The four images above were simulated with the same sampling bandwidth and read-out gradient strength. The “sample” for the simulation was a water balloon coated in fat, so the ring around the outside of the sample resonates at a different frequency from the water.

**Question 1:** Which 2 were acquired with a FLASH pulse sequence, and which two were acquired with an EPI pulse sequence?

*B and D were acquired with FLASH. You can tell because the chemical shift artifact is small (for a matched read-out time).*

**Question 2:** Which 2 were acquired with a left/right phase-encode direction, and which 2 were acquired with a anterior/posterior phase-encode direction (assuming that these are axial slices, so the top of the image is “anterior”)?

*A and D were acquired with a RL phase-encode. You have to know whether it’s FLASH or EPI to decide which direction is PE, since the biggest shifts go in the PE direction for EPI but RO for FLASH.*

**Question 3:** Describe, in your own words, in 1 or 2 sentences, what is happening to make the fat ring show up at the wrong place in the image.

*Key idea: the protons there are resonating at a different frequency from what is expected (for water), and images are basically maps of how much signal was at what frequency.*