Orion Nebula

(Image Credit: HST/NASA)

The central region of the Orion Nebula is shown in an image from the Hubble Space Telescope. What do you see in this image?

In this Exploration, find out:

- What is a nebula? Interstellar Cloud?
- How many stars are born each year?
- Which classes of stars are born most often? Which classes are born least often?

Star Birth

Not all stars are the same age. In our galaxy, the **Milky Way**, a few stars are born every year. Long before stars begin to shine as main sequence stars, the matter they will be made of is spread out in large thin clouds of gas and dust. Lying dark and cold between the stars, these vast **interstellar clouds** are usually only visible to astronomers because they can dim or block out the light of background stars. The atoms, molecules of gas, and tiny bits of dust in interstellar clouds are usually spread

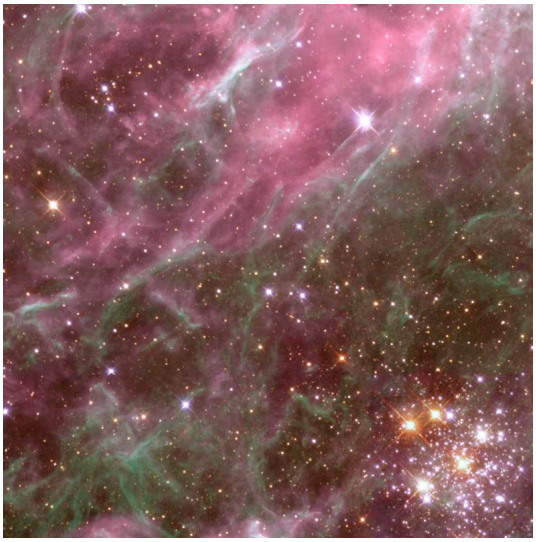
A Nearby Interstellar Cloud

***(Image Credit:** NASA, ESA, and The Hubble Heritage Team (STScI/AURA))*

A dark knot of gas and dust in an interstellar cloud 9,500 light years from Earth blocks the light of the stars and stellar nursery behind it. This image shows an area of the sky about 6.5 light years wide.

very thin. The space between the stars isn't really empty, but the matter in a typical interstellar cloud is spread more thinly than any matter here on the Earth. Interstellar clouds can be tens, or even hundreds, of light years across. Even though they have

Tarantula Nebula



(Image Credit: HST/NASA)

At the center of this Tarantula Nebula is a cluster of stars that make this formation appear very bright when observed from Earth. It is such a bright object in the night sky that it was at first mistaken for a star.

The Tarantula Nebula is so large, that if it were as close to us as the Orion Nebula, it would take up half the sky. The Tarantula Nebula is a known as a ***starburst*** *region – that is, an area where an unusually high number of stars are being formed.*

such a low **density**, these clouds can contain enough matter to make hundreds of thousands of stars like the Sun.

Every single bit of matter in the universe has gravity, including the atoms and dust grains between the stars. Events such as a **supernova** sometimes trigger these low density clouds to begin to collapse under their own gravity. The collapse of an interstellar cloud begins the process of star birth.

The collapsing cloud fragments separate into smaller pieces (clumps) that will form individual stars or systems of stars. These bits of cloud heat up as they collapse, with the inner portions becoming very hot. Eventually, if the fragments have enough mass, the inner part of the collapsing gas and dust becomes hot and dense enough to start converting hydrogen into helium. And a star is born. When hot new stars begin to shine in these interstellar clouds, the gas becomes energized by the light of the stars and begins to glow. The parts of the cloud nearest to the hot young stars become a type of **nebula. Nebulae** (the plural of **nebula**) are simply glowing clouds of interstellar gas and dust. Nebulae that contain many new born stars are also called stellar nurseries.

Star Birth Activity

Answer these questions **before** the activity:

1) If you have 50 red objects, 10 yellow objects, and 1 blue object all mixed up together in a box, what is the probability that an object you take out of the box (without looking) will be blue?

2) What is the probability it will be red?

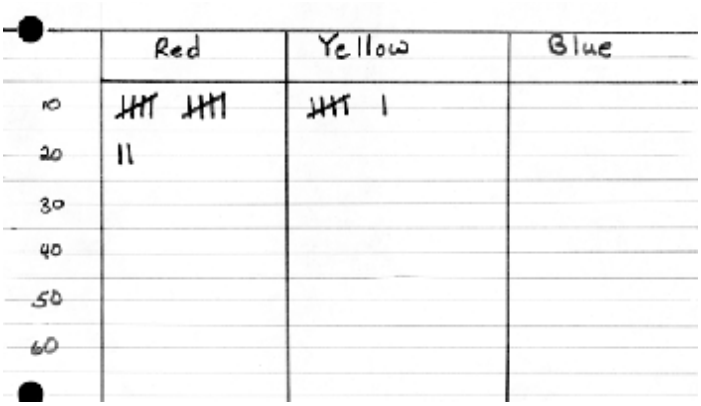
3) What is the probability it will be yellow?

4) If you put the first object back, mix up the objects in the box, and draw out another object, will the probabilities of drawing out an object of a particular color change or will they be the same?

5) If you draw out an object one at a time, record the color, and put it back before drawing another object, and do this 61 times, how many red, yellow, and blue objects will you expect to draw out? Will this number be exact or approximate? Why?

Now, using the 61 colored objects in the container you have been given, you'll have a chance to see if your prediction is correct. Before you start, your group should make a table on a separate piece of paper with columns for red, yellow, and blue.

Your table might look something like this.



Keep track of the number of objects you have drawn out of each color using tick marks. Grouping tick marks 10 to a line will help you quickly count how many objects you have drawn so far. To help you count quickly, you can put numbers in the margin as shown in this example. Write the names of each of the members of your group on the top of the paper.

Next, shake up the objects in the container, and take one object out without looking.

Now, look at the object, record the color of the object, and put it back.

Repeat this until you have drawn a total of 61 times.

Answer these questions **after** you finish the activity:

6) Total the tick marks in each of the 3 columns. How did you numbers compare with the numbers of objects of each color in the box? Did you get the numbers you expected?

7) What if you **hadn't** put the first object back? Would your probabilities for drawing out an object of a given color change, or be the same? Why?

8) What would the total values in your columns be if you didn't put any of the objects back before drawing out the next object, and drew 61 times?