Earth's Field NMR

Get a good reference on the physics of nmr.
The following web link is useful for getting the basic idea of nmr:
http://www.cis.rit.edu/htbooks/nmr/inside.htm
Note that the situation described in this site and in conventional nmr systems is not quite the same as the idealized one used in our lab. Typically, in conventional nmr systems the dc field is much stronger than the applied ac field. Make sure you understand the connection between our system and the conventional arrangement.

Questions:

T_1 is the spin lattice relaxation time. In conventional nmr, T_1 is the time constant for the spins to return to their equilibrium orientation after a 90 degree tipping pulse. In this lab it is measured a different way. Explain why we are still measuring T_1 in the method used in the labscript.
T_2 is the spin-spin relaxation time. Why do we have the constraint that $T_2 \leq T_1$?

Experiments:

Perform all of the experiments outlined in the EF-NMR Student Manual.
1. "Measurement of the proton-spin lattice relaxation time in water"
2. "Curies' law"

Perform a selection of experiments from the "Operating manual, version 1 (expanded)

First, perform section I.C, "First use of the EF-NMR Field Coils Controller".

Next, do section II.B, "Varying the magnetic field". See appendix 5 for a useful suggestion on how to acquire a tuning curve. By varying the field, extract the gyromagnetic ratio for the proton and then for flourine.

Also, measure T_2 for the fluorinated oil for various viscosities.

Fluorobenzene gives a very interesting free induction decay. Look at it first on the oscilloscope. Using Labview, acquire a triggered time series of the free induction decay for this chemical. Make sure your sampling rate is fast enough to avoid aliasing. Using Igor or Labview, calculate the Fourier transform of your time series and plot the NMR energy spectrum for this material.

Other experiments:
If time permits, do one of the following:
IID: "Studying the spin-spin relaxation time T_2"
IIE: "Pulsed gradient spin echoes"
II.F. "Magnetic resonance imaging"