TEACH2LEARN

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

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.”

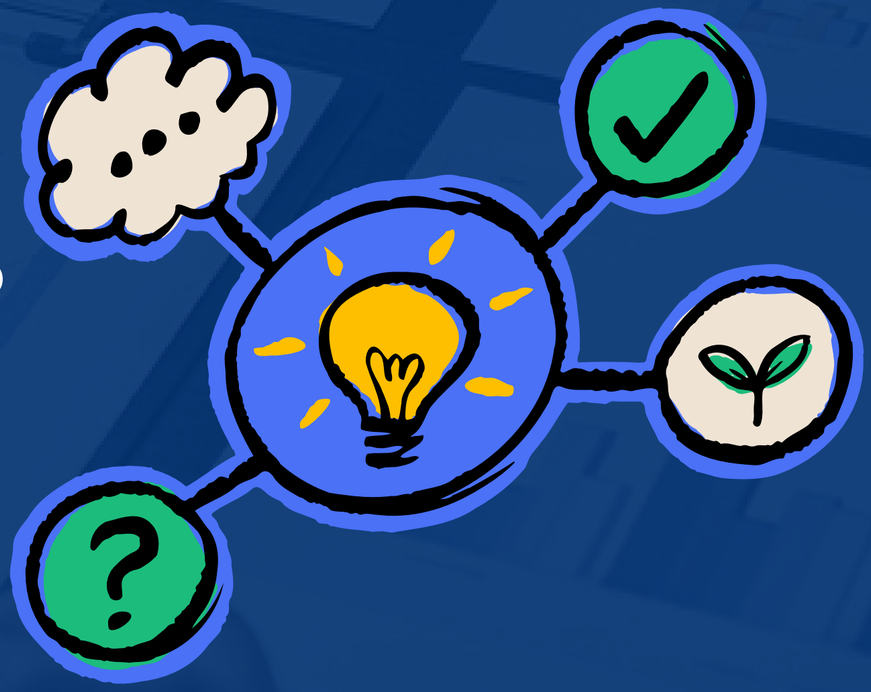
Does this...

- 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

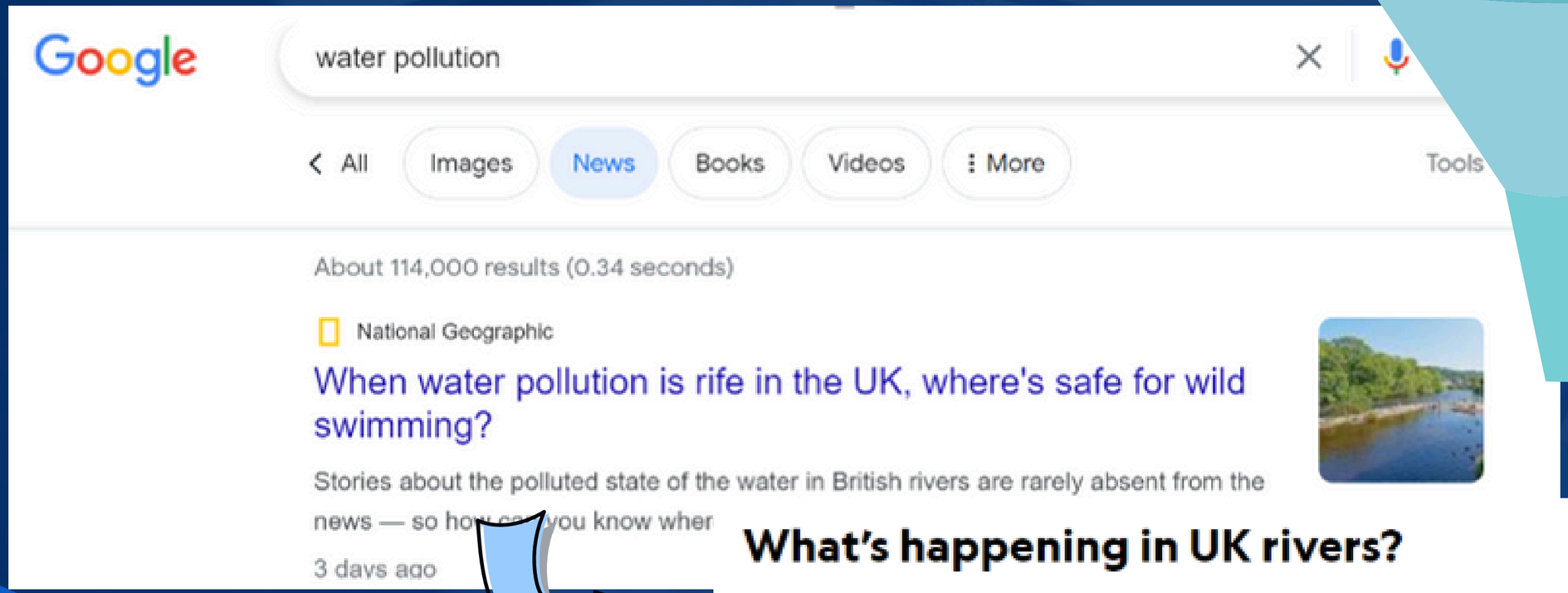
Narrow into smaller subtopics and go down a rabbit hole
(Wikipedia pages, journal articles, etc.)

Write down any ideas, questions and useful links

THE FUNNEL METHOD

Example Search

“I’m interested in water pollution!”



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

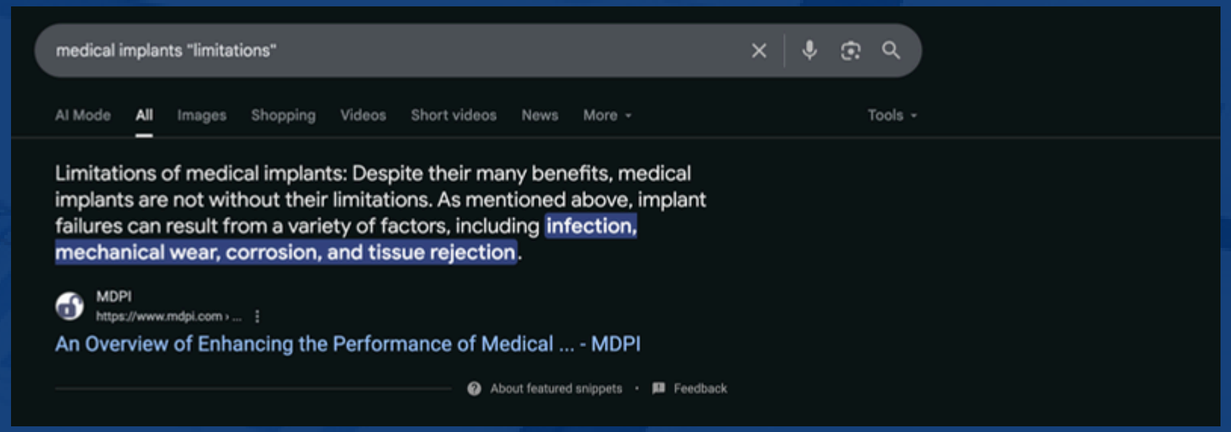
Use credible sources (.edu, .org, .gov etc.) NOT WIKIPEDIA

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

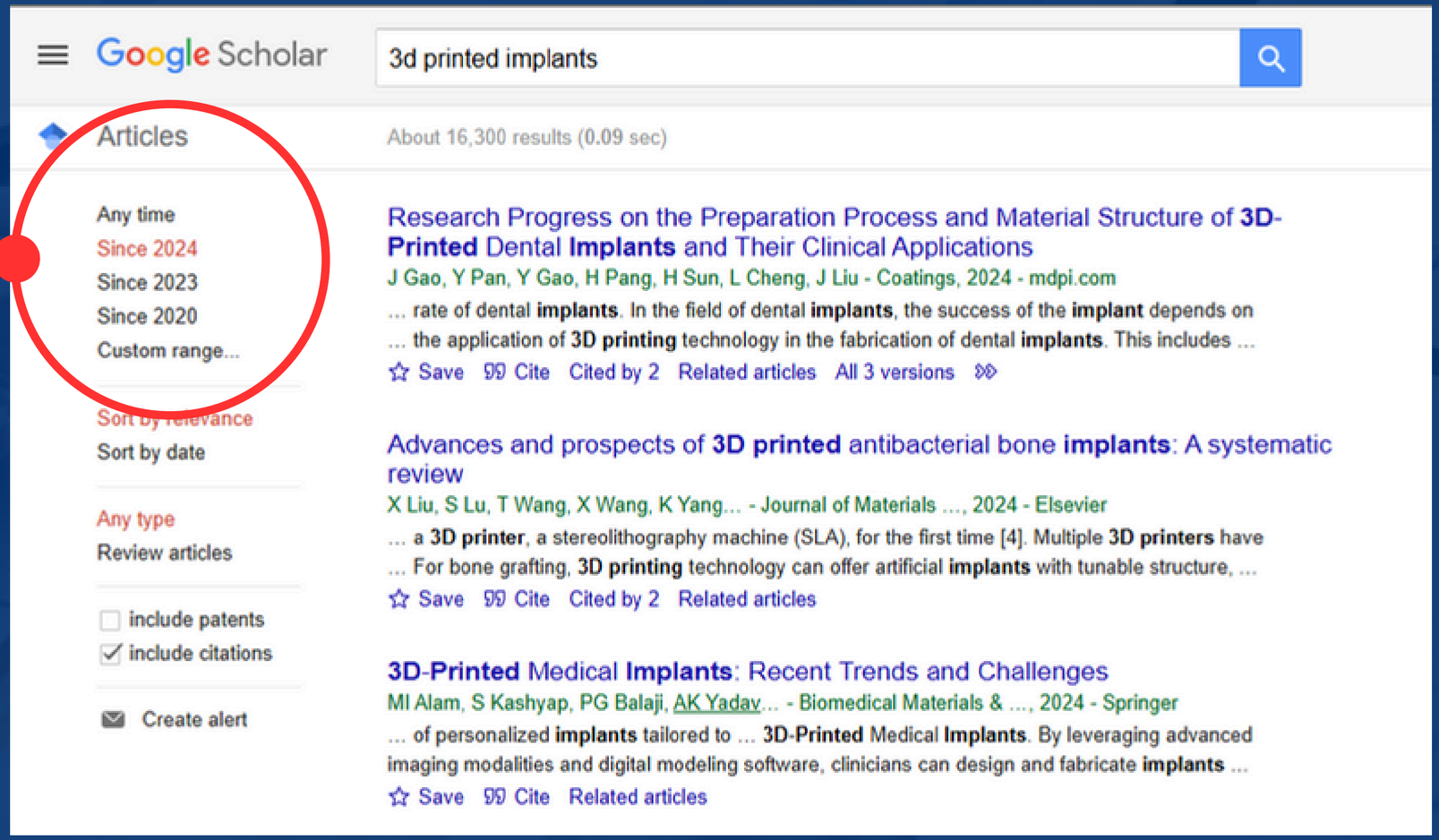
- Get a better understanding of the field and what has been done
  - Ex. I want to do a project about medical implants
  - **Key Google searches**
    - “Medical implants limitations”
    - “Medical implants innovations”
- This helps the general direction of research



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

BACKGROUND RESEARCH

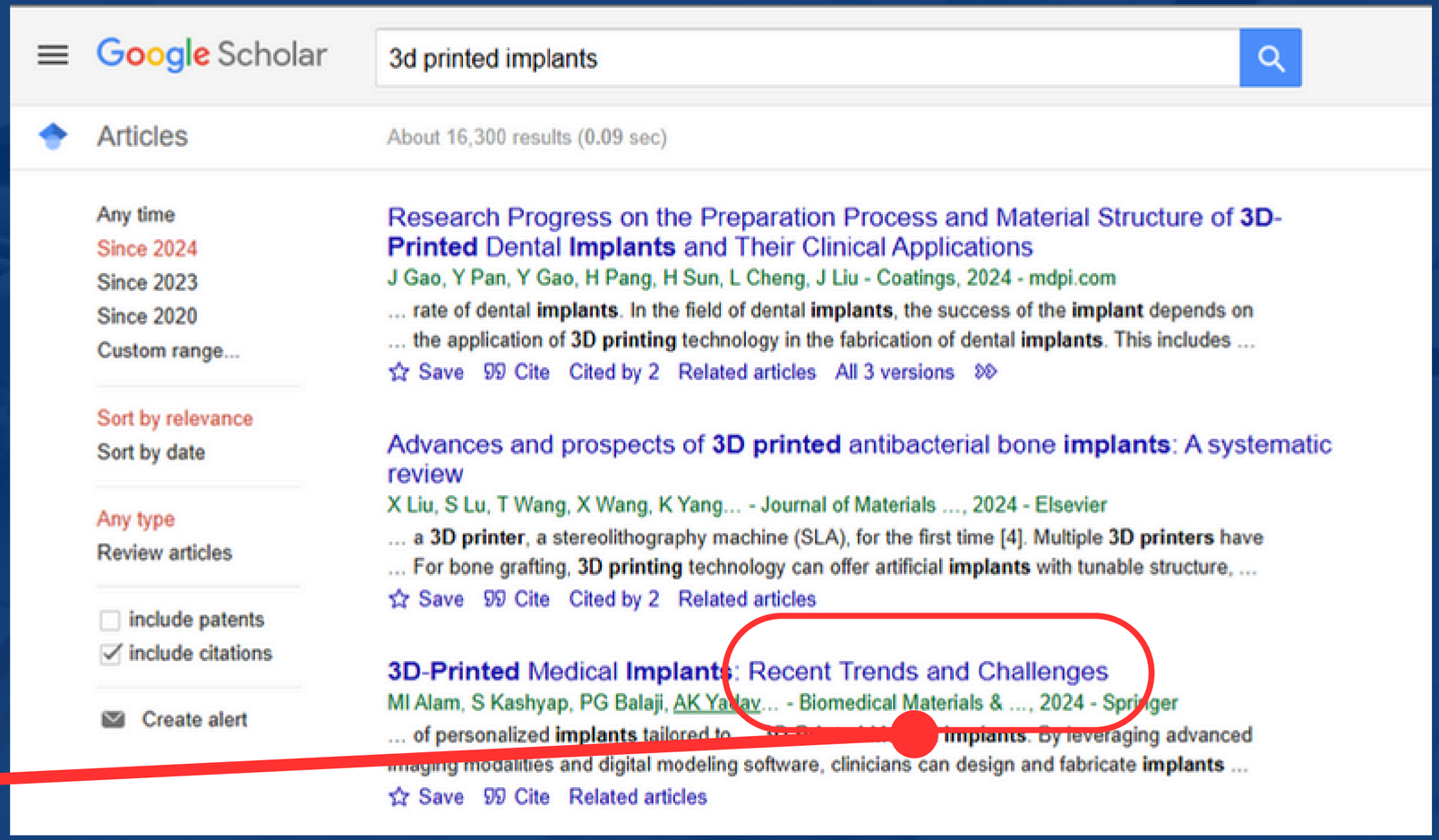
By using Google Scholar, we are able to filter academic papers into the most recent findings and by review article



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



BACKGROUND RESEARCH

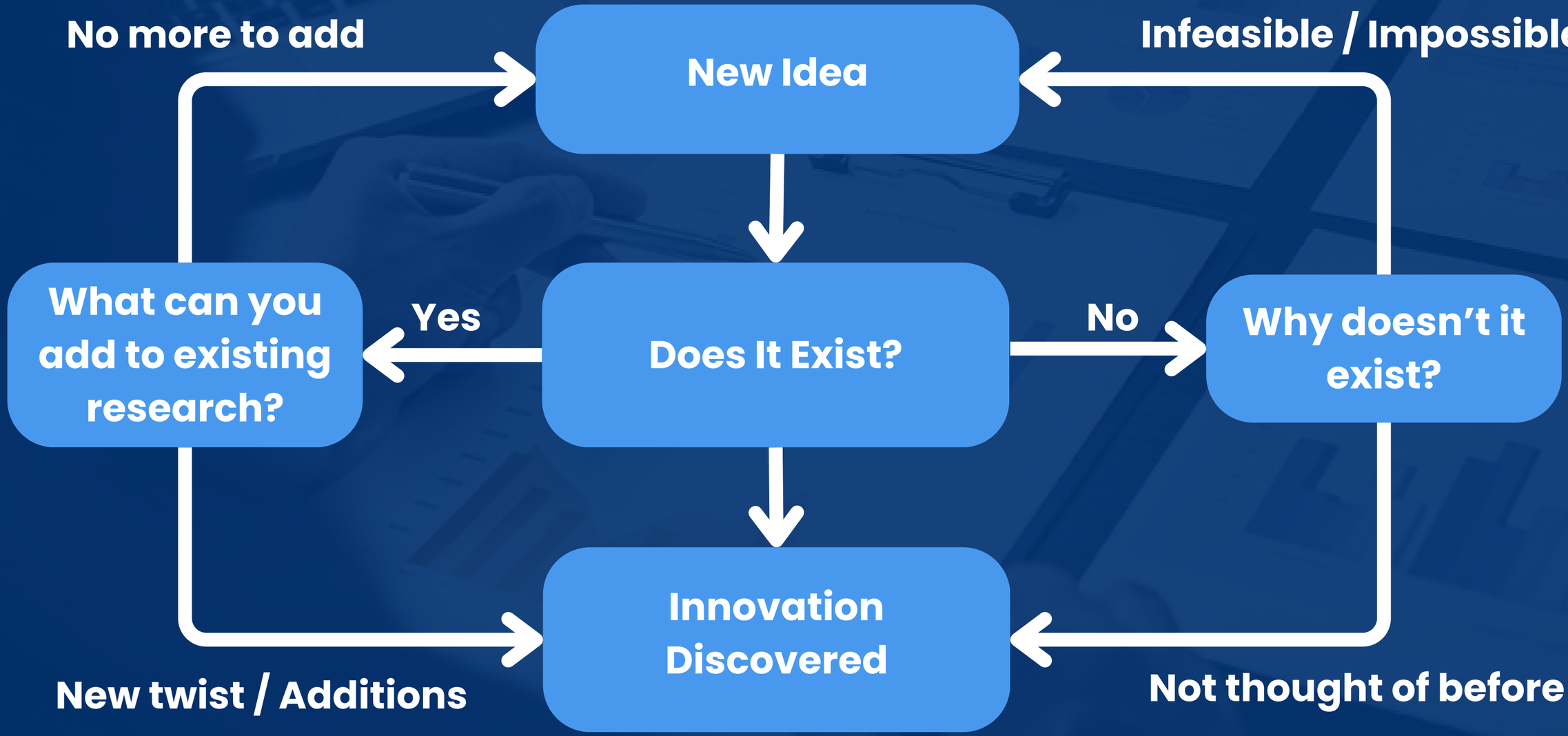
Abstract

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?

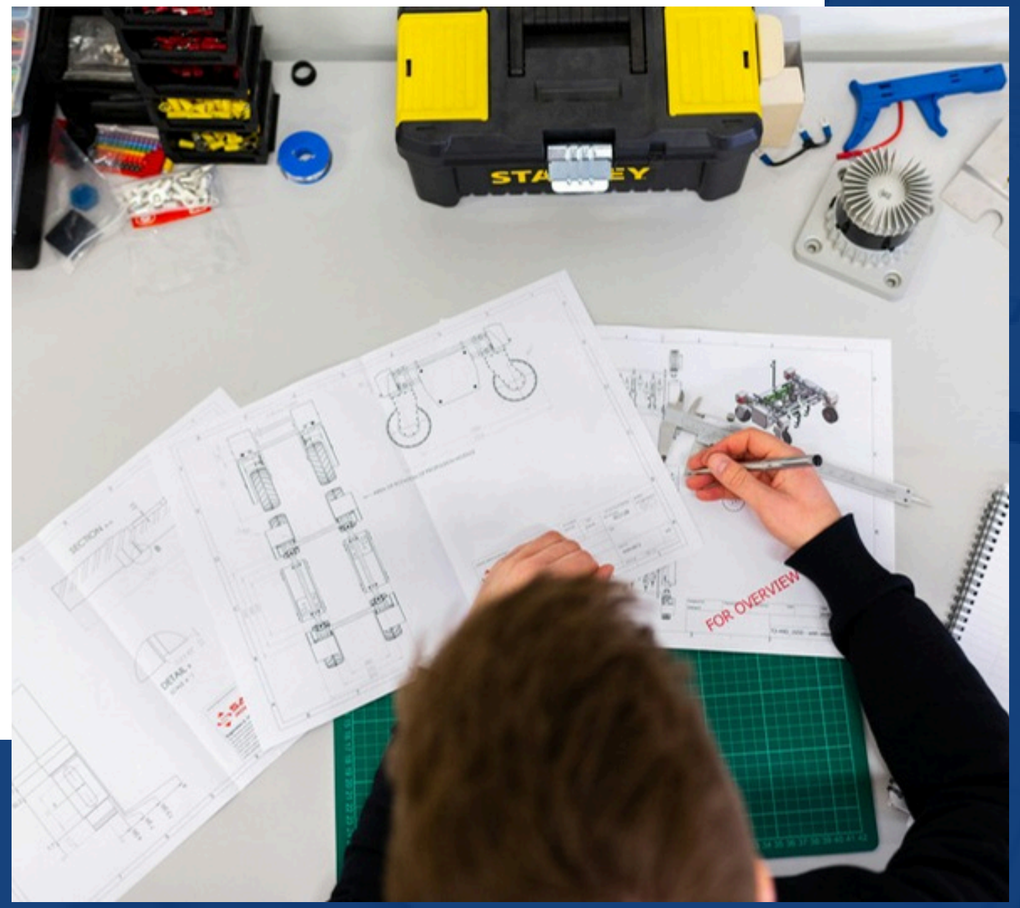
- Science fair projects (and research as a whole) falls into two general catgeories”
  - **Experimental**
    - Answers a question
  - **Engineering**
    - Develops a solution to a problem

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%.

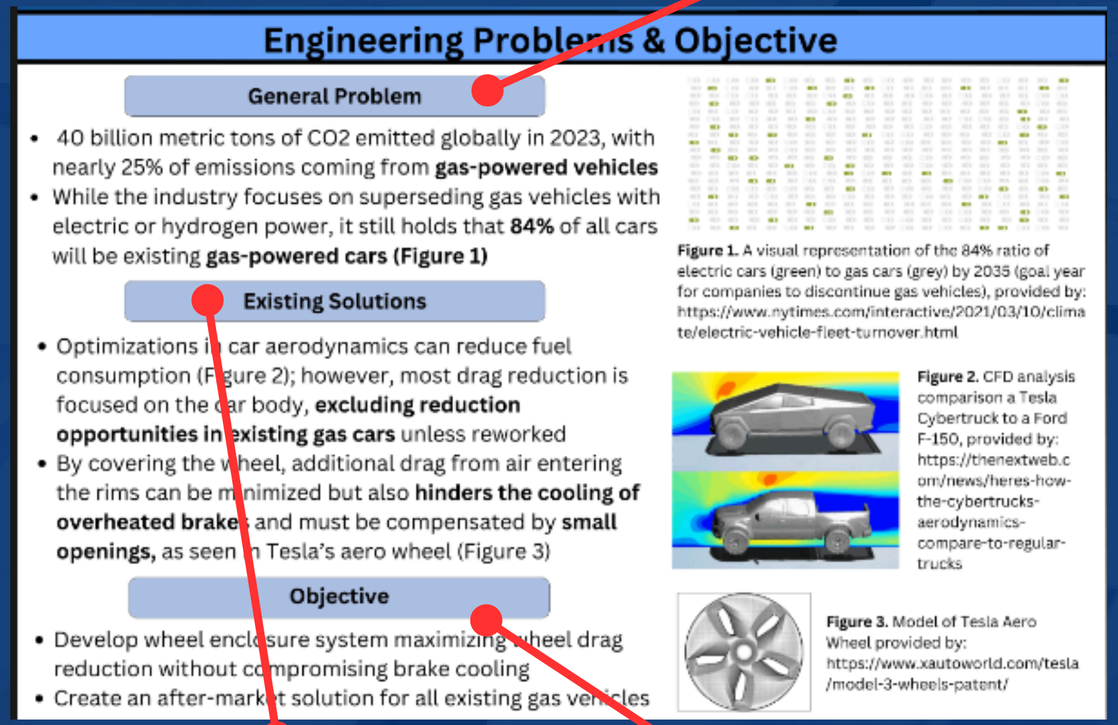
The engineering goal lacked a measurable goal or statistic. In this case, it was lacking a 40% improvement statistic.

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



Q&A

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Thank you for Listening!