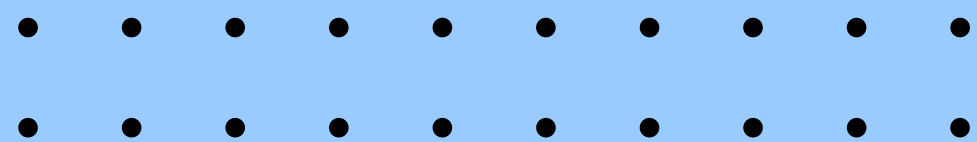


IDEATION: WHERE TO START

SEFH SCIENCE FAIR SEMINAR





TEACH2LEARN

What do we do?

- Host STEM Workshops at local middle schools
 - Science Fair
 - Computer Science
 - Destination Imagination
- Inspire curiosity in STEM
- Foster intellectual growth



TEACH 2 LEARN

SCIENCE FAIR : CS: DI WORKSHOPS



Need help with Science Fair?

- Receive personalized Science Fair help from our mentors through Teach2Learn workshops
- Guidance provided through each step or go to <https://www.teach2learn.org>
- Mentors have won awards at SEFH, TXSEF, and ISEF!

Interested in Programming?



Learn how to code in Python

Write fun programs, create online games, and more!



STEM



No prior experience necessary!

Easy-to-follow classes taught by high school T2L mentors



More Info ↓



WHERE DO WE START?

- A good science fair project is...
 - One that **YOU** are interested in
 - Has **DEPTH**
 - Has a **MEANINGFUL** result
- Doesn't have to be completely new
 - "If I have seen further, it is by standing on the shoulders of giants." – Isaac Newton

WHERE DO WE START?

- Finding an idea can be the most difficult part
- Start **broad**
 - What are you interested in?
 - What problems do you notice in the world?
- Pay attention to the world around you
 - Conversations, TV shows, social media, literature etc. – Curiosity can stem from anywhere!
 - Then dive deeper! Original projects often come from extensive research on specific fields/topics

PURPOSE

- Your project needs an **APPLICATION**
- Answers the questions:
 - “How does my project apply to the real world?”
 - “Why are my results important?”
- Results should **help solve a problem** or **provide more information** about a problem



EXAMPLES

“Plants exposed to more sunlight experience greater growth and productivity.”

Does this...

- Help solve a real problem?
- Provide more information about a problem?

EXAMPLES

“Bricks made of recycled materials are cheaper and more sustainable than conventional construction materials.”

Does this...

- Help solve a real problem?
- Provide more information about a problem?

EXAMPLES

“Plants watered with soda experienced slowed growth and wilting compared to plants watered with water.”

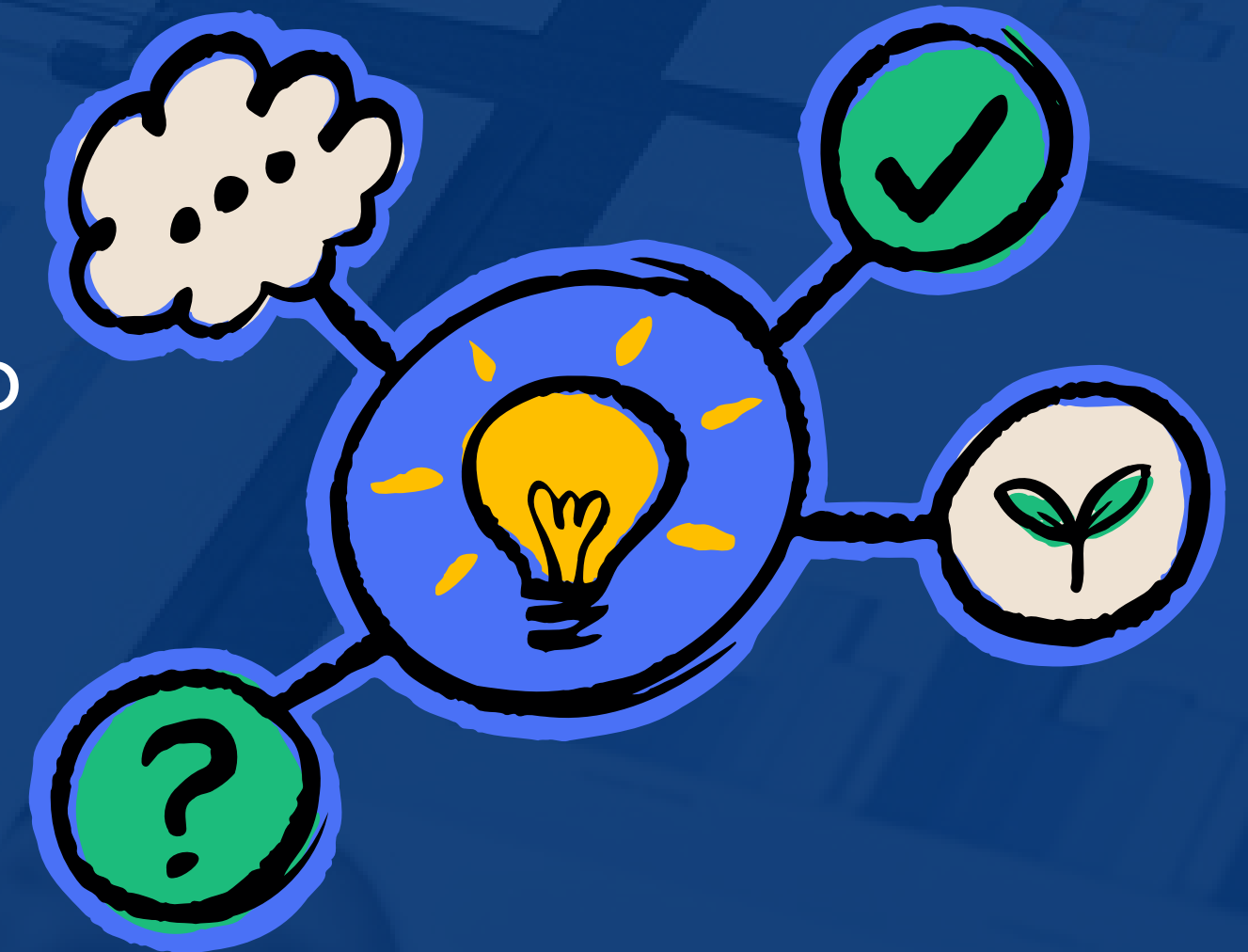
Does this...

- Help solve a real problem?
- Provide more information about a problem?

REDIRECTING IDEAS

A student wants to conduct an experiment where he exposes various plants to different types of sodas to see how it affects their growth.

- How can we **redirect this student's idea** to produce a **more effective project**?



REDIRECTING IDEAS

Possible approaches

- Addressing urban pollution and its effects on plants
- Current limitations of the fertilizer industry
- Mapping soda factories and vegetation health across America

Get students started on the right path and allow them to **do their own research**

AREA OF INTEREST SURVEY



1. Click the green button that says run
2. Type in a number 1 to 10
 - 1 = strongly disagree
 - 5 = neutral
 - 10 = strongly agree
3. Click enter
4. Repeat until you receive you suggested area of interest

THE FUNNEL METHOD

Search up a broad problem of interest on Google and click on the news tab

(ex: global warming, pollution)

Read & take note of the problems that are currently relevant or interest you

Narrow into smaller subtopics and go down a rabbit hole

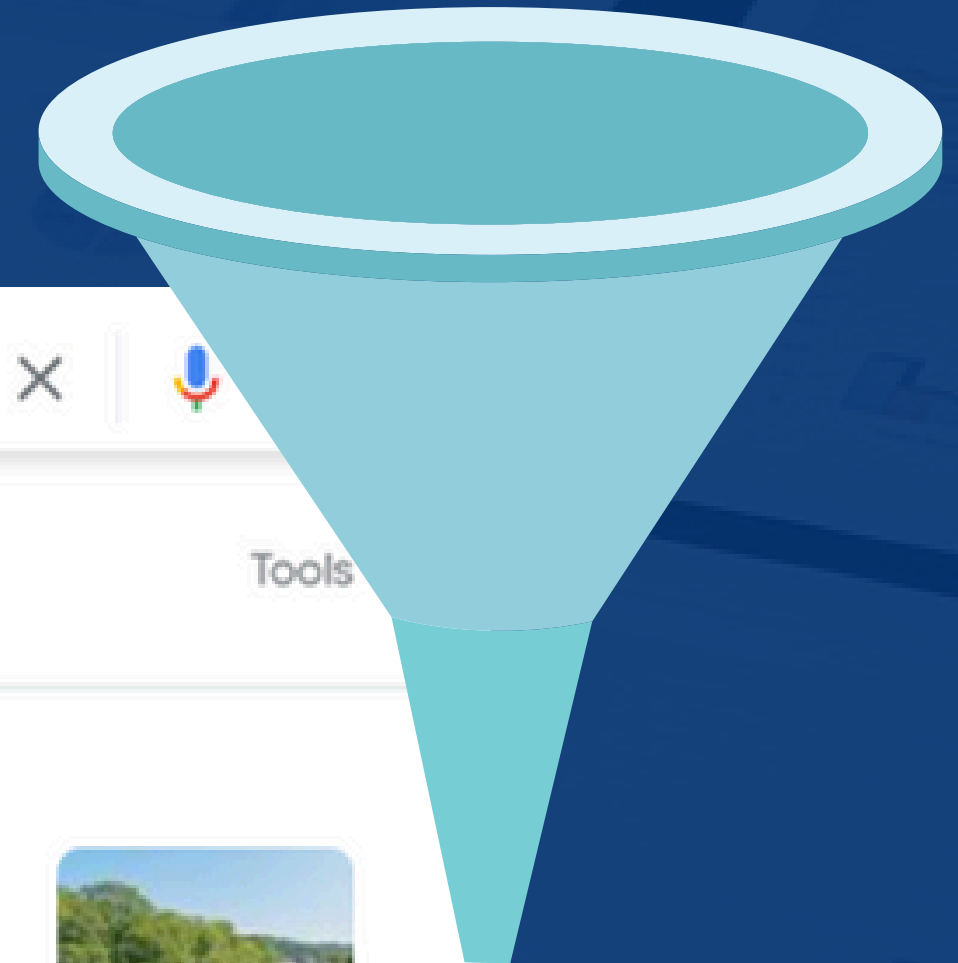
(Wikipedia pages, journal articles, etc.)

Write down any ideas, questions and useful links

THE FUNNEL METHOD

Example Search

"I'm interested in water pollution!"



A screenshot of a Google search for "water pollution". The search bar shows "water pollution" with a clear button and a microphone icon. Below the search bar, the "News" tab is selected among other options like "All", "Images", "Books", "Videos", and "More". The results show "About 114,000 results (0.34 seconds)". The first result is from National Geographic, titled "When water pollution is rife in the UK, where's safe for wild swimming?". The snippet below the title reads: "Stories about the polluted state of the water in British rivers are rarely absent from the news — so how can you know when...". The date "3 days ago" is visible. To the right of the text is a small image of a river with green banks.

What's happening in UK rivers?

Sewage spills and agricultural pollution are the leading causes of dirty rivers. And the latest figures are alarming: only 14% of England's rivers are

THE FUNNEL METHOD

Example Brainstorm List

- Does city pollution or rural pollution impact water quality more?
- Which areas would be safer for animals to live?
- Do certain areas generate more pollution in water?
- How do nutrients used in agricultural fertilizers affect water quality?
- Could be used to determine which places are at risk of contaminated water
- Find out what areas need to focus on addressing water pollution the most

Repeat this with multiple topics

BACKGROUND RESEARCH



Conduct background research to make sure you understand all aspects of your project

3 Principles

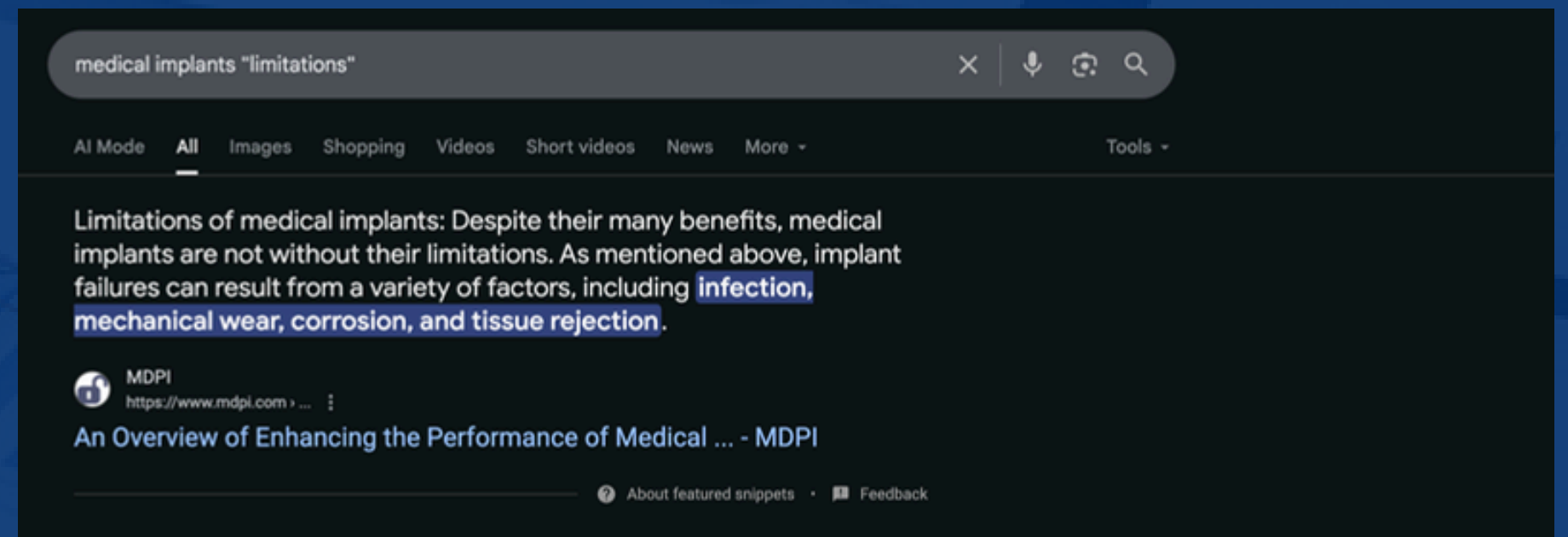
Use credible sources (.edu, .org, .gov etc.) NOT WIKIPEDIA

Should be somewhat recent (less than 10 years old);
Look for studies similar to your idea

Begin to plan your methods (how you will conduct your project)

BACKGROUND RESEARCH

- Get a better understanding of the field and what has been done
 - Ex. I want to do a project about medical implants
 - **Key Google searches**
 - “Medical implants limitations”
 - “Medical implants innovations”
- This helps the general direction of research

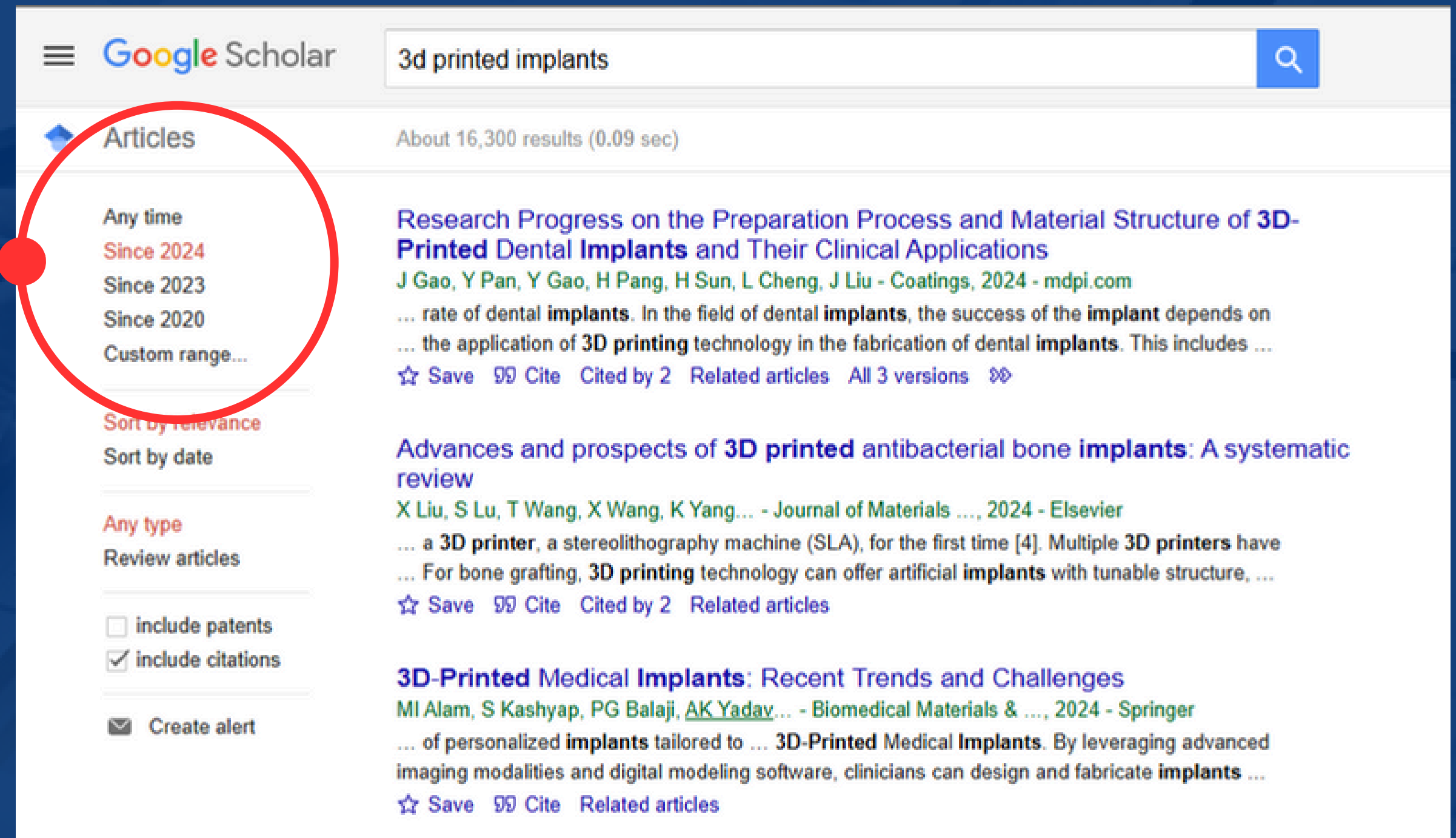


ASK:

Is there anything I can do to **help solve this problem**?
Is this something I should **watch out for**?

BACKGROUND RESEARCH

By using Google Scholar, we are able to filter academic papers into the most recent findings and by review article



The screenshot shows the Google Scholar interface with the search term "3d printed implants". The search results are filtered to "Articles". A red circle highlights the "Articles" filter section, which includes options for "Any time", "Since 2024", "Since 2023", "Since 2020", and "Custom range...". Below this, there are sorting options: "Sort by relevance" (selected), "Sort by date", and "Any type". There are also checkboxes for "include patents" (unchecked) and "include citations" (checked), and a "Create alert" button.

Google Scholar

3d printed implants

About 16,300 results (0.09 sec)

Articles

Any time
Since 2024
Since 2023
Since 2020
Custom range...

Sort by relevance
Sort by date

Any type
Review articles

☐ include patents
☒ include citations

☐ Create alert

Research Progress on the Preparation Process and Material Structure of **3D-Printed Dental Implants** and Their Clinical Applications
J Gao, Y Pan, Y Gao, H Pang, H Sun, L Cheng, J Liu - Coatings, 2024 - mdpi.com
... rate of dental **implants**. In the field of dental **implants**, the success of the **implant** depends on ... the application of **3D printing** technology in the fabrication of dental **implants**. This includes ...
☆ Save Cite Cited by 2 Related articles All 3 versions

Advances and prospects of **3D printed** antibacterial bone **implants**: A systematic review
X Liu, S Lu, T Wang, X Wang, K Yang... - Journal of Materials ..., 2024 - Elsevier
... a **3D printer**, a stereolithography machine (SLA), for the first time [4]. Multiple **3D printers** have ... For bone grafting, **3D printing** technology can offer artificial **implants** with tunable structure, ...
☆ Save Cite Cited by 2 Related articles

3D-Printed Medical Implants: Recent Trends and Challenges
MI Alam, S Kashyap, PG Balaji, AK Yadav... - Biomedical Materials & ..., 2024 - Springer
... of personalized **implants** tailored to ... **3D-Printed Medical Implants**. By leveraging advanced imaging modalities and digital modeling software, clinicians can design and fabricate **implants** ...
☆ Save Cite Related articles

BACKGROUND RESEARCH

Here we can identify
our indicating phrase:
“Recent Trends and
Challenges”

This is our exigence to
look further into what
this paper might have
to offer

Google Scholar

3d printed implants

Articles About 16,300 results (0.09 sec)

Any time
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☆ Save Cite Related articles

BACKGROUND RESEARCH

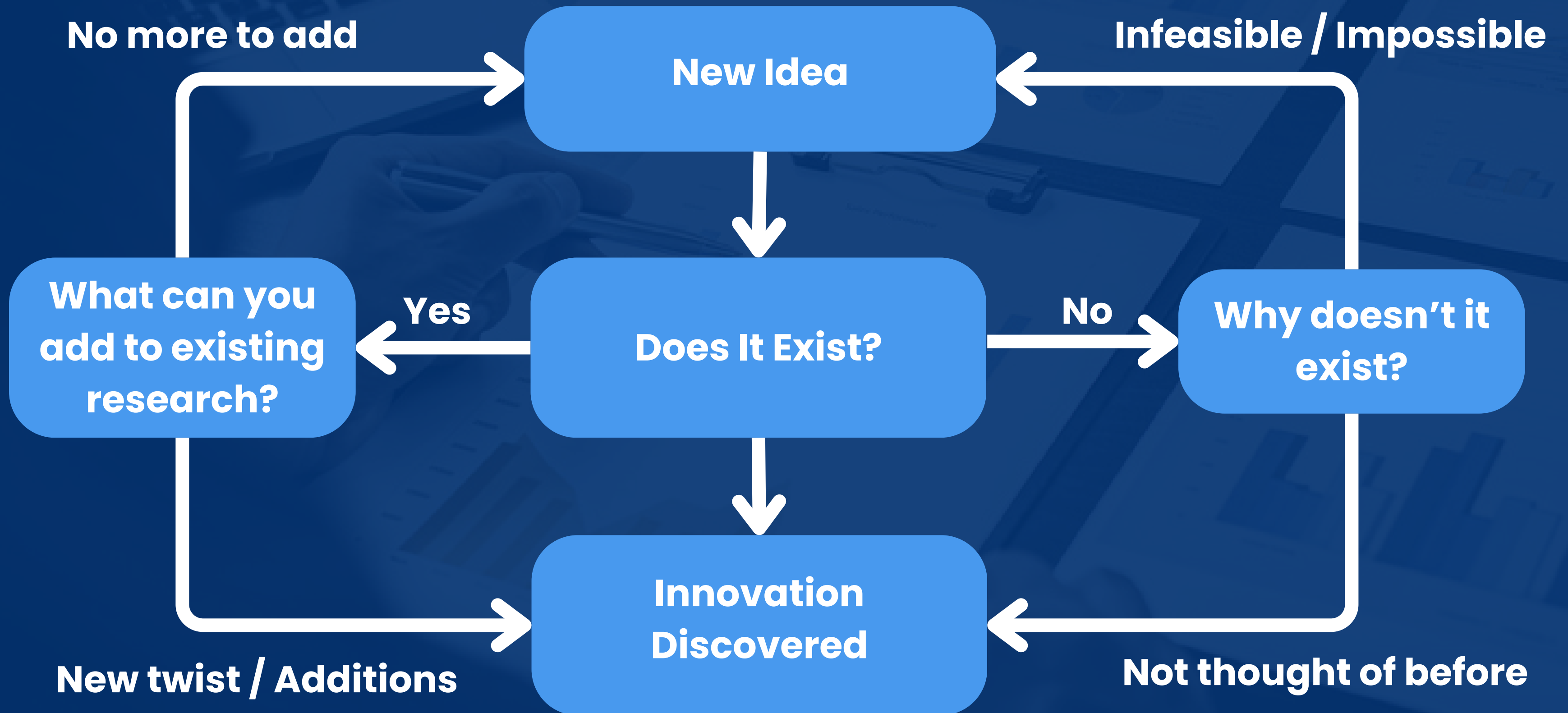
Abstract

Three-dimensional (3D)-printing, also known as additive manufacturing, has revolutionized various industries, including biomedical devices, by enabling the production of personalized implants tailored to individual patient anatomical variations. This review article provides an overview of the applications of 3D-Printed Medical Implants. By leveraging advanced imaging modalities and digital modeling software, clinicians can design and fabricate implants that ensure optimal fit, function, and biocompatibility for each patient. Additionally, 3D-printing has transformed cancer treatment as well as neurodegenerative disorders by facilitating the fabrication of patient-specific medical implants and devices used in surgical oncology, radiation therapy, and reconstructive surgery. These customized implants enhance treatment efficacy while minimizing adverse effects by precisely targeting cancerous tissues. Moreover, 3D-printing technology enables the development of 3D cell cultures, bridging the gap between traditional 2D cell cultures and in vivo models. This advancement enhances researchers' capabilities for studying cancer progression and evaluating responses to therapeutic interventions. Furthermore, 3D bioprinting shows promise as a therapeutic approach for neurological diseases, with preclinical studies demonstrating the efficacy of 3D-printed neural tissue scaffolds and implantable drug delivery platforms. Overall, 3D-printing holds significant potential in personalized medicine, offering innovative solutions to improve patient outcomes across various medical disciplines.

Here, we can see that that
3D Printed Implants show
promise for treating
neurological diseases

This is our indicator to
possibly do some further
research and look at other
articles cited in our review
article

IDEA GENERATION CYCLE



WHERE NEXT?

- Science fair projects (and research as a whole) falls into two general categories”
 - **Experimental**
 - Answers a question
 - **Engineering**
 - Develops a solution to a problem



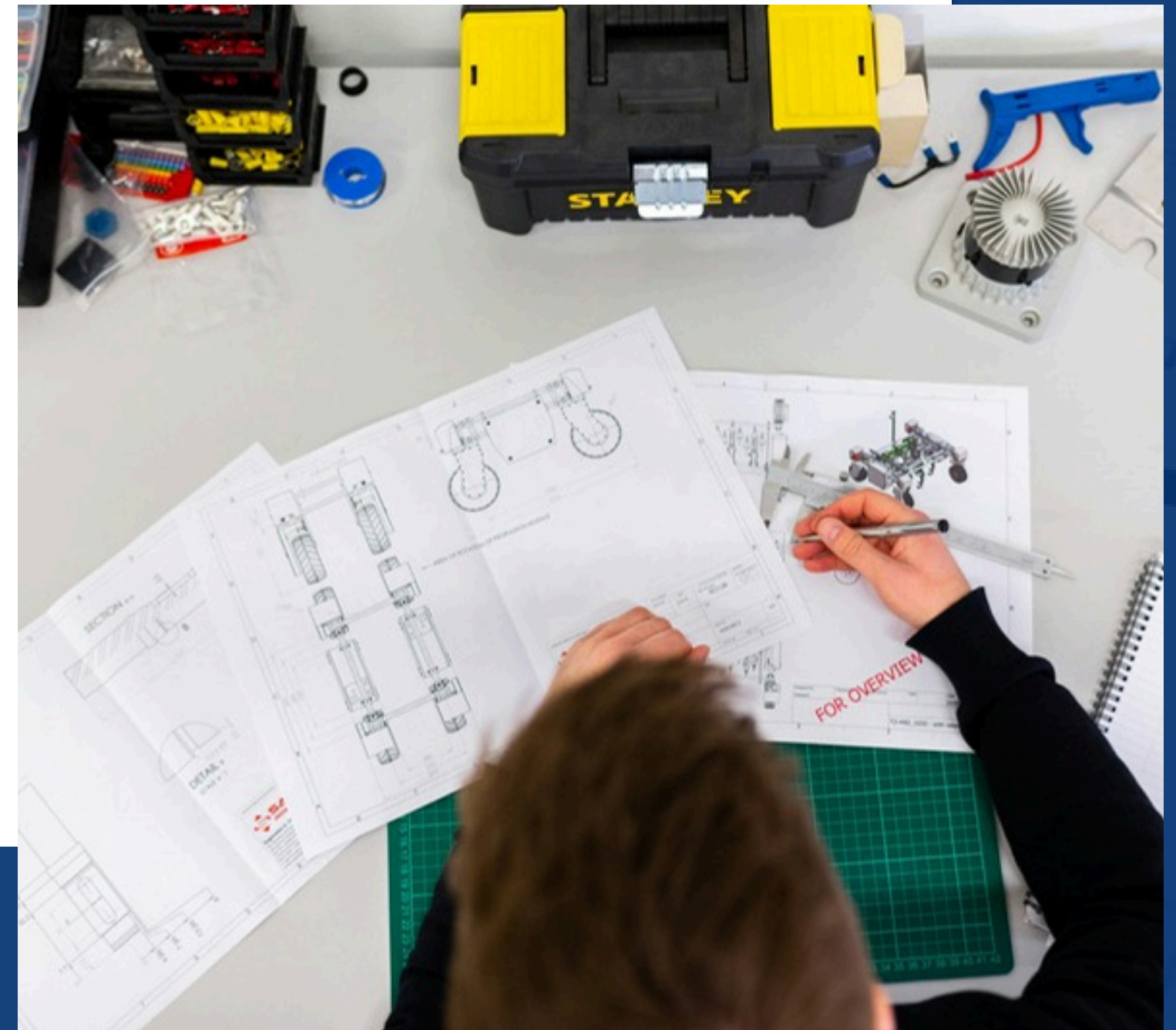
HYPOTHESIS

- **Experimental projects**
- Think about what question you will be testing/trying to answer
- **Predict what you think will happen and WHY**
- If (a change is applied), then (an outcome occurs), **BECAUSE** (why that outcome happened)



ENGINEERING GOAL

- Engineering projects
- Should include a **measurable** goal or statistic that can be used to assess the performance of a design compared to current solutions.
- **What are you trying to accomplish/improve?**



EXAMPLES

“To create a material composed of recycled byproducts that is 30% cheaper than existing construction materials.”

“If the lake is by the city, then the water will be more acidic, because there is more pollution.”

Which is the **hypothesis?** The **engineering goal?**



ACTIVITY

EXAMPLES

If classical music is played, then the dogs will exhibit calmer behavior.

How can we rewrite this to be a more effective hypothesis?

SOLUTION

If classical music is played, then the dogs will exhibit calmer behavior, because of its slower pace and consistent rhythm.

The hypothesis was lacking the “because”. Refer back to the “If (some change is applied), then (outcome), because (reason for outcome).”

EXAMPLES

To use machine learning to diagnose lung cancer.

How can we rewrite this to be a more effective engineering goal?

SOLUTION

To use machine learning to **improve** diagnosis of lung cancer by **40%**.

The engineering goal lacked a measurable goal or statistic. In this case, it was lacking a 40% improvement statistic.

FINAL TIPS

- Finding an idea can be a long process
 - Be patient
- Stay updated on literature in your project's field
- Ideas are subject to change at any point before starting experimentation (and sometimes during!)
 - Possible issues: limited materials, new research published, timeframe limitations etc.
- Be adaptable! **Science is not linear**

ONLINE RESOURCES

- sciencebuddies.org
 - Helpful if you need inspiration of projects to do
 - **Don't take the projects, just see the scientific method and what projects look like**
- ISEF projectboard.world
 - Perfect for seeing how people do **background research** and execute
 - Look at the quad chart
 - Watch the video if you would like a verbal explanation

Current problem & Real world application

Engineering Problems & Objective

General Problem

- 40 billion metric tons of CO2 emitted globally in 2023, with nearly 25% of emissions coming from **gas-powered vehicles**
- While the industry focuses on superseding gas vehicles with electric or hydrogen power, it still holds that **84%** of all cars will be existing **gas-powered cars** (Figure 1)

Existing Solutions

- Optimizations in car aerodynamics can reduce fuel consumption (Figure 2); however, most drag reduction is focused on the car body, **excluding reduction opportunities in existing gas cars** unless reworked
- By covering the wheel, additional drag from air entering the rims can be minimized but also **hinders the cooling of overheated brakes** and must be compensated by **small openings**, as seen in Tesla's aero wheel (Figure 3)

Objective

- Develop wheel enclosure system maximizing wheel drag reduction without compromising brake cooling
- Create an after-market solution for all existing gas vehicles

Figure 1. A visual representation of the 84% ratio of electric cars (green) to gas cars (grey) by 2035 (goal year for companies to discontinue gas vehicles), provided by: <https://www.nytimes.com/interactive/2021/03/10/climate/electric-vehicle-fleet-turnover.html>

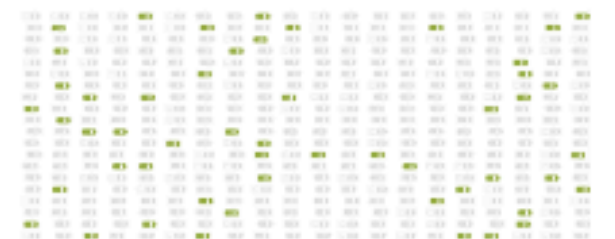


Figure 2. CFD analysis comparison a Tesla Cybertruck to a Ford F-150, provided by: <https://thenextweb.com/news/heres-how-the-cybertrucks-aerodynamics-compare-to-regular-trucks>

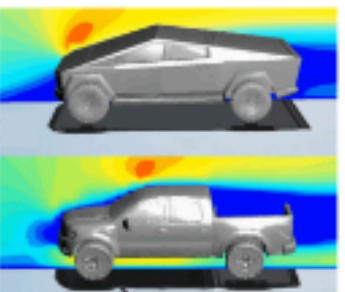



Figure 3. Model of Tesla Aero Wheel provided by: <https://www.xautoworld.com/tesla/model-3-wheels-patent/>



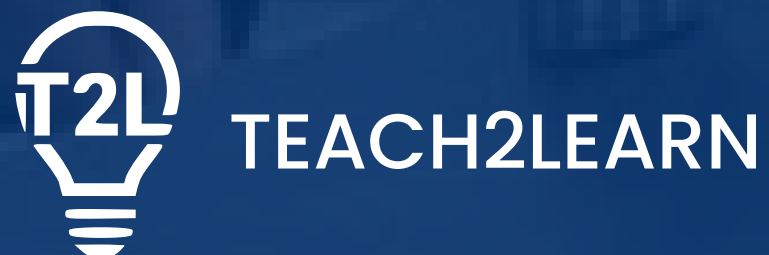
Background research of current innovations

Engineering goal

Q&A

Website:
weteach2learn.com

Instagram:
[@officialteach2learn](https://www.instagram.com/officialteach2learn)





Thank you for Listening!