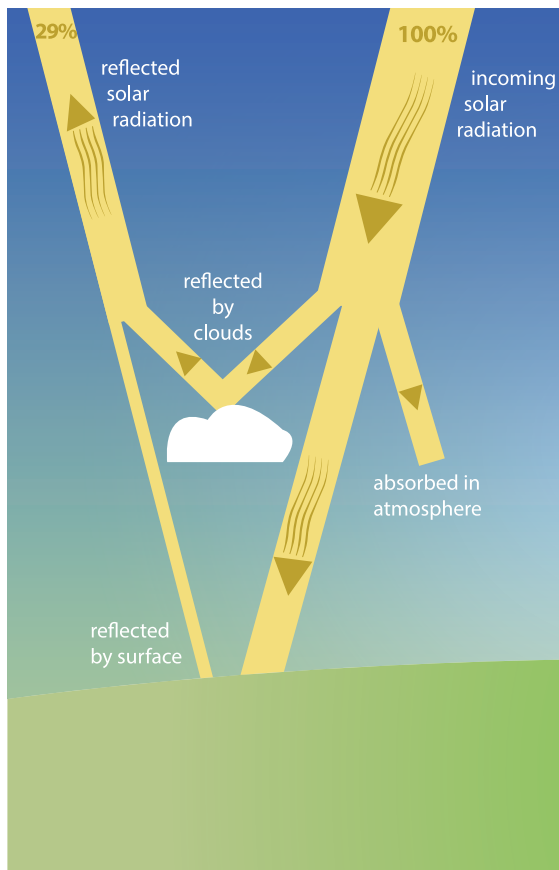




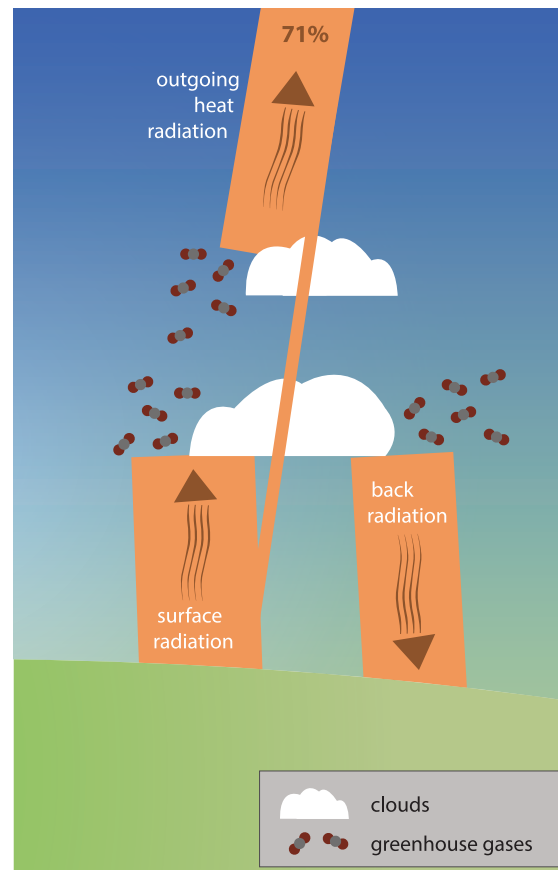
# Get the Picture: Clouds and Climate

## Image 1

### Incoming Solar Radiation



### Outgoing Heat Radiation



### Are the following statements true or false?

1. If there were no clouds in the atmosphere, Earth would be cooler.
2. Clouds sometimes reflect incoming solar energy out to space.
3. If the incoming amount of energy is the same as the outgoing amount of energy, then Earth's temperature will warm.
4. Clouds and greenhouse gases in the atmosphere can cause heat to radiate back to the Earth.

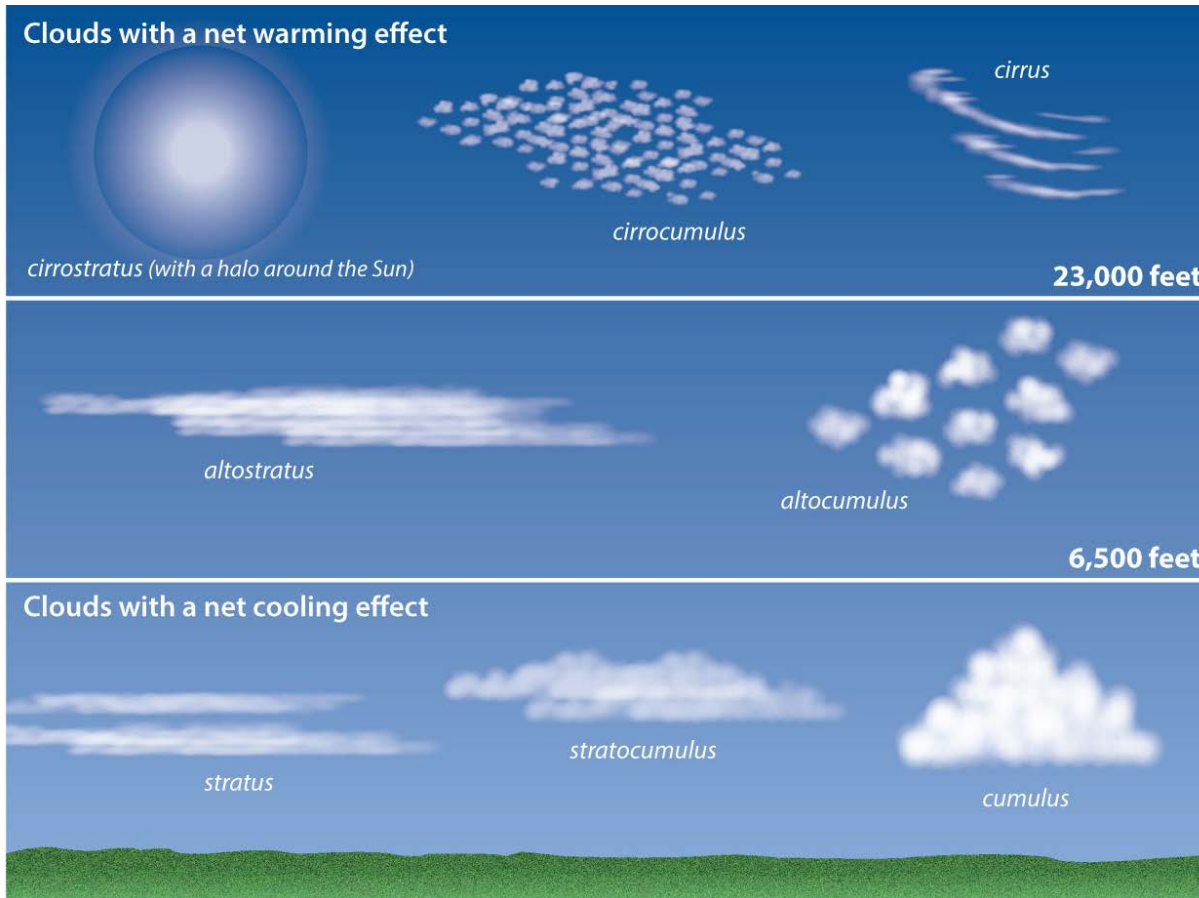
Incoming solar radiation (left). Once that energy is absorbed by the Earth's surface, it is emitted as heat, also known as infrared radiation (right).

(Credit: L.S. Gardiner/UCAR)



## Get the Picture: Clouds and Climate

### Image 2



Non-precipitation cloud types and their effect on daytime temperature.

(Credit: L.S. Gardiner/UCAR)

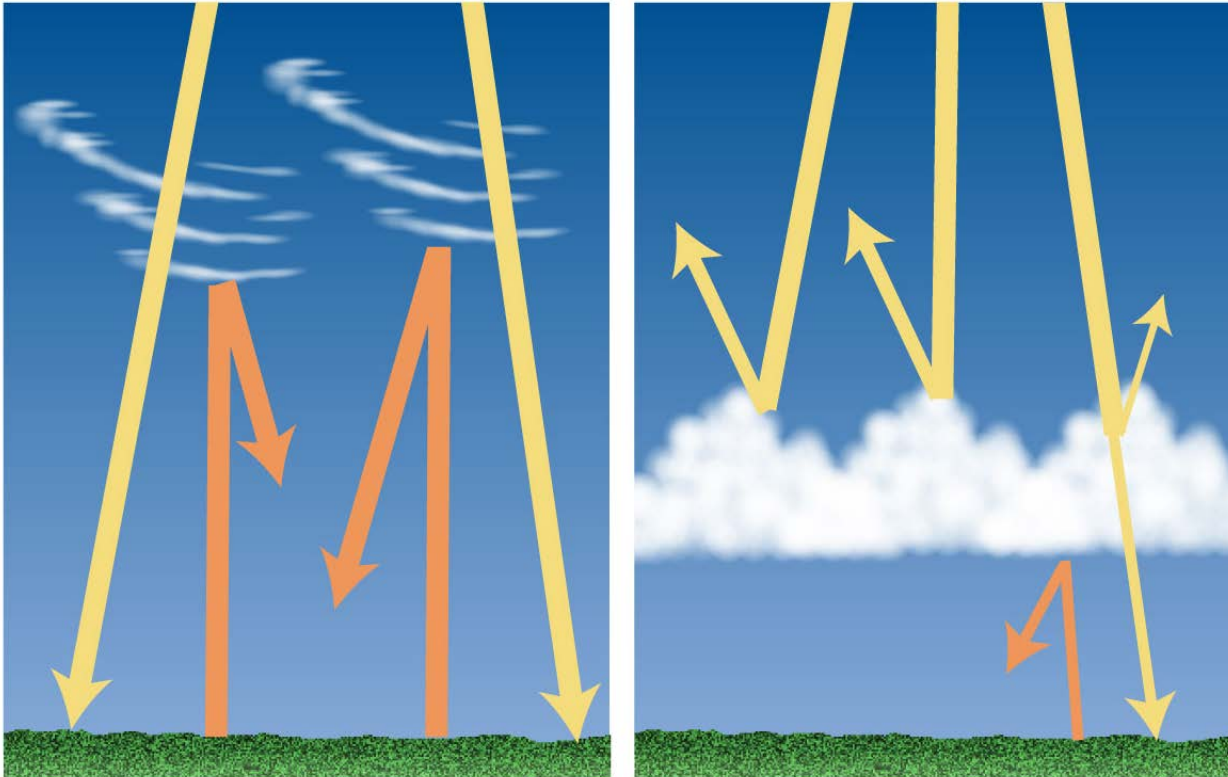
#### Are the following statements true or false?

1. Cirrus clouds are too small and wispy to have an impact on temperature.
2. The lowest cloud types cause temperature to cool.
3. Because of their puffy shapes, cumulus, altocumulus, and cirrocumulus clouds all have the same effect on temperature.
4. Cirrostratus clouds block sunlight, causing a cooling effect as well as a halo around the Sun.
5. Cirrocumulus, cirrostratus, and cirrus clouds cause temperatures to warm.



## Get the Picture: Clouds and Climate

### Image 3



Incoming solar radiation is shown in yellow. Infrared radiation (heat) emitted from the Earth's surface is shown in orange. At the left are high, cirrus clouds. On the right are low, cumulus clouds.

(Credit: L.S. Gardiner/UCAR)

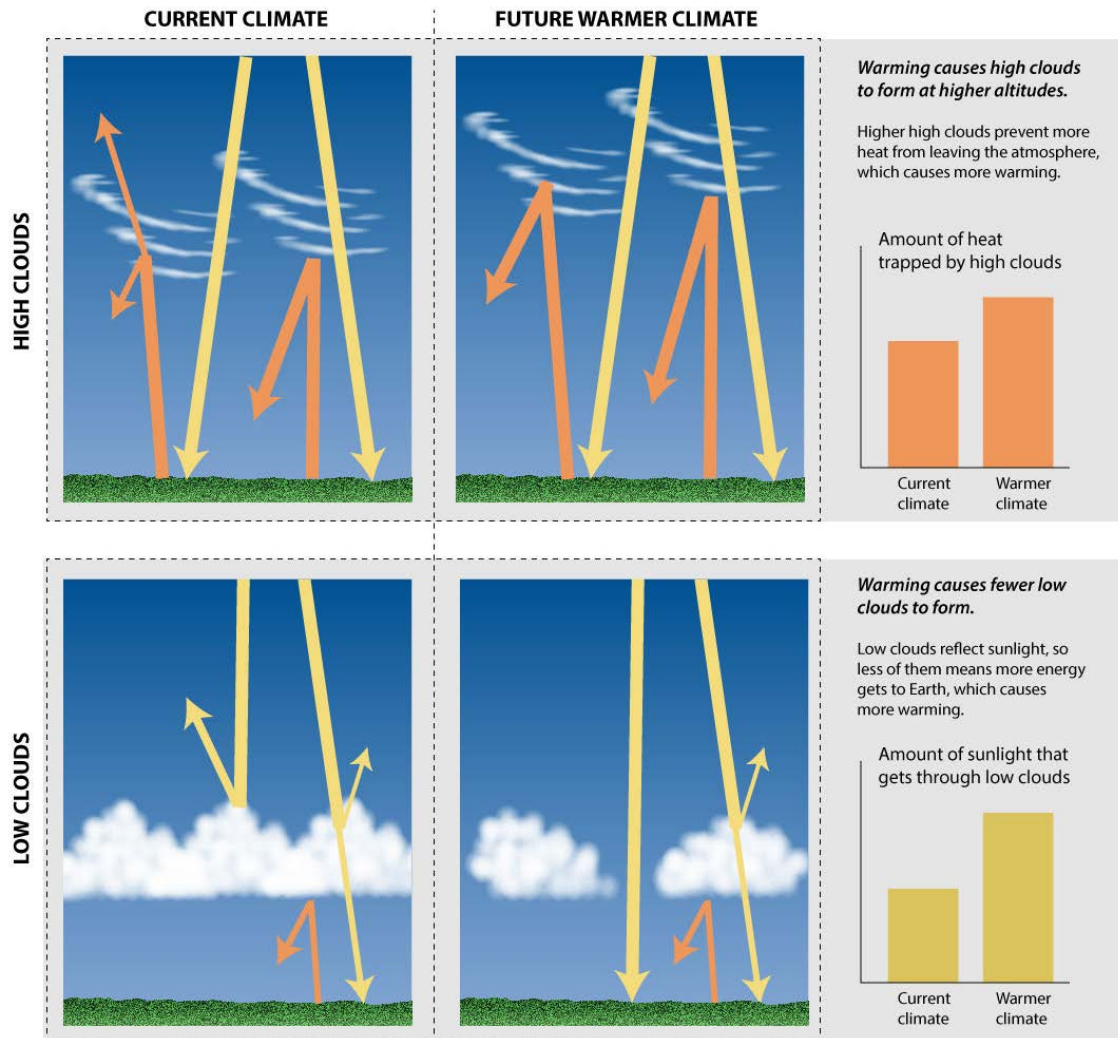
#### Are the following statements true or false?

1. Clouds keep temperatures at the ground warm by reflecting energy from the Sun back out to space.
2. High clouds can trap heat, preventing some from getting out to space.
3. Low clouds can prevent some energy from the Sun from getting to the Earth's surface.
4. High clouds are very thin and allow most of the incoming solar radiation to pass through and reach the Earth's surface.



# Get the Picture: Clouds and Climate

## Image 4



### Are the following statements true or false?

1. High clouds will become higher in the atmosphere as climate warms in the future.
2. As climate warms, there will likely be more low clouds.
3. Future changes in high clouds will cause more heat to be trapped in the atmosphere.
4. Future changes in low clouds will cause more sunlight to get to the Earth surface, which is then released into the atmosphere as heat energy.

Clouds are changing as climate warms, which causes changes in the amount of energy that gets into and out of the atmosphere. Incoming solar radiation is shown in yellow. Infrared radiation (heat) emitted from the Earth's surface is shown in orange.

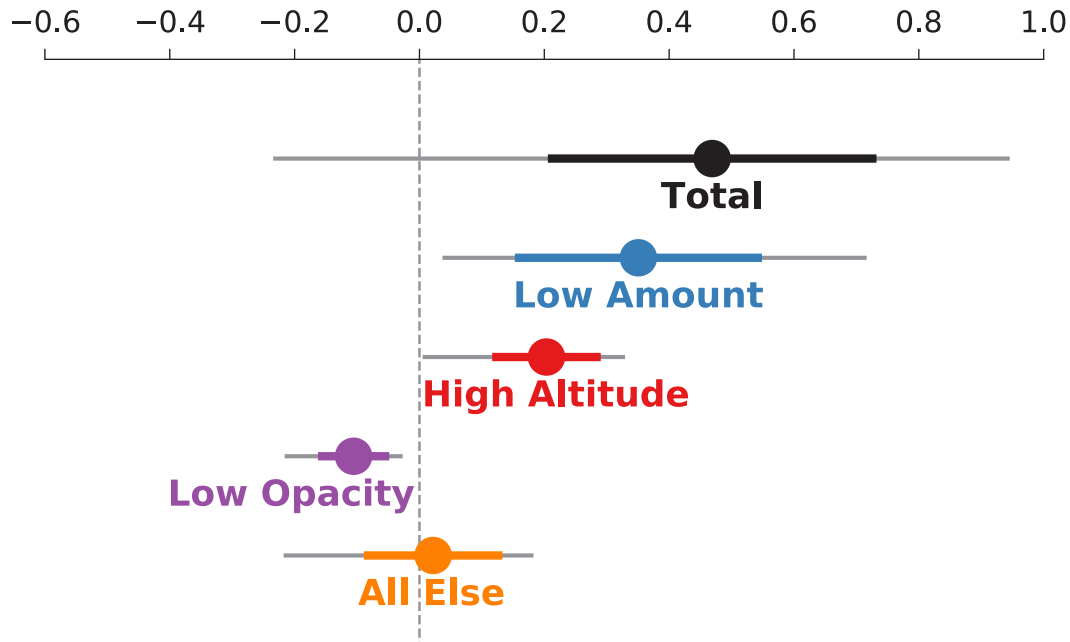
(Credit: L.S. Gardiner/UCAR)



# Get the Picture: Clouds and Climate

## Image 5

**Global Average Clouds Feedbacks (W/m<sup>2</sup>/°C)**



How clouds will likely affect future climate according to 18 climate models. Positive numbers indicate likely warming. Negative numbers indicate likely cooling. Bars around each dot indicate the range of results from the models. Black is the average of all cloud feedbacks, including change due to decreasing amount of low clouds (blue), change due to high clouds increasing altitude (red), thickening low clouds (purple), and all other cloud feedbacks (orange).

(Credit: Mark Zelinka/Springer Nature)

**Are the following statements true or false?**

1. If low clouds become thicker (and more opaque) in a warmer climate, they will have a cooling effect on climate.
2. Overall, climate models show that changes in clouds will decrease the amount of climate warming.
3. If the amount of low clouds decreases, this will likely warm the climate.
4. Some clouds cause warming and others cause cooling, so in the future it will even out and clouds won't have much effect on climate change.
5. The bars around each dot indicate that models don't all agree about the amount of impact that changes in clouds will have on climate, so there is still more to learn about clouds' impacts on climate.