DNA Origami
Biotech Blueprint

INTRODUCTION
There is art in science. Few innovations embody this axiom as well as DNA origami. Nearly three decades after Watson, Crick, and Franklin's groundbreaking research established a set of base-pairing rules for DNA strands, research published in the Journal of Theoretical Biology suggested the idea of turning DNA into building blocks for nanostructures. Today, the use of DNA as a structural material has become more prevalent. These advances use the specific complementary base pairing properties of DNA for applications in drug delivery, biosensors, and enzyme-cascades. This article will review the DNA origami design process and its promising applications.

DESIGNING THE STRUCTURE
DNA origami involves the directed folding of a long single-stranded DNA (ssDNA), called the scaffold, through the binding of hundreds of specifically designed shorter ssDNA, called staples. The scaffold is usually sourced from viral DNA (e.g. M13 bacteriophages) and is typically 7,000 nucleotides long. The staples are capable of base pairing to different regions of the scaffold, thereby bringing physically distant regions of the long ssDNA together. The design of the DNA origami structure is dependent on the staple sequences. Designing a DNA origami structure requires translating the desired structure into a series of folds followed by synthesizing the appropriate staples to perform them. Creating a DNA origami structure is simplified through computer-assisted design. Currently, three generations of DNA origami design tools exist. While the first-generation tools require manually routing the scaffolds and generating the crossover patterns, which are produced by the staple annealing. This ensures a more secure design.

Upon completion of the software-assisted design, the complementary strands of the staples and scaffolds are annealed and DNA nicks are placed in the scaffold backbone of the DNA to balance strain in the overall structure.

APPLICATIONS OF DNA ORIGAMI: CONTROLLED DRUG DELIVERY
DNA origami nanostructures (DONs) hold potential for use in drug delivery systems. The structural versatility of DONs allows them to be programmed to bind to different therapeutic agents, facilitating the delivery of these agents to their targets. In addition, the charge of DONs may be altered by surface modifications (capsid proteins, cationic polymers, etc.) to improve uptake by certain organs or intracellular organelles. Overall, the performance of these nanostructures are dependent on factors such as size, geometry, charge, stability, degradation, and drug capacity.

The efficacy of conventional cancer therapy is limited due to low solubility, low stability, and cytotoxicity of conventional chemotherapeutic agents. DONs can help overcome these drawbacks by acting as a targeted drug delivery system that can deliver the agents specifically to tumour cells. DONs have notably been used to deliver the anticancer drug doxorubicin in chemotherapy treatments. Doxorubicin (Adriamycin) is used to treat solid tumours by inhibiting tumour DNA synthesis and causing cell death in areas such as the breast,
References can be found on our website: www.themeducator.org