Experiment 1: Differential Pair Current-Voltage Characteristics

- Construct either an nMOS or pMOS differential pair from Fig. 7.1.
- Set the bias voltage Vb so the bias current is just at or slightly below threshold
- Set V2 to a value sufficiently far away from the appropriate power supply rail so the bias transistor is saturated.
- With full power supply across the diff pair, measure each of the output currents, I1 and I2, and the common-source node voltage V, as you sweep V1 from a few tenths of a volt below V2 to a few tenths of a volt above V2.
    - Repeat this process for at least two more values of V2 are still keep the bias transistor saturated.
    - Include LTspice schematic(s) **(FIG 1)**
- Include a single plot showing I1, I2, I1-I2, and I1 + I2, as function of V1 - V2 for all three values of V2 you used (twelve curves on the same plot that will be practically indistinguishable) **(FIG 2)**
    - Q: Do the current voltage characteristics change significantly as V2 changes?
- Include a plot showing the common source node voltage V, as function of V1-V2 for all three values of V2 **(FIG 3)**
    - Q: How does the value of V change as V1 goes from below V2 to above it?
- For each of the three values of V2 you used, fit a straight line to the plot of I1-I2 as function of V1-V2 around the region where V1 ≈ V2 (V1-V2 ≈ 0) **(FIG 4)** (might be 3 separate plots need to check with Brad)
    - The slope should be ≈ equal to the incremental differential-mode transconductance gain of the diff pair (look at lab for eq.)
    - Does the value of the diff-mode gm change significantly as V2 changes?
- Set bias voltage Vb so the bias current is above threshold. For 1 value of V2 that is far enough away from the power supply rail to keep the bias transistor saturated, perform the same measurements as before. (Might want to increase the range you sweep V1-V2 slightly. **(FIG 5 FIG 6 FIG 7)**
    - Q: how does the behavior of the circuit change as the bias current changes from weak or moderate inversion to strong inversion?