Dancing Molucules CYSF Logbook

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November 06 2025

We have gathered a wide range of topics, with our main focus being on the topic of medical studies/biology. Some of topics are in our thought process were...

1. How quantum biology affects animal navigation.
2. Smart Glove for Visually Impaired Navigation
3. How motion sparks the spinal cord.
4. The regulator "T cells"-Guardians of the immune system.
5. **A Biological Scaffold: Designing Dynamic Healing Mechanisms**

November 10 2025

We decided to look further into this interesting topic by reading several research papers and articles

Five key developments

By sending bioactive signals to trigger cells to repair and regenerate, the breakthrough therapy dramatically improved severely injured spinal cords in five key ways:

1. The severed extensions of neurons, called axons, regenerated
2. Scar tissue, which can create a physical barrier to regeneration and repair, significantly diminished
3. Myelin, the insulating layer of axons that is important in transmitting electrical signals efficiently, reformed around cells
4. Functional blood vessels formed to deliver nutrients to cells at the injury site
5. More motor neurons survived

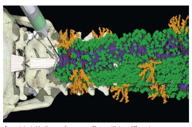
THE ADVANCED PHOTON SOURCE

"Dancing Molecules" Successfully Repair Severe Spinal Cord Injuries

Northwestern University researchers have developed a new injectable therapy that harnesses "dancing molecules" to reverse paralysis and repair tissue after severe spinal cord injuries. In a study, which included research at the U.S. Department of Energy's Advanced Photon Source (APS), the team administered a single injection to tissues surrounding the spinal cords of paralyzed mice. Just four weeks later, the animals regained the ability to walk.

By sending bioactive signals to trigger cells to repair and regenerate, the breakthrough therapy dramatically improved severely injured spinal cords in five key ways: (1) the severed extensions of neurons, called axons, regenerated;

the therapy immediately gels into a complex network of nanofibers that mimic the extracellular matrix of the spinal cord. By matching the matrix's structure, mimicking the motion of biological molecules, and incorporating signals for receptors, the synthetic materials are able to communicate with cells. Stupp and his team found that fine-tuning the molecules' motion within the nanofiber network to make them more agile resulted in greater therapeutic efficacy in paralyzed mice. They also confirmed that formulations of their therapy with enhanced molecular

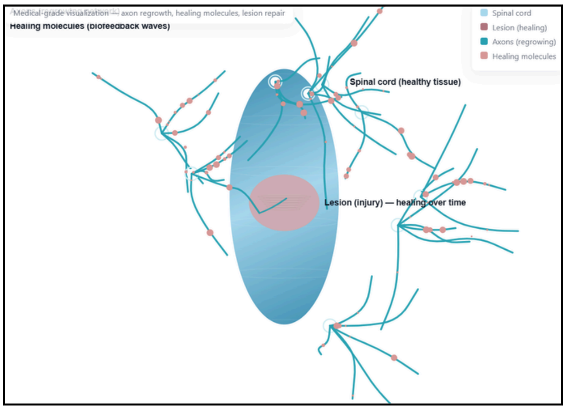


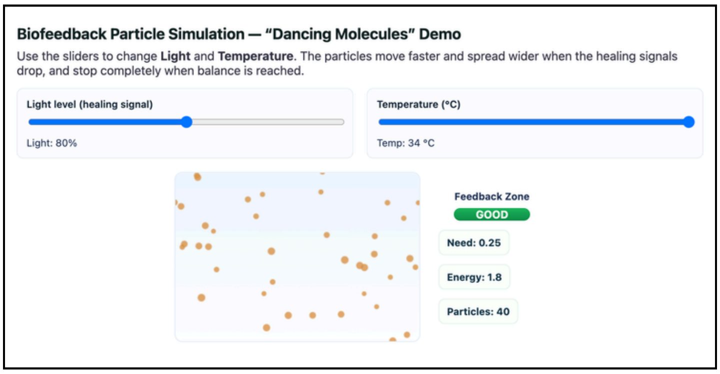
Anew,injectable therapy forms nanofibers with two different bioactive signals (green and orange) that communicate with cellstoinitiate repair of the injured spinal cord. Illustration by Mark Seniw

This helped us create a deeper understanding about the project that was instrumental during our next steps.

November 13 2025

To give us a clear perspective on what dancing molecules are and what are their effects we created small simulations to help us better understand areas of our research.





November 18 2025

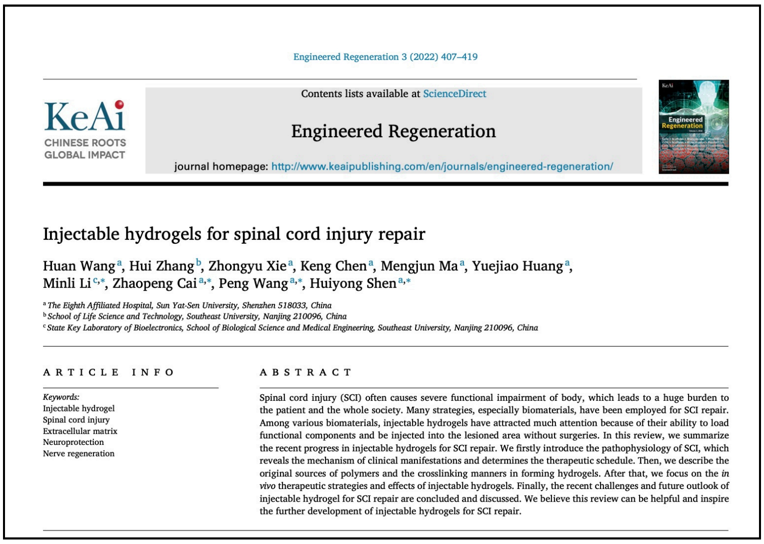
We started our first step into building a concrete research and started working on CYSF Sections. We figured out how dancing molecules are created, and what are the factors that make them so innovative?

Type	Example	Function
Growth Factors	BDNF (Brain-Derived Neurotrophic Factor), NGF (Nerve Growth Factor), VEGF (Vascular Endothelial Growth Factor.	Stimulate neuron survival, growth, and blood vessel simulation.
Cytokines	IL-6, TNF-a, IL-10 (These cytokines above drive inflammation).	Regulates the amount of inflammation
Extracellular Matrix Proteins	Laminin, Fibronectic, and Collagen	Give structural scaffolds and guide axon alignment.

November 23 2025

'Why are dancing molecules are so special and what makes them so good?'

This was a question that pursued us during this project. To help us solve this question we used research papers as below to figure out earlier treatment methods, what were there faults and how 'Dancing Molecules' were different.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Injectable hydrogels for spinal cord injury repair

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ABSTRACT

Spinal cord injury (SCI) often causes severe functional impairment of body, which leads to a huge burden to the patient and the whole society. Many strategies, especially biomaterials, have been employed for SCI repair. Among various biomaterials, injectable hydrogels have attracted much attention because of their ability to load functional components and be injected into the lesioned area without surgeries. In this review, we summarize the recent progress in injectable hydrogels for SCI repair. We firstly introduce the pathophysiology of SCI, which reveals the mechanism of clinical manifestations and determines the therapeutic schedule. Then, we describe the original sources of polymers and the crosslinking manners in forming hydrogels. After that, we focus on the *in vivo* therapeutic strategies and effects of injectable hydrogels. Finally, the recent challenges and future outlook of injectable hydrogel for SCI repair are concluded and discussed. We believe this review can be helpful and inspire the further development of injectable hydrogels for SCI repair.

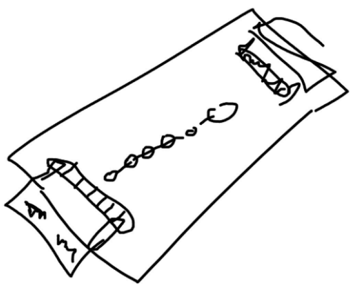
November 24 2025

We designed a core problem section that gives an overview of what problem we are trying to tackle and to figure out methods of how exactly we can make our project effective for tackling its concerns. This section is to be expanded later on with in-depth information, In natural biological systems, tissue healing and regeneration occur across multiple scales, from macroscopic tissue remodeling down to molecular motion. at the molecular level, proteins, extracellular matrix components, and signaling molecules are never static - they constantly exhibit vibrational, rotational, and translational motions driven by thermal energy and Brownian dynamics. This continuous movement leads to frequent molecular collisions, which are essential for interactions such as receptor binding, mechanosignaling, and structural organization (Frantz, Stewart, & Weaver, 2010; Magani et al., 2025). According to collision theory, the effectiveness of interaction increases when molecules can move freely, reorient, and adapt - a principle foundational to biological function and molecular communication.

Living tissue relies on this dynamic behaviour. Structural proteins like collagen, laminin, and fibronectin are not rigid; they dynamically reconfigure in response to mechanical forces, enabling cells to sense strain, adjust orientation, and promote organized growth after injury (Mangani et al., 2025). This motion-driven adaptability enables tissue to regain structure, strength and alignment following trauma - for example, guiding axons during nerve regeneration or remodeling the extracellular matrix during wound healing.

December 01 2025

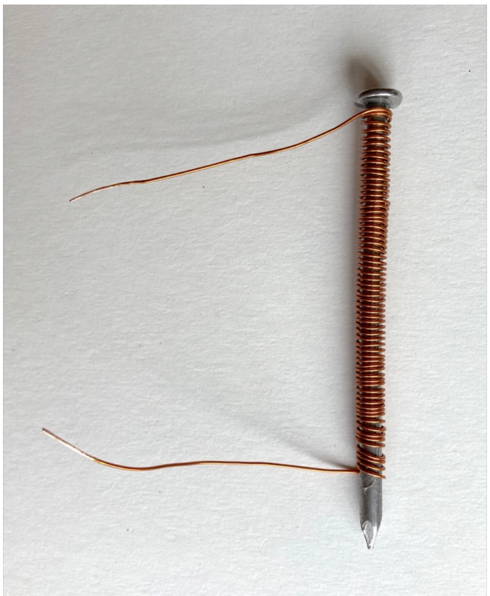
To demonstrate our project in a level in which we can see. We have decided to create models to better display what is happening at the molecular level.



(Early concept design)

December 07 2025

For our first model we have decided to create a small electromagnet, which we can show Dancing Molecules aligning themselves using paperclips as the molecules itself.

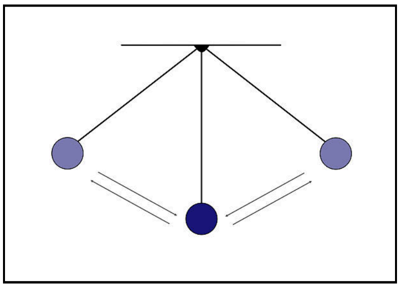


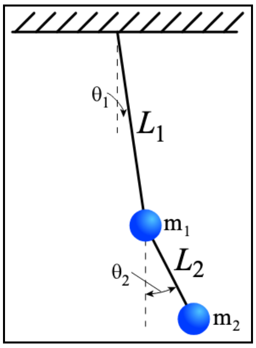
December 12 2025

We conducted our first test and we could find that the electromagnet is not strong enough to lift even 1 paperclip. We conclude that continuing in with project isn’t worthwhile with the amount of time and effort spent. We have decided to move on into better ways to create models. Using simple mechanical concepts seems like the better alternative.

December 17 2025

Brainstorming ways to model the interactions and movements using simple mechanics brings us into using pendulums. A way to show dancing molecules is by using a double jointed pendulum to represent the molecular movement. Ergo;the best way to show the movement of rigid molucules or otherwise past unsuccesful treatment methods is by using a normal single jointed pendulum.



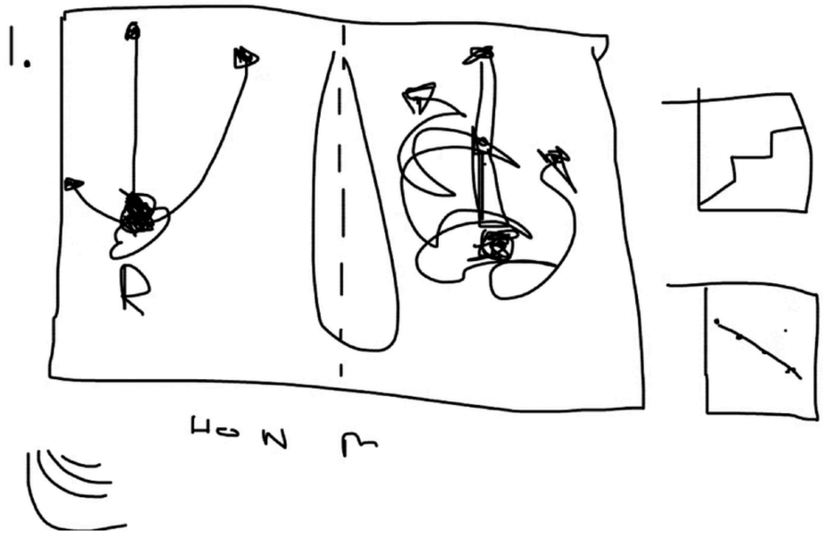


January 03-17 2026

We focused on finishing many sections of the platform and cleaning up weak spots in our research.

January 22 2026

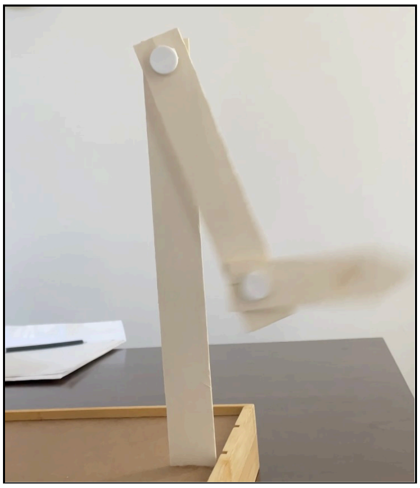
We finished our plan to create a model that shows the molecular movement and interaction between dancing molecules, and rigid molecules.



(Early concept design)

January 28 2026

Created the model of interactons between dancing and rigid molucules.



February 02 2026

Made plans to buy trifold

February 20 2026

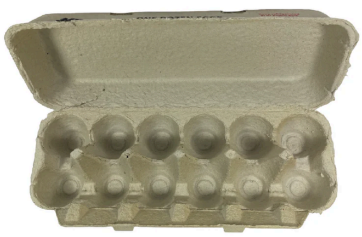
Bought trifold

February 27 2026

Start practicing presentation.

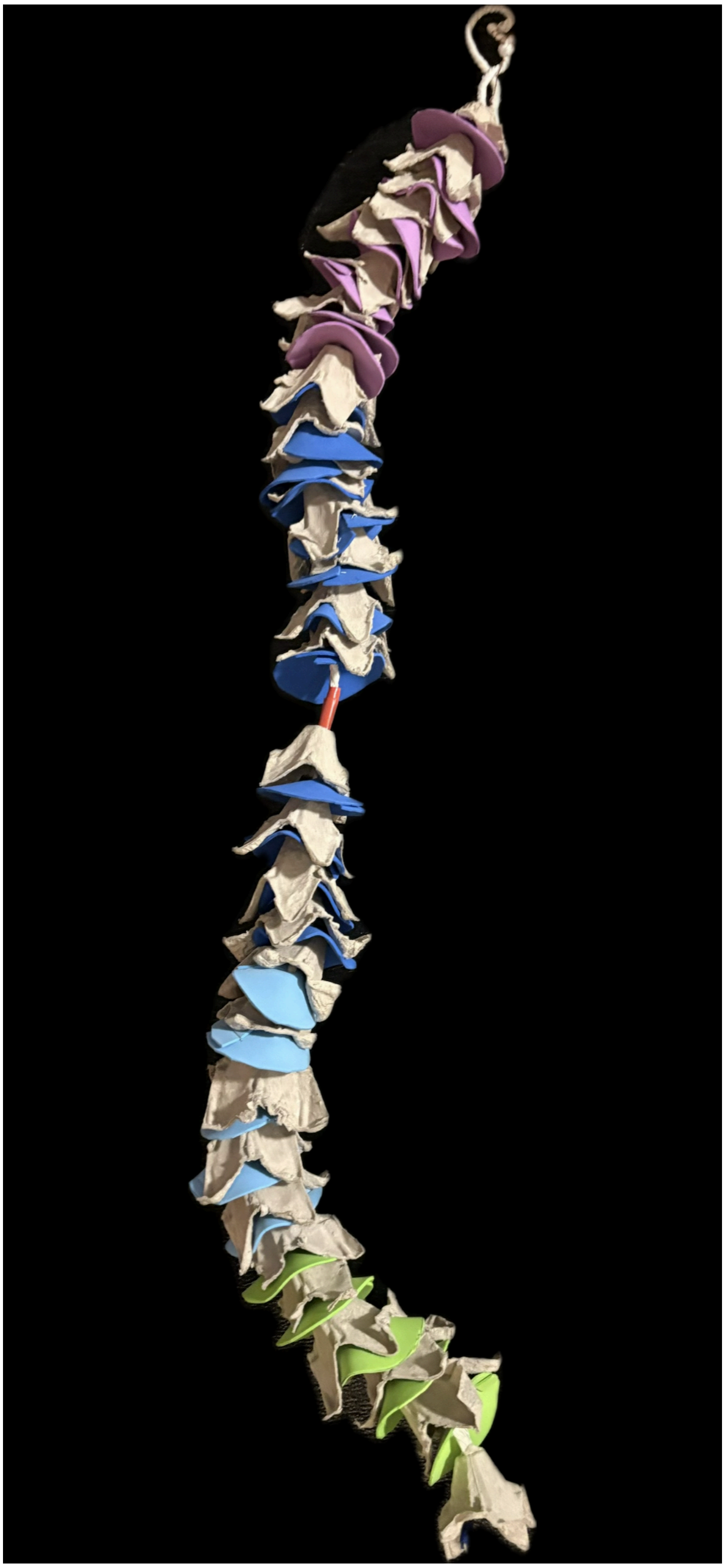
February 28 2026

We needed to create a new model that better represented the anatomy of the spinal cord. Constructing the spinal cord with egg cartons and foam sheets.



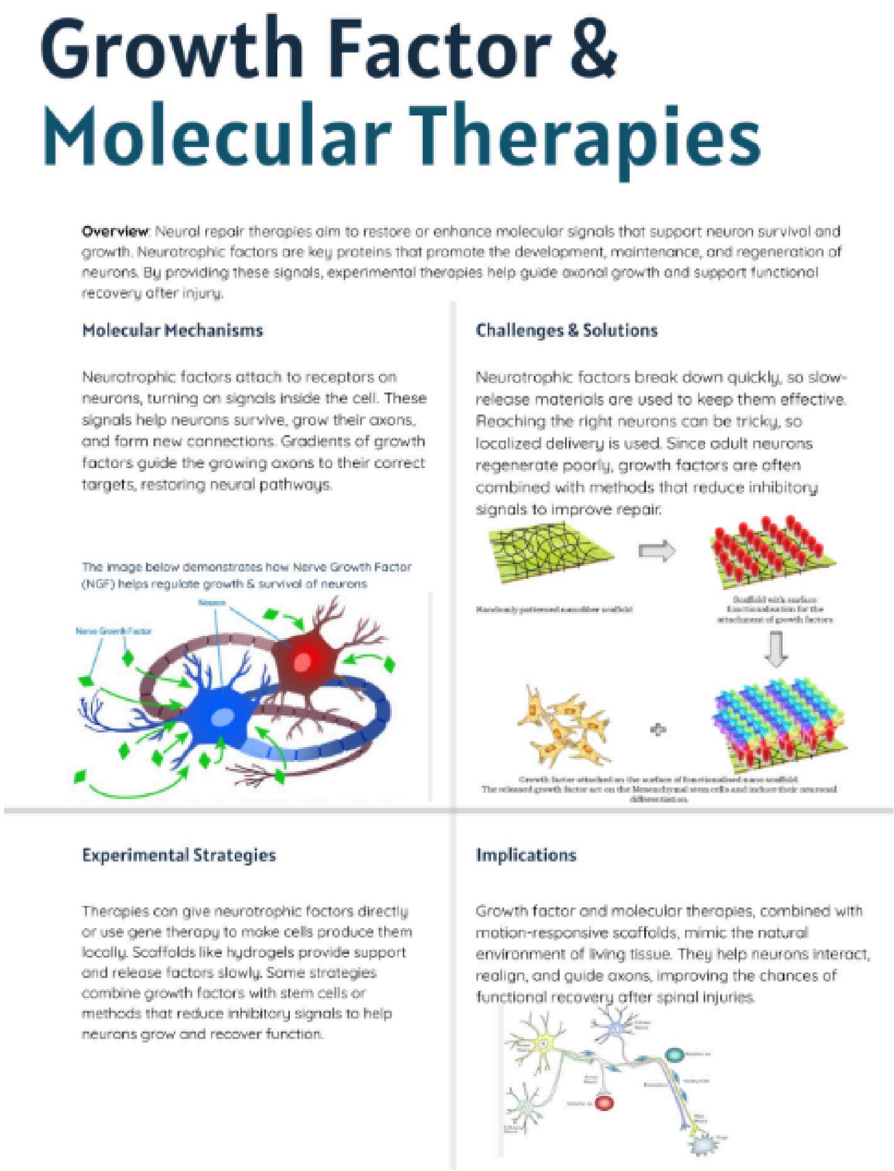
February 29 2026

Finished creating the spinal cord.



March 01, 2026

In this time, we understood that visuals can strengthen the core foundation of our project and will assist the research that has been provided. To showcase this, we decided on strengthening our applications made connections of how molecular therapies help to restore signals. This visual below was created with our understanding:



March 02, 2026

We finalized our analysis and made sure that our data were accurate and were measured with fair testing skills. Furthermore, this helped us because we spent the time to make the overall section more detailed with qualitative and quantitative observations that really make impacts when connecting to real-world concepts.

March 03, 2026

We made sure that all parts of the platform were completed thoroughly and took time to really make sure we covered the concepts and points of our project.