

**"Connect-A-Contig"
A Hands-On Sequence Assembly Activity
Teacher Guide for the Rope-Based Materials (DRAFT)**

Abstract

Students align different lengths of rope "DNA" based on the distance between "markers" to generate a DNA consensus sequence. This kinesthetic activity can be used as a classroom demonstration, solved in small groups of students, or done individually. The activity helps students conceptualize how different lengths of tagged DNA can be used to generate a physical map of a genome.

Learning Objective

Overlapping sequences or features on short segments of DNA can be used to assemble much longer contiguous DNA sequences, or "contigs."

Estimated time

Prep time: 2 - 3 hours, one time only

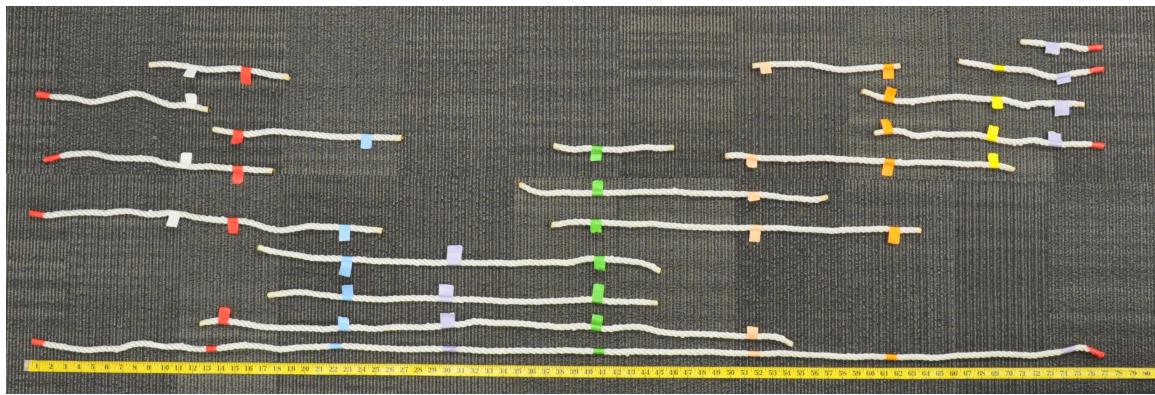
Class time: 20 - 30 minutes to introduce the activity, allow students to assemble a contig set, and then discuss the activity. Note that while contig sets #1 and #2 should each take a few minutes for students to assemble, contig set #3 is significantly more difficult and will take longer for students to solve.

Materials

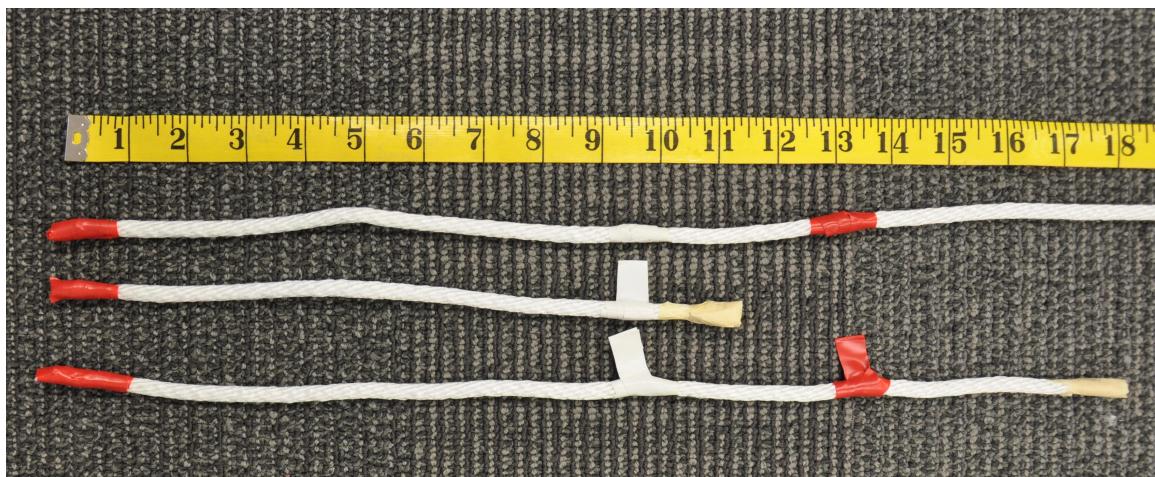
Supplies listed to assemble all three contig sets; you may choose to assemble only one for use as demonstration materials. Cost of materials: approximately \$30.

- 50 feet of rope (such as $\frac{1}{4}$ inch braided nylon rope, shown in the activity illustrations)
- colored tape (such as electrical or lab tape), at least 7 different colors
- masking or clear tape
- scissors
- measuring tape, at least 8 feet long

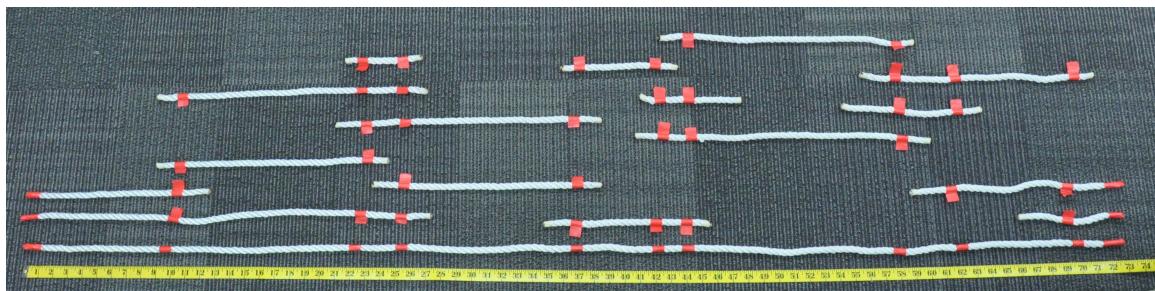
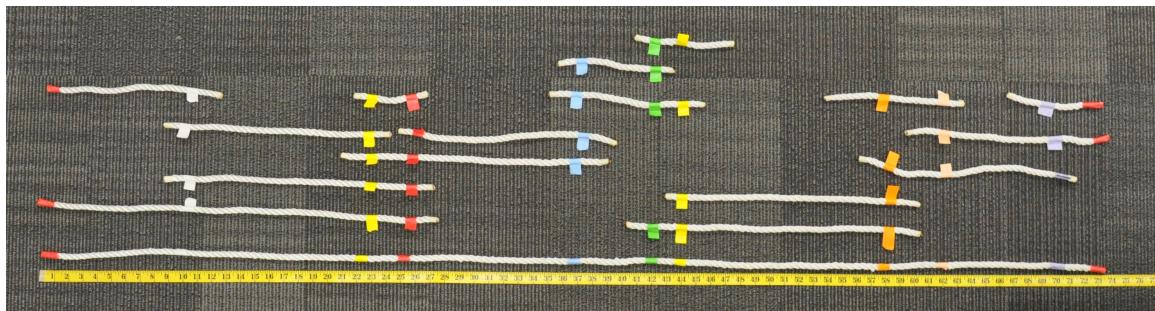
Instructions to prepare and solutions to rope contig sets:



1. First cut and mark off the longest piece of rope/DNA: the consensus sequence. Measure out a length of rope and mark it with tape as shown in the photo above.



2. All subsequent smaller pieces should be held up against the consensus sequence to make sure that the tape-tag colors and spacing are identical to the consensus rope. The absolute length of the shorter pieces matters less than: 1) matching the colors and spacing of the tape on the consensus sequence and 2) providing multiple examples of overlap on multiple contigs (referred to as “depth of coverage”). The ends of the rope not held together with electrical or lab tape should be taped up with masking or packing tape to prevent it from unraveling. Users who have access to and are comfortable with open flame may consider briefly exposing the ends of the rope to high heat, allowing the strands of nylon to slightly melt together to further prevent unraveling before taping the ends of the rope.



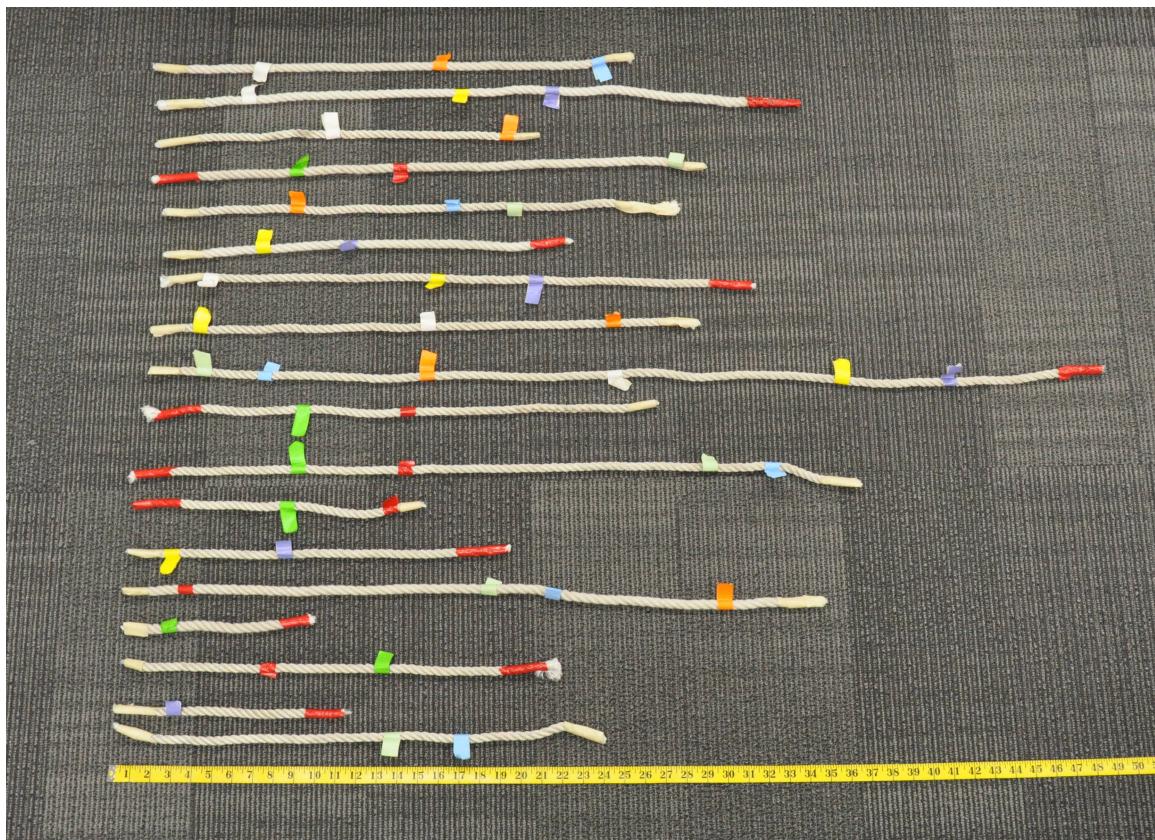
Classroom Implementation

To describe the simulation prior to passing out the contig sets, review the Genome Mapping webpage with your students. Explain that it will be the job of the students to act like the computational software genomic researchers use to assemble genomes. They will need to match up the spacing of the genomic markers (the patterned bars) on the overlapping shorter lengths of DNA to infer the spacing on the longer genomic sequence. Consider solving one set together as a class, and leaving the remaining two contig sets to be solved in small groups.

Distribute a contig set to each group of students and ask them to empty the contents of the bag.



Solving a contig set may be an intuitive activity for some students, particularly those who enjoy solving puzzles. If students need scaffolding, suggest that they begin by orienting each strip of paper in the same direction, as shown in photograph below. This helps make patterns apparent and matching easier. If students need additional guidance, suggest that they select a longer rope, and focus on several adjacent colored tags to begin matching these same colors and spacing up on other ropes in the set.



Students should record their solution to a “consensus sequence” for each of their contig sets. Display the solution to each contig set and ask students to compare their answers.

Variations: For an easier activity, include the consensus sequence in each contig set bag. For an extra challenge, leave it out.

Discuss observations with your class:

Which pieces of DNA/paper are the most informative? Why?

Explore the concept of “depth of coverage.” Which markers in each set provide the greatest depth of coverage?

What do the taped tags on the rope represent? Restriction sites: where an enzyme will nick the DNA at a predictable sequence, and in this case, add a fluorescent tag. In the exercise we used restriction sites to generate a map of a sequence from a single genome.

If you have a reference sequence, it’s easier to align other tagged sequences to it than to build a reference sequence from scratch.

Credits

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