In Chapter 5 we start on magnetic fields. Griffiths begins the chapter with moving electric charges (why not magnets?) and the experimentally derived magnetostatic equations. The chapter then develops the key concepts of the Lorentz force, the Biot-Savart and Ampère laws, the vector potential and boundary conditions. Much of the first part of the chapter will be familiar.

Problems:

1. 4.22 Add the solution for the outside E-field as well.
2. 4.36 An intriguing connection to Snell’s Law...
3. You might be curious about the relation between $\alpha$ and $\chi_e$. If so, solve 4.41.
4. 5.2 Charged particle trajectories
5. 5.4 Finding the magnetic force on a loop via “$I\ell \times B$”.
6. 5.6 Finding current densities
7. 5.9 Use superposition
8. 5.11 Putting the Biot-Savart integration to practice
9. 5.13 A cute problem and, yes, you do run into relativistic speeds.
10. 5.14 Ampère’s law for a cylinder
11. 5.26 Finding A

Presentations: The additional readings I have noted are optional.

- Abby: The Biot-Savart law from pronunciation to Ampère. (On the pronunciation on the name, think French.) Be prepared to present 5.11 [If intrigued: Magnetic forces do not work. It may also be a bit embarrassing that the interaction between two current elements does not obey Newton’s Third Law (see Problem 5.50). (or is it?) Possible References: Lyness Contemp. Phys. 4 (1963) 453. Peach and Shirely Am. J. Phys. 50 (1982) 410. Whitney Am. J. Phys. 56 (1988) 871.]
- Katie: An intro to vector potentials: What are the used for? Can the magnetic field be zero in a region where the vector potential is non-vanishing? Guide us through example 5.12.
- Hannah: More on A Does the vector potential have have physical meaning? Consider reading the article Am. J. Phys. 64 (1996) 1361. Be prepared to present 5.26
- RJ: Review the Poisson’s equation and the BC’s for the vector potential fo us.
- Seth: [if there is time] Introduce the multipole expansion of A. Do an example illustrating the method.

Notes on text:

- page 212 The key equation for the motion of charged particles. The examples on the next couple of pages are classic.
- page 223 Griffiths looses a great opportunity to get his “static/stationary” definitions precise. Let’s fix this problem. The physics behind the full mathematical definition is this: A stationary system is time independent (when you know the solution at one time, you know it for all time). A static system is stationary and is invariant under time reversal ($t$ goes to $-t$). With these definitions “stationary current” doesn’t sound so strange at least to some ears. Can you think of a system which is stationary but not static?
- page 231 The familiar and important Ampère’s law is derived from Biot-Savart.

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1If we were working through Maxwell’s treatise on electrodynamics he would have us study electrostatics, magnetostatics, and electrodynamics simultaneously.
• pages 236-7 Locally, the current sheet used in the solenoid of Example 5.9 is identical to the current sheet of Example 5.8. Why aren’t the fields equivalent, i.e. Eq. (5.58) and Eq. (5.59)?
• page 243 The vector potential! A step closer to reality or a step away?
• page 251 Boundary conditions for $B$ and $A$!
• page 252 Multipoles for $A$
• page 253 The magnetic dipole moment is introduced. Do you buy the argument? See Eq. (1.107).