

Name:..... Date:.....

Star chemistry

The hydrogen problem

The 'hydrogen problem' is this: atoms of hydrogen combine in space to form molecules, formula H_2 . A lot of these molecules are destroyed by ultraviolet light. But the amount of hydrogen molecules in space does not change. Atoms of hydrogen are too far apart to enable molecules to form easily. To keep enough molecules forming at the rate needed to keep the amount of hydrogen molecules constant, a special mechanism is needed. Scientists do not know for certain what this mechanism is. We can see the start of the 'hydrogen problem' by looking into space and finding out where molecular hydrogen is formed.

The Interstellar Medium (ISM)

Seeing the Milky Way

The pictures show part of the sky called the Milky Way. To see the Milky Way for real, stand outdoors on a clear night in a very dark place with no street lights. Give your eyes time to get used to the dark. When you look up at the sky after about 10 minutes, look for a band of stars stretching across the sky. This is the Milky Way.

The pictures are taken using telescopes which can 'see' light of different wavelengths. Molecular hydrogen does not emit light in the visible region. Look at the pictures to find out where the molecular hydrogen is found by looking into space for 'nonvisible' light.

Seeing space information table	
Colour	What makes the colour
Red	Atomic hydrogen
Yellow	Mixture of atomic hydrogen and molecular oxygen
Green	Molecular oxygen
Blue	Starlight reflected by dust
Black	Dust
Purple	Atomic hydrogen and starlight reflected by dust

What you do

Look at the images of the Milky Way carefully. They show the same part of the Milky Way. Use the 'Seeing space information table' to help you answer the following questions.

1. Look at Figure 1 which shows the section of the Milky Way, the visible light picture. Use the information table to work out which substances are present.

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2. Look at Figure 2 which shows the atomic hydrogen. The brightest patches are the most dense areas of hydrogen atoms. How does Figure 2 compare with Figure 1? Where are the brightest patches of atomic hydrogen?

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3. Look at Figure 3. This shows where the molecular hydrogen is found. Compare this picture with Figure 1. Try to match the areas of molecular hydrogen to the coloured parts in the picture. Where is the molecular hydrogen found?

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4. Look at Figure 4. This shows complex molecules detected using infrared. Compare this picture with Figure 1. Where can these molecules be found?

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5. What do you notice about what is in the Interstellar Medium (ISM)?

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6. Where does the stuff in the ISM come from? Discuss your answer with a partner.

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Note: This resource can be downloaded as part of a set of activities investigating the chemistry of outer space (<https://rsc.li/3jPAUBC>) or for use with a lesson plan for 14–16 year olds exploring molecules in space and the possibility of extraterrestrial life (<https://rsc.li/3ic3s7D>).