YOUNG GLOBAL SCIENTISTS

OCT 2023

# YGS

MAGAZINE

VOLUME 2

## How to Perform Research as a Student

## Scientific Discovreries by Students

IMPACT OF HORMONES ON PLANT GROWTH

THE PHYSICS OF CRUMPLED PAPER

EFFECT OF AIR FRESHENERS ON LIVING ORGANISMS

# Editor's Note

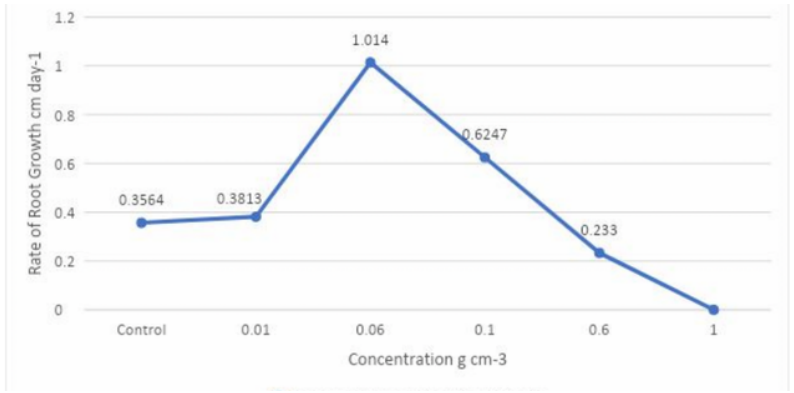
The Young Global Scientists Journal (YGS) is an online student-run journal that creates opportunities for young scholars around the world to share their learning and publish their thoughts and discoveries.

This magazine aims to highlight select scientific publications from the latest edition of the YGS Journal. Articles in this magazine cover the major discoveries in the published papers, making the incredible work done by these high school students accessible to the public.

Throughout the magazine, various articles describe tips for pursuing research in high school along with advice on how to design and perform experiments. This was done to promote scientific research in high school.

The purpose of this magazine is to inspire and support students in their pursuit of scientific discovery, preparing them for futures in research-related careers.

**NIRBAAN MAKEN**




# Research Reveals Surprising Impact of Plant Hormone IAA on Radish Root Growth

**Paper written by Ian Han**

In a study conducted by Ian Han from Australia, the effects of varying concentrations of indole-3-acetic acid (IAA), a common plant hormone, on the rate of root growth in Raphanus sativus (radish) have been unveiled. The research aimed to investigate the relationship between IAA concentration and root growth in this plant species. Surprisingly, the findings challenge conventional wisdom by revealing that lower concentrations of IAA actually enhance root growth, with 0.06 g cm-3 concentration showing the most significant positive effect. However, as IAA concentrations increase beyond a certain threshold, the hormone begins to inhibit root growth. The study's meticulous experimental design and statistical analysis firmly support these conclusions.

Indole-3-acetic acid (IAA) is a well-known plant hormone, but its intricate relationship with root growth in Raphanus sativus had not been thoroughly explored until now. The investigation spanned five different IAA concentrations, ranging from 0.01 to 1.00 g cm-3, with careful consideration given to controlled variables such as species, light intensity, CO2 concentration, temperature, and more. The research showed that as IAA concentrations increased, the rate of root growth initially saw a boost. However, beyond a certain threshold, IAA had a noticeable inhibitory effect on root growth, even leading to the failure of germination in the highest concentration tested.

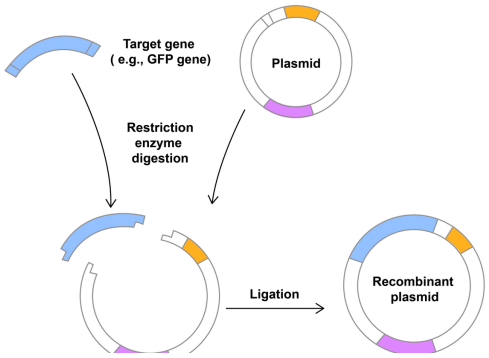
This study challenges the prevailing belief that IAA consistently inhibits root growth. Instead, it offers a nuanced perspective, highlighting that the impact of IAA on Raphanus sativus root growth is concentration-dependent. This newfound understanding of the hormone's dual role as both an enhancer and an inhibitor of root growth in different concentrations has significant implications for plant science and agriculture. It sheds light on the delicate balance between hormones and root development, potentially paving the way for more precise plant growth control in the future.

# How to Produce and Purify Proteins: The First Step to Biochemistry Research

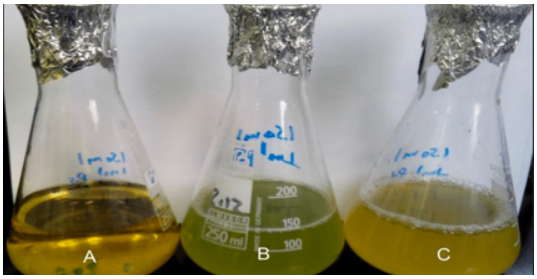
Special Edition: How to Perform Research in High School

After you've got access to a lab, you may be asking "now what?" Developing a research project in the field of biochemistry/biology can be a complex endeavor. However, it can be useful to select a specific protein you would like to study by reading through current literature in the field. The protein you choose depends on your interests, the disease you would like to study, and various other factors. Even if you don't know what specific protein you would like to study, it can be useful to first purify a sample from an organism and then choose what you'd like to study. The following steps are a very brief overview of how this is done in order to guide you in the right direction. This is, by no means, an in-depth procedure on how to produce and purify proteins. You must read papers and actual methods!

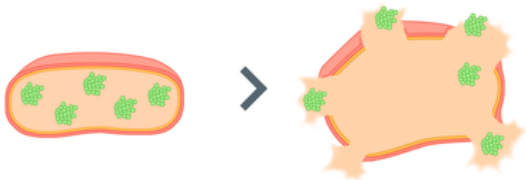
Create a recombinant plasmid with your gene of interest. This can be ordered or produced using restriction enzymes. Ask your advisor on specific details!



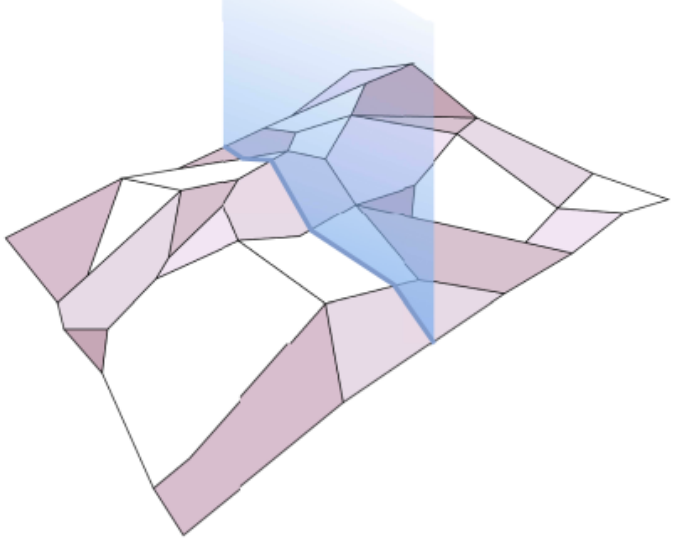

Express this in E. Coli cultures. E. Coli naturally absorbs many proteins however there are many published papers tailored to individual proteins and genes.




Lyse the cell to allow proteins to appear in solution. This can be done through a sonicator or by using lysis buffer. Once again, read, read, read!

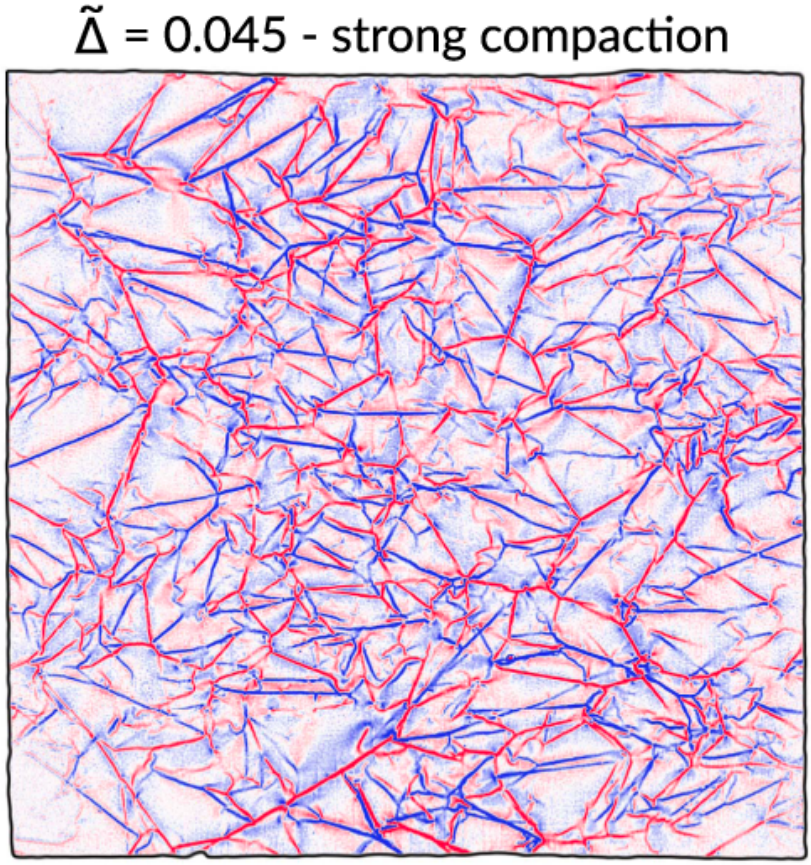


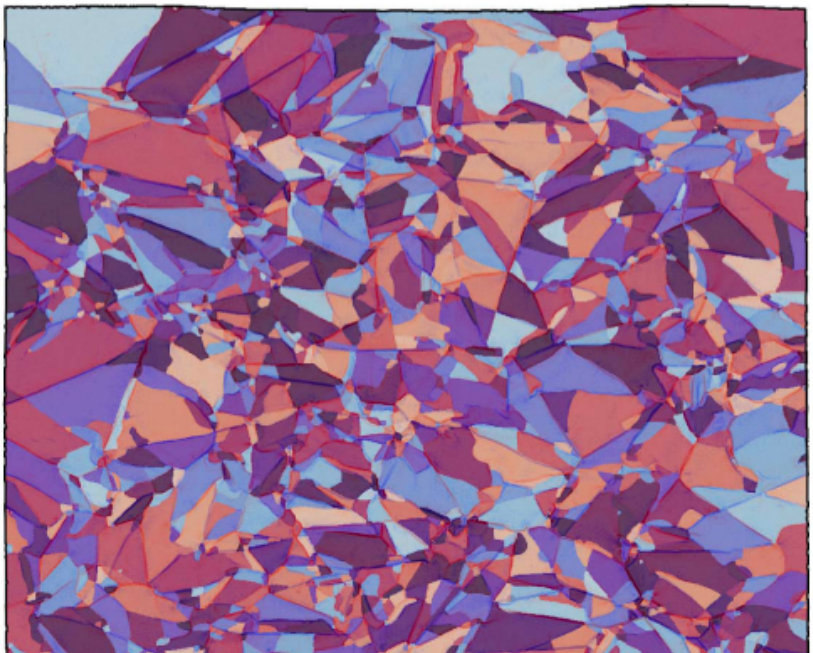
Use an AKTA or other method to purify the proteins and perform assays to determine the concentrations of protein.



# The Physics of Crumpled Paper

PAPER WRITTEN BY HAYLEY CHU



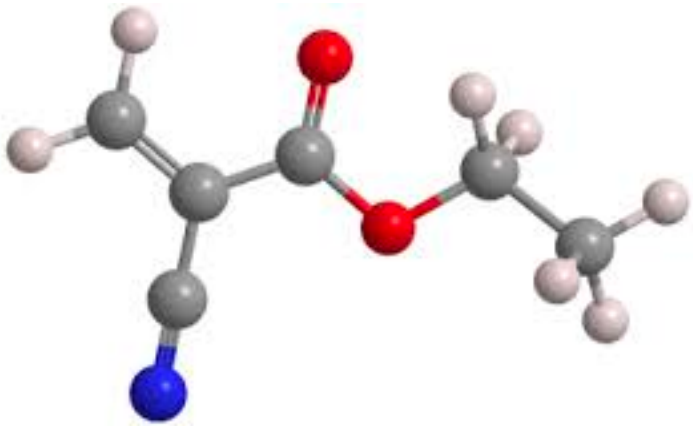
Recent scientific research has unraveled the physics hidden within crumpled paper, shedding light on its unexpected strength and intricate structure. The process of crumpling, which transforms a flat sheet into a three-dimensional structure comprising a web of ridges and facets with varying density, has long intrigued scientists. This study, led by researchers like Ian Han and Croll, Twohig, and Elder, found that crumpled paper becomes remarkably sturdy, boasting a significant compressive strength, despite its initial flimsiness. Key structures within the crumpled sheet, such as bends, folds, developable cones (d-cones), and stretching ridges, were identified as critical components contributing to this newfound strength. The research also unveiled that crumpled paper balls are predominantly composed of air, accounting for approximately 75-90% of their volume, a surprising revelation that adds to the material's resilience. Additionally, the study explored the relationship between the dimensions of the original paper sheets and the effective density of the resulting crumpled paper balls, opening up new avenues for understanding deformation processes in nature and their potential applications in various fields, from materials science to biology.

This investigation into the physics of crumpled paper challenges conventional wisdom and offers intriguing insights into the resilience of seemingly simple materials. Beyond the curiosity factor, the findings hold promise for innovative applications, as understanding the strength and structure of crumpled paper could have implications in fields where similar deformations occur. As scientists continue to probe the mysteries of crumpled paper, the knowledge gained could revolutionize material science and inspire new solutions in various industries.

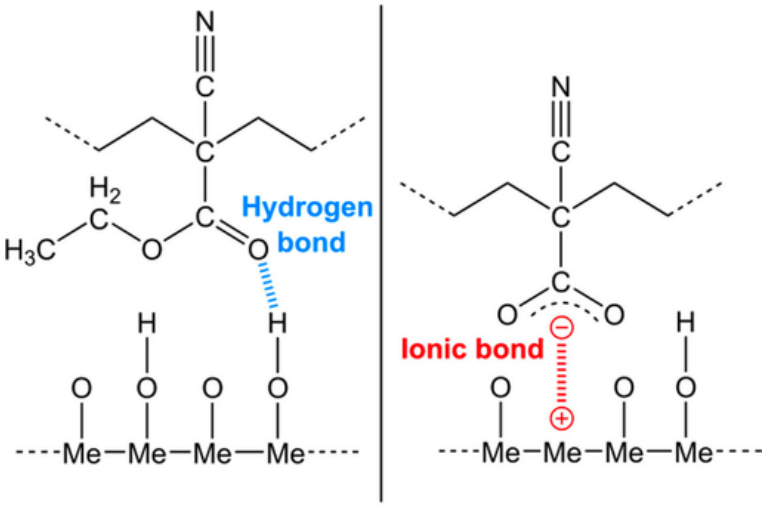
# Cyanoacrylate: The Super Glue

PAPER WRITTEN BY OSCAR GIBSON

In the latest issue of Young Global Scientists, Oscar Gibson, a British junior scientist, delves into the multifaceted world of cyanoacrylate, commonly known as superglue. Gibson traces the origins of this revolutionary adhesive back to Dr. Harry Coover Jr.'s accidental discovery during World War II. Originally intended for optical purposes, superglue's unintended sticking power led to its emergence as a vital tool in various industries.

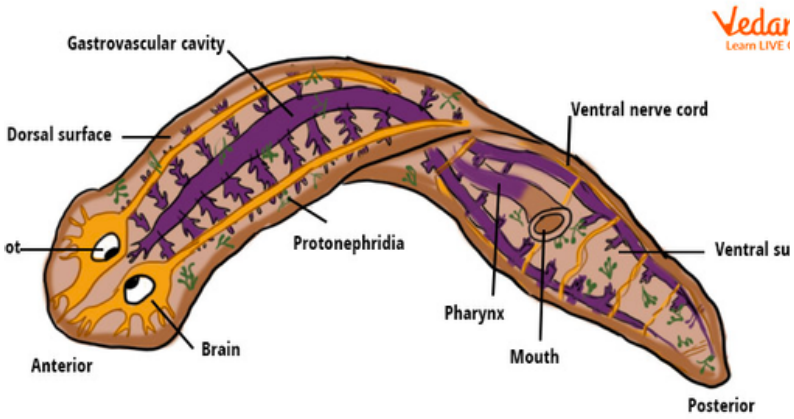
Instant adhesive (ethyl cyanoacrylate)

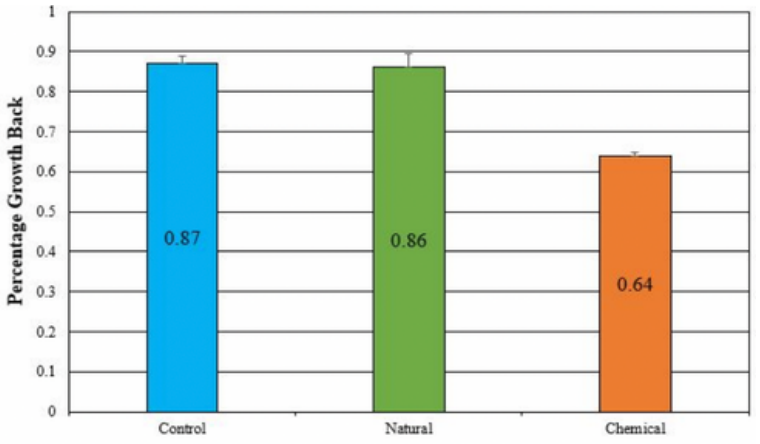



Natively oxidized metal substrates

Cyanoacrylate's chemical composition, $CH_2=C(CN)CO_2R$, with R representing an organic molecular group, plays a pivotal role in its rapid polymerization process, which allows it to bond with nearly any surface, especially in the presence of water. This unique property has made it indispensable in fields such as forensics, where cyanoacrylate fuming is used to develop latent fingerprints, and medicine, where it is employed for wound closure and even drug delivery systems. Its adaptability extends further into unexpected domains, like the world of music, where it's utilized for repairing instruments, and even underwater bonding. Researchers are now exploring its potential for use in photovoltaic cells and as a herbicide.

The story of cyanoacrylate serves as a testament to the unexpected innovations that can emerge from scientific curiosity and the pursuit of unexplained phenomena. Dr. Coover's accidental discovery underscores the importance of remaining open-minded and exploring the hidden potential in scientific observations, ultimately leading to groundbreaking discoveries with far-reaching applications across various sectors.




# Impact of Air Fresheners on Regeneration of Planaria

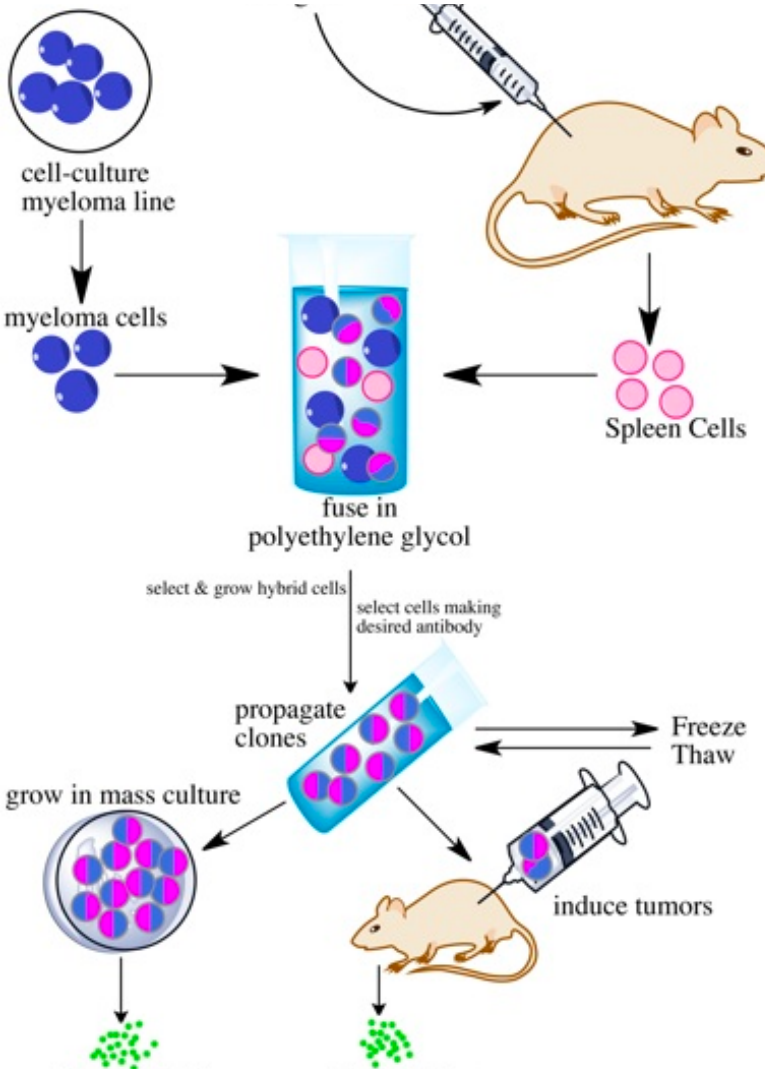
Paper Written by Katy Lam

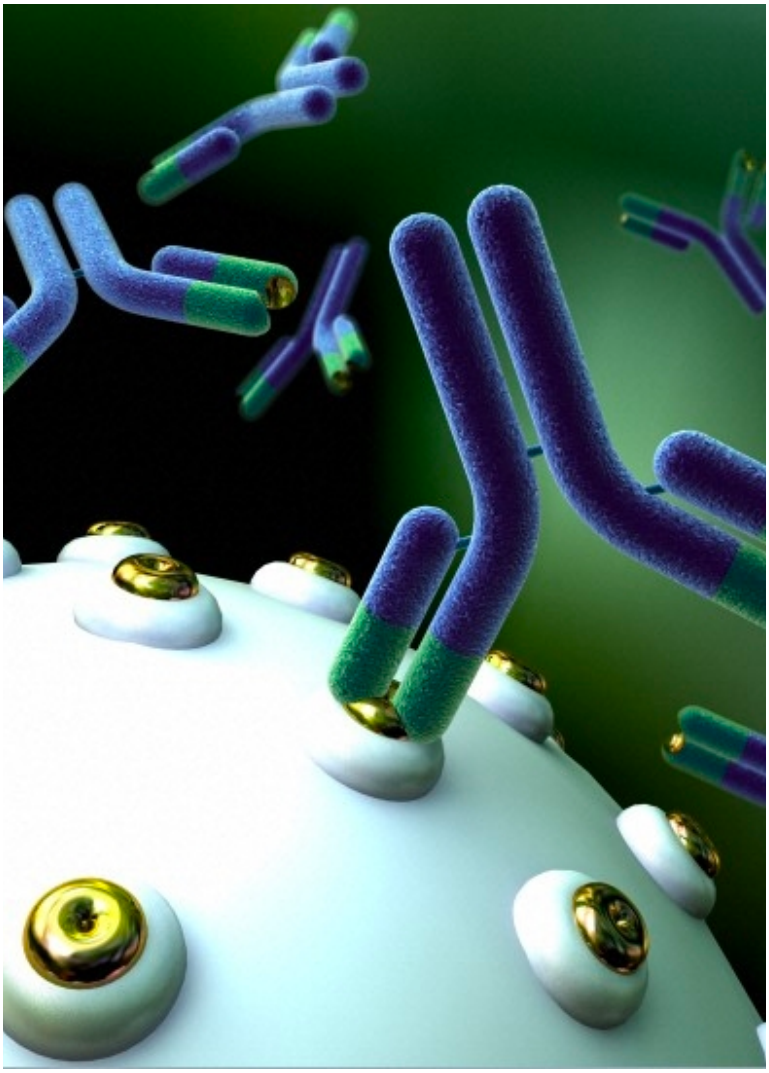
This study has shed light on the potential dangers lurking in our homes, particularly those seemingly innocuous air fresheners. Researchers from a prominent university embarked on a mission to investigate the effects of air fresheners, differentiating between chemical and so-called "natural" variants, on the regeneration capabilities of planaria, a type of flatworm known for its regenerative prowess. The findings of this study have raised concerns about the health implications of prolonged exposure to air fresheners, as well as the influence of varying concentrations.

## CHEMICAL VS. NATURAL: A STARTLING CONTRAST

The research results revealed a stark contrast between chemical and natural air fresheners. While control and natural air fresheners demonstrated similar regrowth rates, the chemical group exhibited a significant negative impact on planarian regeneration. Control and natural conditions boasted impressive regrowth percentages of 87% and 86%, respectively. In contrast, the chemical group lagged behind with only a 64% regrowth rate. These findings suggest that natural air fresheners might be a safer choice for both environmental and health concerns.

Moreover, the study delved into the effects of different concentrations of air fresheners on planarian regeneration. Higher concentrations, whether chemical or natural, were found to have a more pronounced negative impact on regeneration rates. This highlights the importance of not only the type of air freshener but also the concentration used, as elevated levels of exposure could potentially lead to greater health concerns. As air fresheners continue to be a common household item, these research findings underscore the need for greater awareness and caution when choosing and using such products to ensure both environmental and personal well-being.



# Monoclonal Antibodies

Paper Written by Jerry Zhang

In an exploration of monoclonal antibodies, Australian scientist Jerry Zhang sheds light on the pivotal role these tiny proteins play in our fight against diseases. In a July 2020 issue of Young Global Scientists, Zhang unveils the intricate process of monoclonal antibody engineering, explaining how these antibodies are meticulously produced to target specific antigens. Using hybridoma technology, scientists induce plasma cells to create large quantities of monoclonal antibodies against a particular antigen. By fusing these plasma cells with cancerous myeloma cells, the resulting hybridomas gain immortality and the ability to produce antibodies continuously. Through a selective process involving HAT medium, scientists choose the most promising hybridomas, enabling the production of highly specific monoclonal antibodies, a cornerstone of modern medicine.

In the realm of cancer immunotherapy research, Zhang highlights the three types of monoclonal antibodies: naked, conjugated, and bispecific. Naked monoclonal antibodies seek out specific antigens and call upon the body's immune system to mount a defense against cancerous cells. Conjugated monoclonal antibodies, armed with toxins, are designed to specifically target cancer cells, delivering a lethal blow upon binding. Bispecific monoclonal antibodies, a marvel of precision, simultaneously bind to two different antigens, guiding cytotoxic immune cells to eliminate malignancies. Furthermore, Zhang explores the fascinating world of antibody-dependent cellular cytotoxicity (ADCC), where immune effector cells are activated to destroy target cells marked by antibodies, potentially heralding a new era in cancer treatment and personalized medicine. Monoclonal antibodies, it seems, hold the promise of revolutionizing how we combat diseases at their very source.

# Links and Sources

## Articles

**Research Reveals Surprising Impact of Plant Hormone IAA on Radish Root Growth**

https://www.ygsjournal.com/_files/ugd/389a2b_fadd323e62ee48f0b89b9197683f7f84.pdf

**Physics of Crumpled Paper**

https://www.ygsjournal.com/_files/ugd/389a2b_eb019b2e39504a50b25a0490f8adfaff.pdf

**Cyanoacrylate: The Super Glue**

https://www.ygsjournal.com/_files/ugd/389a2b_771d2465b2d94ac2807b7a1c3a5d1ab1.pdf

**Air Fresheners and Planaria**

https://www.ygsjournal.com/_files/ugd/389a2b_3f5cf782283947b9885b7969c9648f11.pdf

**Monoclonal Antibodies**

https://www.ygsjournal.com/_files/ugd/389a2b_fadd323e62ee48f0b89b9197683f7f84.pdf


**Check out our latest editions at https://www.ygsjournal.com/**