

## Astronomy for Kids - Red Shift

If you have been doing much reading on astronomy, you have probably come across the term "red shift". When astronomers are explaining how far away a distant object is, they will usually say something like "The red shift of the galaxy (or other object) indicates that it is about 4 billion light years away". What does "red shift" mean, and how can it tell us how far away an object is?

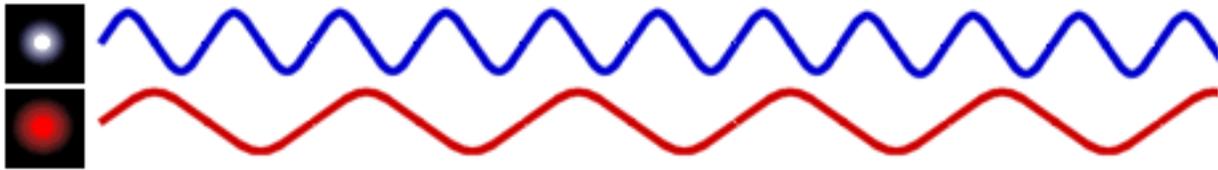
Since most of the things we look at in the sky are so far away, we cannot visit them and find out what they are made of, what temperature they are and so on. The way that scientists decide what a distant star is made of, how hot it is and other things is to study the light that the star gives off. The study of light is called spectrography. By making careful observations of the light that a star gives off, or the light that is reflected from a planet, scientists can find out a lot of information about the distant object. This is the first part of the red shift puzzle.

The second part of the red shift puzzle is a little more complicated, but you can understand it. We have all heard a police car with its siren on go by. You have probably also noticed that if the police car is moving towards us, the pitch of the siren is higher than it is when the police car is moving away. To make a long story short, this effect is what is known as the "Doppler Effect". The question that you have right now is "What does a siren have to do with a distant star?". The answer is that light behaves same way that the siren does. Instead of the sound changing, though, the color of light from an object changes by a very small amount, depending on whether the object is moving closer to us or further away. By the way, an object has to be moving very, very fast in order for the light to change color even a little.



The first step in our explanation of red shift is a look at the colors that our eyes can see. In the picture above, you can see what looks a little like a rainbow. The colors start at red on the left side of the picture and go all the way to blue on the right side. This graphic shows the entire range of what are called visible colors. It is also called a spectrum. Just like sound, light has "pitch". The red end of the spectrum has a lower pitch, or frequency, than the blue end of the spectrum. If you think of it in sound terms, the red colors would be the low notes on a piano, and the blue colors would be the high notes.

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Here is another way to look at it. The star on top represents a blue-white star, like Sirius. Since the light it gives off has a lot of blue in it, the pitch, or frequency, of the light is high, which is shown by how close together the waves of light are. The star on the bottom represents a red star, like Arcturus. The light it gives off is red, which is shown by how far apart the waves of light are. Remember, the closer together the light waves are, the higher the frequency, and the more blue the light is. The further apart the light waves are, the lower the frequency and the light is more red. If you go back to the piano example we used above, the lower notes on the piano would be red and the higher notes would be blue.

By now you are probably wondering when we will get to the "shifting" part. The answer is right now. If you remember the example we gave of the siren at the beginning, we pointed out that the pitch of the siren got higher as it got closer to us and then got lower as it moved away.

The reason is because as the siren moved closer to us the sound waves got "squeezed" together, which made the pitch get higher. As the siren moved away, the sound waves got "stretched" a little, which makes them further apart, which makes the sound lower. A real good way to get a picture of this is to use a Slinky toy. Hold one end of the Slinky and give the other end to someone else and have them move a short distance away from you. You will notice that as the Slinky stretches out, the loops get further and further apart. If the other person then moves back towards you, the loops get closer together. Sound and light behave in the same way.

If a star is moving closer to us, the light it gives off gets squeezed together, which makes it appear bluer than it actually is. If the star is moving away from us, the light gets stretched out, which makes it appear more red than it really is. If the star is also going faster all the time, or accelerating, this effect is even greater.

At the beginning of this page, we said that scientists can find out what a star or other object is made of and how hot it is by studying the light that it gives off. When scientists determine what the star is made of and how hot it is, they can also determine what color of light the star should be giving off.

Once they have found this out, scientists can determine whether the star is moving towards us or further away by whether the light is "blue shifted" or "red shifted" If the light is "red shifted" the star is moving away from us. If it is "blue shifted", it is moving closer.

After they have calculated how much the light is shifted either towards red or blue, scientists can then calculate how far away the object is and how fast it is moving either towards us or away from us.

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### Find Out More Red Shift

#### [The Doppler Effect](#)

Daniel Russell of Kettering University has a very good, technical explanation of the Doppler Effect.