Magnetic Field Mapping

Needed:  Masonite board with hole magnet  
paper  
masking tape  
small compass

Background:  Magnetic fields are produced by moving charges.  In a permanent magnet, aligned spins of electrons in the atoms produce the strong field.  The direction of the magnetic field, \( \mathbf{B} \), at any point in space is taken to be the direction that the north pole of a compass needle would point at that location.  Magnetic field lines do not end.

Procedure:  Place a bar magnet in the hole in your board, and tape a large piece of plain paper to your board over the magnet. Use a pencil to trace around the shape of the magnet. Once you start your mapping, do not move your setup.  Note the geographic directions along the edges of the paper to indicate the orientation of your setup in the lab.

Determine the polarity of your compass by holding it far from your permanent magnet and noting which side of the compass needle points north.  You may need to repeat this procedure from time to time during the mapping because bringing a compass close to a strong magnet can reverse the polarity of the needle.  The direction of the magnetic field you are investigating will be determined by the direction of the north-seeking pole of your compass points. Make certain that your pencil has no effect on your compass needle.

Begin your mapping at some arbitrary point on the paper by placing a dot on the paper.  Position your compass such that the north needle of the compass is pointing toward the dot.  Mark the position of the other end of the needle with a second dot (see Fig. 1).  Then move the compass beyond the second dot and continue the process until you have a line of dots that lead to the pole of a magnet or to the edge of the paper.  Connect this series of dots by a smooth curve.  This line represents a line of force and you should place arrows on it to represent the direction of the magnetic field along the line.  Continue with this process until you have the entire sheet mapped, spacing the lines so that they are spaced by about one inch when you are far from the magnet. Each partner should do an appropriate fraction of the mapping with the appropriate name on the corresponding side of the sheet.  These mappings should be part of your report.

Can you tell where the regions of strong field intensity are located?  Explain.

Did you find any points where the compass acts in a strange manner?  If so, take a careful look at the field pattern there and see if you can explain your observations.