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. Figures 1, 2, 3 and 4 are pictures of the same part of the sky. Look at the pictures then answer the questions which follow.

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

Figure 1 Section of Milky Way: Visible light

Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Axel Mellinger, University of Potsdam, Germany).

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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Star chemistry

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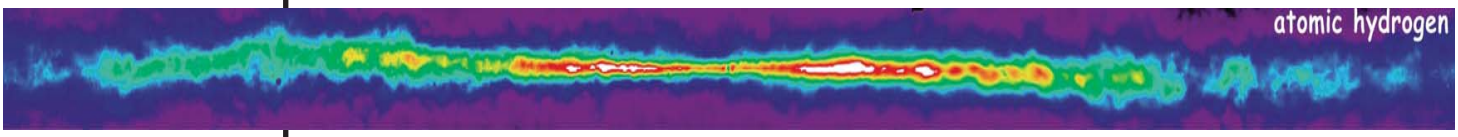

Figure 2 Section of Milky Way showing atomic hydrogen

Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Dap Hartmann, Leiden observatory, Netherlands).

2. Look at Figure 2 which shows the atomic hydrogen. The brightest patches are the most dense areas of hydrogen atoms. The brightest areas of hydrogen atoms match up with the red patches in Figure 1.

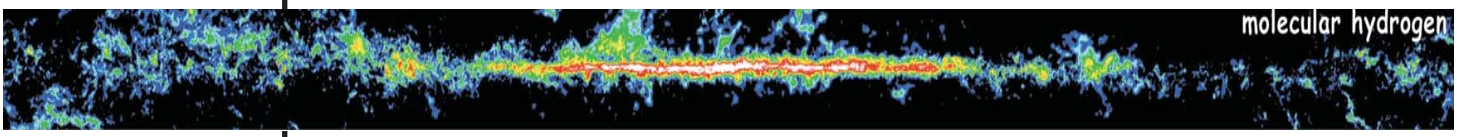

Figure 3 Section of Milky Way showing molecular hydrogen

Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Axel Mellinger, University of Potsdam, Germany).

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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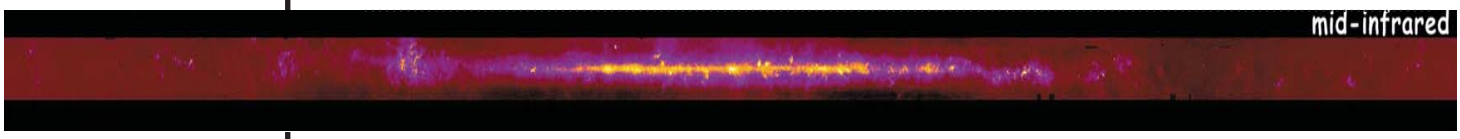

Figure 4 Section of Milky Way showing complex molecules under infrared

Source: Astrophysics Data Facility, NASA Goddard Space Flight Centre. (Reproduced with kind permission from Steve Price, Air Force Research Laboratory, Hanscom, Massachusetts, USA).

4. Look at Figure 4. This shows complex molecules detected using infrared. Compare this picture with Figure 1 to work out where these molecules can be found. .....

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