Mitosis & Meiosis: on the table -- Teacher Directions

Five sheets for each student: 1 sheet with lab (place for name, etc.) on one side, and a Summary page on the back (for part G); 3 layout pages: (1 Mitosis, 1 Meiosis-I, and 1 Meiosis-II); 1 extra Summary page (to use during lab). For the teacher, there are 2 KEY sheets: 1 for the worksheet, and one for each Summary sheet (**Summary Key 1** for the separate Summary sheet used in lab with pipe-cleaner chromosomes (1 pair), and **Summary Key 2** for back of worksheet (which can be finished at home).

I use pink and blue pipe cleaners, cut into pieces about 3 cm long. You'll need 11 little pieces (about 33 cm) of each color for each set (I use one set per student, but you could get by with one set per team of 2). You'll also need 6 beads per set (one bead for each double stranded unit - chromatids - 3 of these for each color). Be sure that two pipe cleaner pieces will fit snugly into one bead. I put each set into a plastic petri dish; you could use small zip-lock bags.

Students should have read and/or seen video on mitosis and meiosis before doing this lab. It's also helpful if they have red and blue pencils to draw the chromosomes. If they don't, they can draw red ones solid, and blue ones open (not shaded).

You need to have students take inventory at beginning and end. They also need to pay particular attention to the **Identification** info, the **Assumptions** (especially the assumptions) and the **Procedure** steps.

Once they're under way, I move around the room quickly, up and down each row, checking to see how they're doing, saying things like "you're close" or "look at assumption #2; start again", etc. When I find one completed properly, I announce loudly and excitedly "She's got it!" (it's usually a girl!), and continue around. It takes about 40 -50 minutes for everyone to finish (including the drawings on the Summary sheet). Then (or next day), I show keys on overhead, and we discuss the lab.

LAB: Things to watch for as you move around the room while students work (see KEY 1 sheet)

MITOSIS:

1. The array of chromosomes in Prophase and the daughter cells is random, with the same two chromosomes in each cell: one long pink and one long blue).
2. Metaphase: duplicated chromosomes (into chromatids, or "chromosome kids") are NOT paired off, but ARE lined up down the middle, in no particular sequence, top to bottom (one example shown).
3. Whatever vertical sequence student shows in metaphase should be followed with *same* sequence in Anaphase.

MEIOSIS:

1. Array of chromosomes in Prophase is random.
2. Metaphase 1: duplicated chromosomes are **paired** side by side. Left-right positions not critical: blue on left, pink on right (as shown) or the reverse.
3. Whatever left-right positions are shown in Metaphase 1 should be followed in Anaphase 1 and Metaphase II. This is critical.
4. Boys are to show chromosomes in sperm, girls in egg and polar bodies. Only one chromosome in each sex cell, with colors matching Metaphase II colors above.

BE FIRM ABOUT VERTICAL PATHWAY CONSISTENCY!

The kinesthetic experience of manipulating the chromosomes in critical ways reveals that many really lack a proper understanding going into it, but come out of it with a much sharper picture.

Here is the address for a mitosis lab where students identify stages, then count and find percentages of each phase. It's probably better than using a microscope, because it doesn't let students misidentify cells.
http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html

HOMEWORK: Parts F, G, and H can be completed when finished with the lab and/or as homework.
Things to watch for on the Mitosis-Meiosis Summary sheet for Part G: Application (see KEY 2 sheet):
MITOSIS

1. The array of chromosomes in Prophase and the daughter cells is random, with the same mix in all three cells (one long pair: one blue, one pink; and one short pair: one blue, one pink).
2. Metaphase: duplicated chromosomes (into chromatids, or "chromosome kids") are NOT paired off, but ARE lined up down the middle, in no particular sequence, top to bottom (one example shown).
3. Whatever vertical sequence student shows in metaphase should be followed with *same* sequence in Anaphase.

MEIOSIS

1. Array of chromosomes in Prophase is random.
2. Metaphase 1: duplicated chromosomes are **paired** (two longs are side by side, same for two shorts); vertical sequence can vary, likewise for which chromosome of each pair (pink or blue) is on the left: there can be a long blue above a short pink on the left, as shown, or a short pink above a long pink, etc.
3. Whatever vertical sequence and left-right positions are shown in Metaphase 1 should be followed in Anaphase 1 and Metaphase II. This is critical.
4. Boys are to show chromosomes in sperm, girls in egg and polar bodies. Again, one member of each pair must be shown in each cell (one long and one short, with colors matching Metaphase II colors above.

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DISCUSSION

1. Going over the Distinguishing Features (item F, see worksheet key) gives you a chance to highlight those features. You can have groups of four compare their answers, then report out one they think is most distinguishing, which you can add to list on overhead of whiteboard, etc.
2. Showing the arrangements for 2 pairs of chromosomes (key 2, on overhead) paves the way for discussion of possible variations, and the concepts of independent assortment and crossing over in meiosis (item H).
3. Review (or point out) how **meiosis** not only prevents a doubling and re-doubling of chromosomes with every generation, but also introduces new combinations of genes (by crossing over and random assortment), contributing to increased **variations** (along with the unique combinations that arise with union of egg and sperm at fertilization), one of the key components of **natural selection**.