NanoDentistRobot

Using DNA origami technology to regenerate enamel.

Liverpool Life Sciences UTC
Inspirational Education for 14 - 19 year olds

IRIS The Institute for Research in Schools

Abstract:

The loss of a tooth has many consequences, even if it is not life-threatening.
In an advanced society, the loss of quality of life caused by the loss of a tooth is an undesirable situation.In an advanced society, the loss of quality of life caused by the loss of a tooth is an undesirable situation.
undesirable. Artificial prostheses, especially removable prostheses, are a primitive approach to solving the problem of missing teeth.Currently, like any artificial prosthesis, dental implants can never replace the function and physiological normality of natural teeth (5).
In addition, dental caries in the enamel can lead to serious complications such as pain, infection and tooth loss.

Aims:

Creation of a DNA Nanostructure using DNA Origami Technology with molecules inside such as (signalling pathways,Wnt) that have the capacity to differentiate dental pulp stem cells into ameloblasts cells.Cells responsible for the formation and proliferation of the enamel.

DNA Origami Technology:

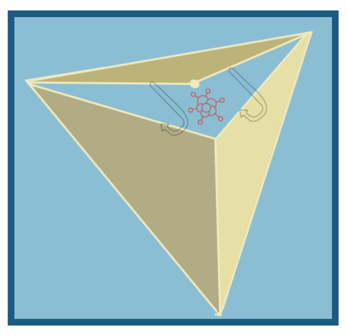
DNA origami technology is a revolutionary approach that exploits the inherent properties of DNA molecules to create complex, programmable structures at the nanoscale. It involves manipulating and folding a long single-stranded DNA template into complex shapes using short DNA strands "staples" that act as connectors. The staple strands are designed to bind to specific regions of the template, guiding its folding and forming the desired structure. Through careful design and selection of staple sequences, scientists can construct a wide range of shapes, including 2D patterns, 3D objects and even functional nanodevices.

DNA origami offers remarkable precision and control, allowing the creation of structures with nanometre resolution.

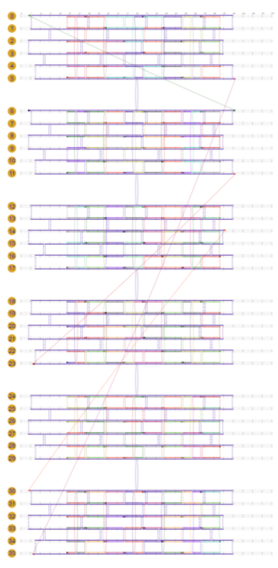
Its programmability allows the incorporation of various functional components, such as proteins, nanoparticles or other molecules, making it a polyvalent platform .

CanDo

Nanostructure:



Nanostructure made using a programing software called ScaDNAno, a program for designing synthetic DNA structure (nanostructure). The stability of the structure have been measured using CanDo software.CanDo offers rapid computational feedback on the 3D structure of programmed DNA assemblies, helping to reduce the time and cost needed to design these structures successfully



Ability to build highly complex structures at the nanoscale, DNA origami technology offers immense potential for advancing scientific research and developing innovative solutions in various fields.

Molecules:

Differentiate stem cell into ameloblasts:

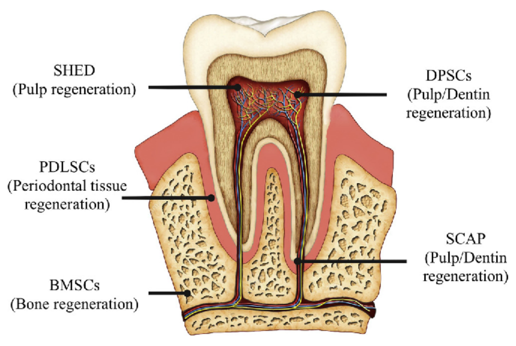
Studies have shown that certain signaling molecules, such as bone morphogenetic proteins (BMPs) and transforming growth factor beta (TGF-β), play a role in the differentiation of DPSCs into odontoblasts and ameloblasts. Additionally, certain transcription factors, such as Msx1, have been shown to play a key role in the differentiation of DPSCs into odontoblasts and ameloblasts. In order to differentiate DPSCs into ameloblasts, researchers typically use a combination of signaling molecules, transcription factors, and other growth factors in a specific culture conditions. They also use different techniques like gene editing to modulate the expression of specific genes that are involved in the differentiation process.

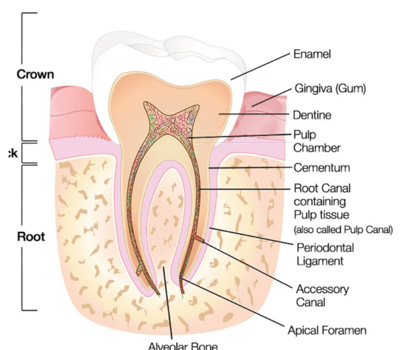
Tooth anatomy:

- A tooth is composed of different layers, each with its own structure and function. The layers of a typical tooth, starting from the outside and moving inward, are:

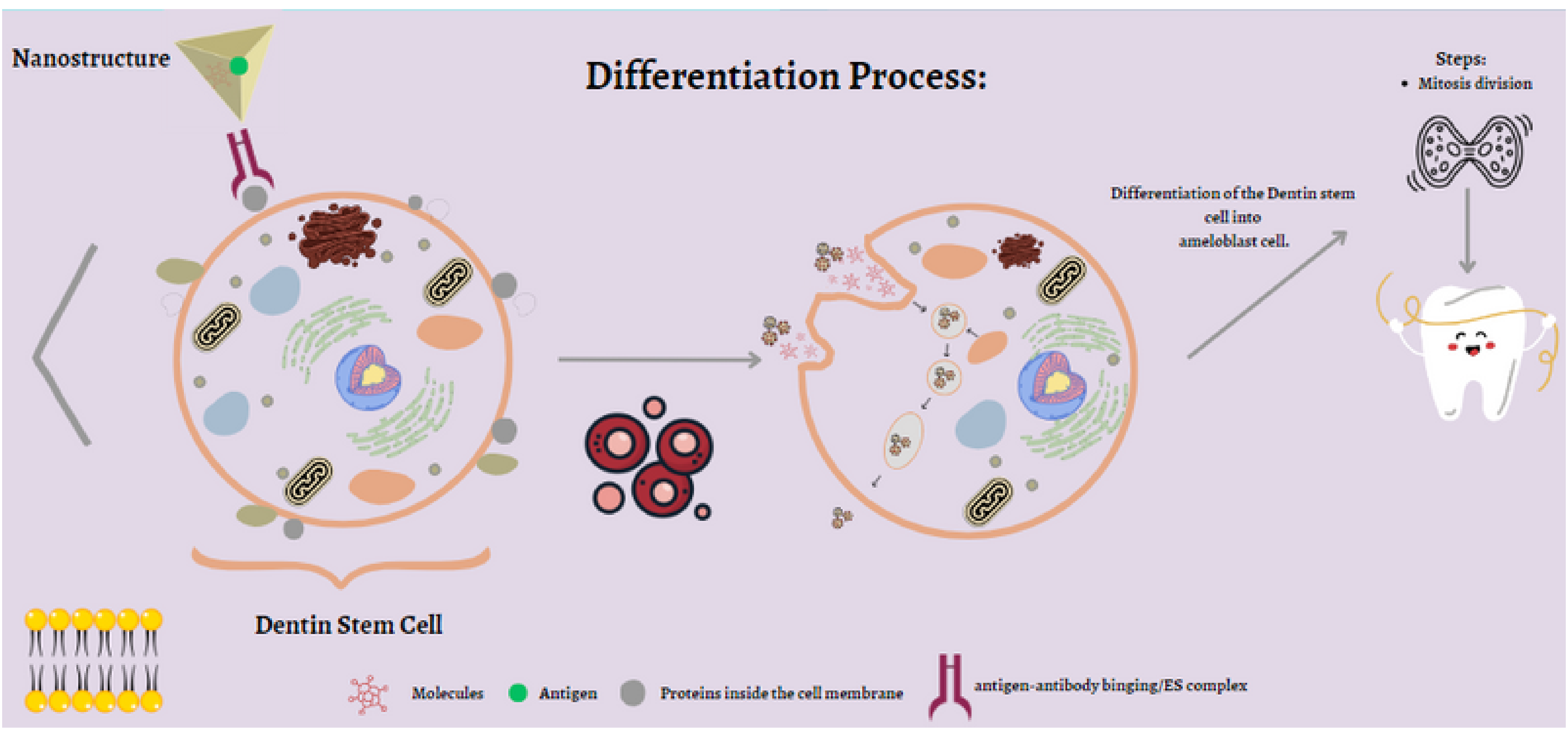
1.Enamel: This is the hard, outer layer of the tooth that covers the crown.
2.Dentin: This is the layer of the tooth that lies beneath the enamel.
3.Pulp: This is the soft, innermost part of the tooth that contains blood vessels, nerves, and connective tissue.

- In the 90s, some scientists have identified a population of stem cells in the dental pulp that could differentiate into multiple cell types.





- During tooth development, there are various signaling pathways and molecules involved in the formation and differentiation of tooth tissues, including enamel. These signaling pathways include the Wnt, BMP, FGF, and Notch pathways, among others.



Conclusion:

Creating an Nanodentistrobot that can regenerate enamel and mineralise teeth could potentially reduce concerns about dental health in the UK by addressing some of the underlying causes of dental problems. And help reduce the prevalence of gum disease in the UK. Therefore, can increase the oral health of the population in Uk.

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