

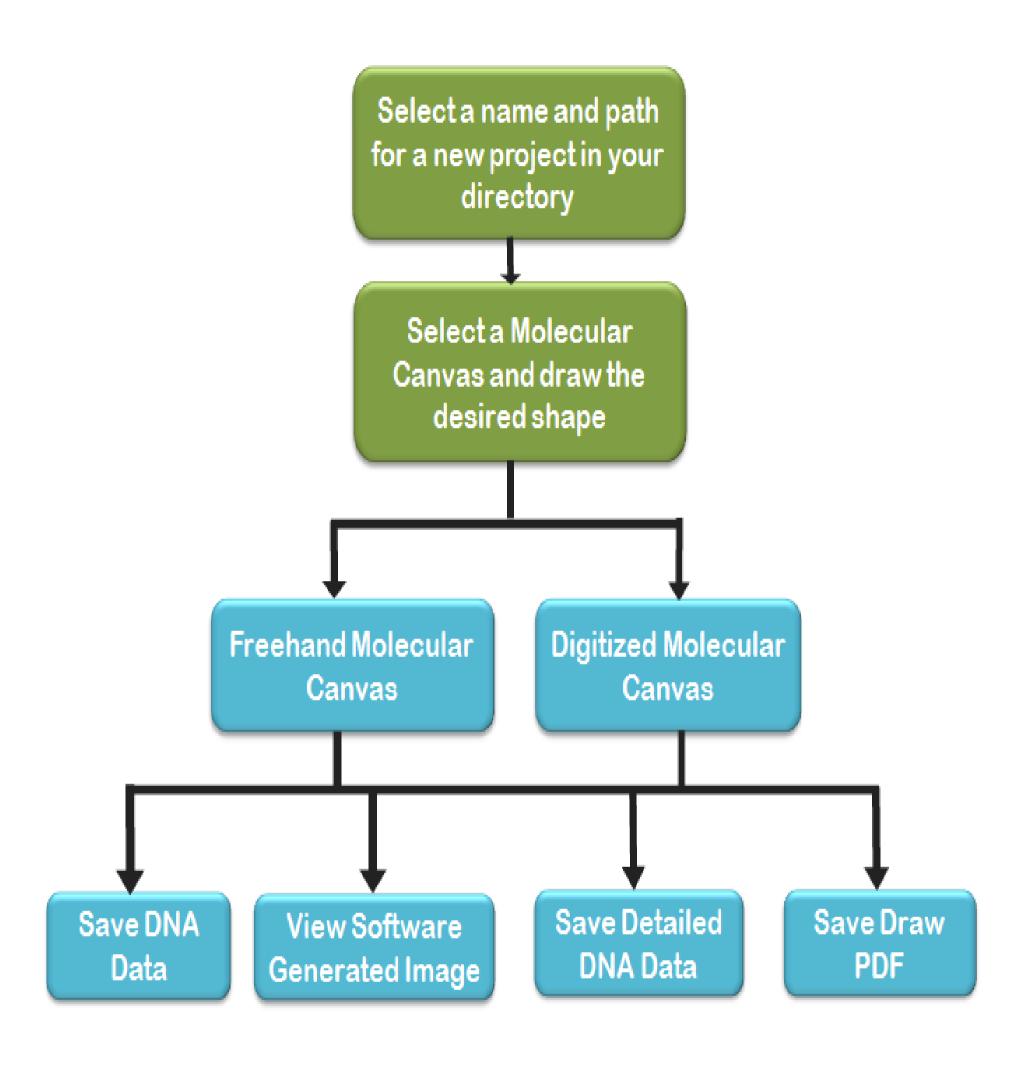
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DNA Pen: A Tool for Drawing on a Molecular Canvas

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Abstract

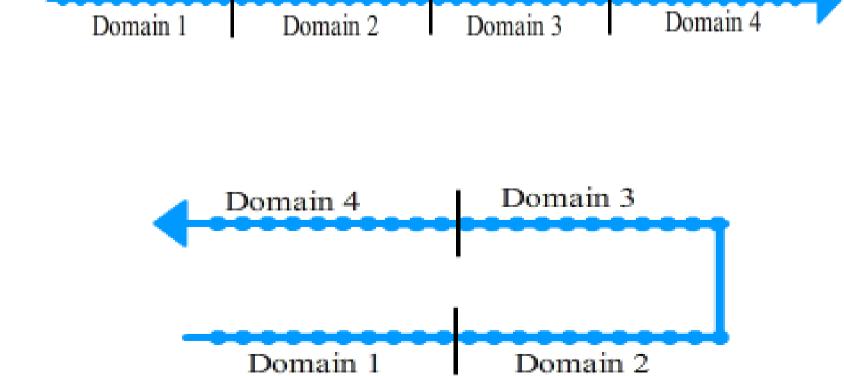
DNA Pen can be used to draw objects at nanoscale. The software generates error free DNA sequences which can be used in the wet lab to create the designed object at the nanoscale. With the help of DNA Pen we have drawn several objects and alphabets using the two different molecular canvases available in the software.



Self Assembling DNA Tiles

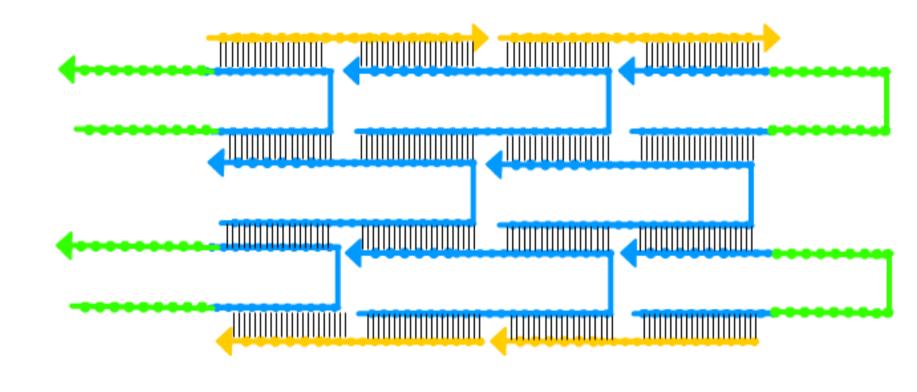
DNA self-assembly is the process by which DNA strands adopt a defined arrangement without guidance or management from an outside source.

DNA Pen works on the process of self-assembly of its individual molecular pixels forming a molecular canvas. Each molecular pixel is denoted by a Single Stranded Tile (SST).



Types of SSTs

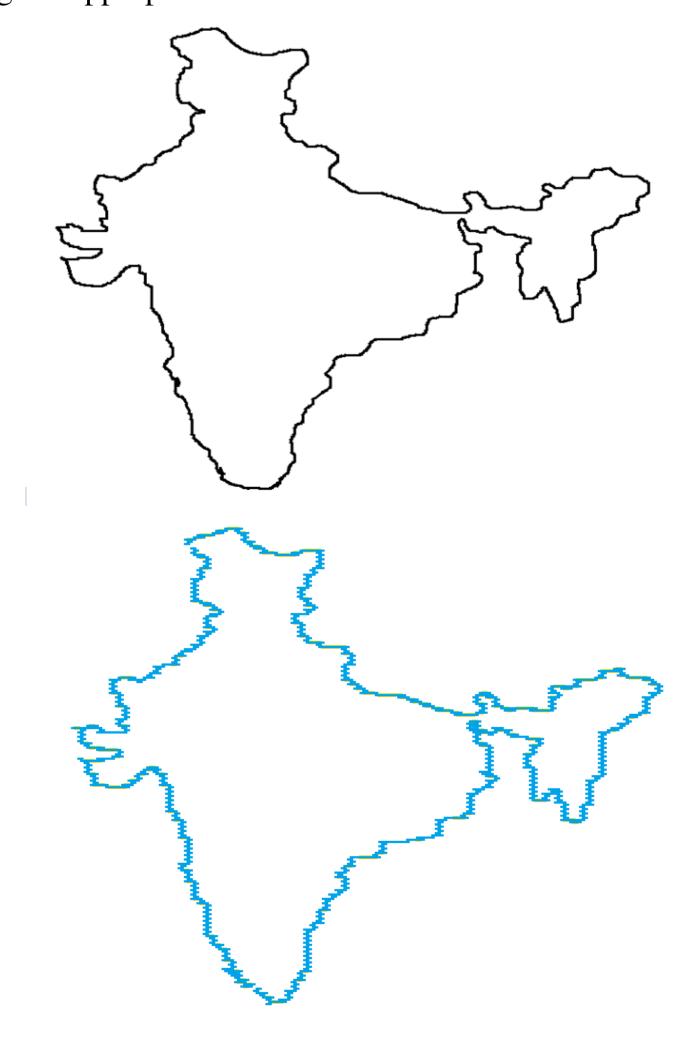
- Full Tile Sequences: Standard DNA sequences having a chain of 42 nucleotides.
- *Half Tile Sequences*: DNA sequences having a chain of 21 nucleotides, used to seal the shape from top and bottom.
- *Impervious Full Tile Sequences*: Full tile DNA sequences on the side borders of the structure consisting of T sequences of length 10 or 11.



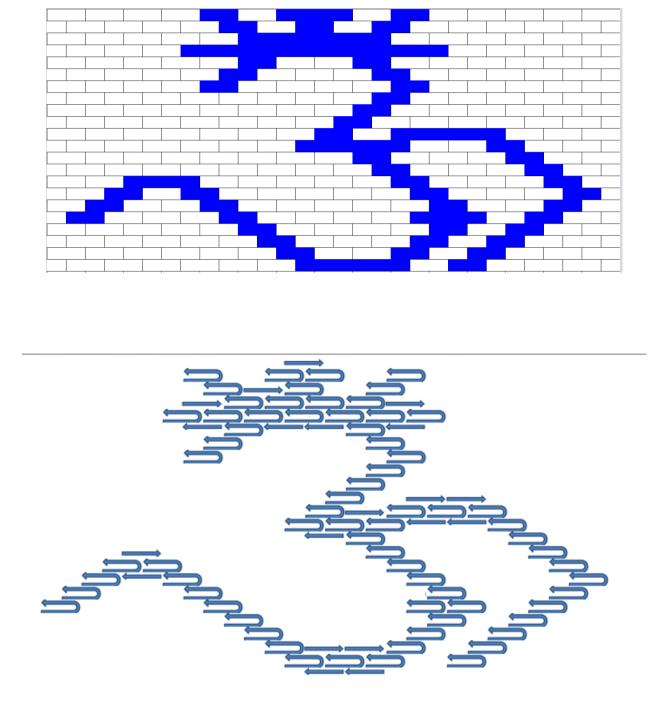
Orange- Half Tile Sequences
Blue- Full Tile Sequences
Blue-Green- Impervious Full Tile Sequences

Molecular Canvas

• Freehand Molecular Canvas: It enables the user to draw any shape on the molecular canvas using the mouse as a paint brush. When the user starts drawing on this canvas, sequences of DNA bricks are added to the output file, which is then available to the user by calling the appropriate save function.

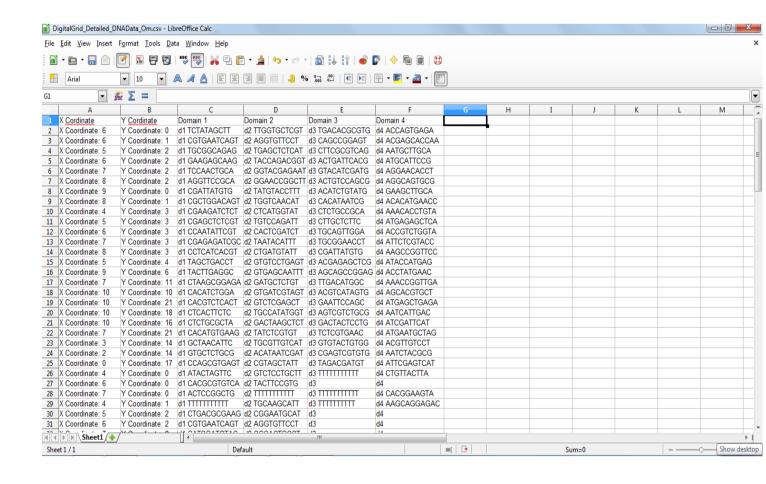


• *Digitized Molecular Canvas*: The Digitized Molecular Canvas allows the user to only draw along the horizontal and vertical lines unlike the free drawing property of the Free Hand Molecular canvas. The user in this case can draw only digitized objects.

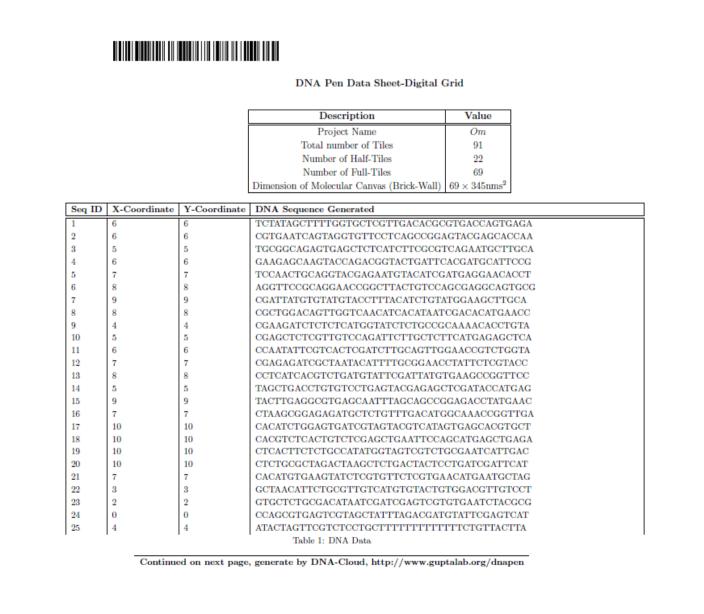


Software Output

Detailed DNA Data



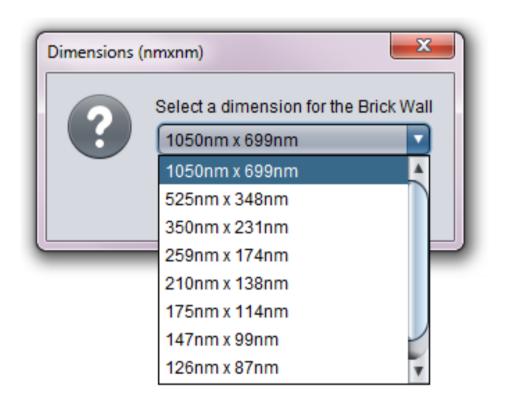
• DNA Pen LAT_EX File



- DNA Sequences: A complete list of full and half tile sequences depicting the shape drawn, which is generated by the software.
- *Draw Data PDF*: A PDF file which contains all the full and half tile sequences alongwith a uniquely identifiable barcode.
- *Tile Draw Image*: A complete list of full and half tile sequences depicting the shape drawn, which is generated by the software.

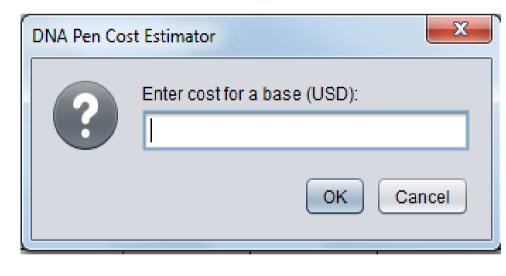
Edit Dimensions

The Freehand Molecular Canvas can have different dimensions- varying from $1050 \text{nm} \times 699 \text{nm}$ to $112 \text{nm} \times 75 \text{nm}$. DNA Pen allows you to vary the size of the canvas, thus altering the max size of the shape that can be drawn.



Estimator Function

It calculates the cost of experiment (USD).



References

1. Wei, Bryan, Mingjie Dai, and Peng Yin. *Complex shapes self-assembled from single-stranded DNA tiles*. Nature 485, no. 7400 (2012): 623-626.

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