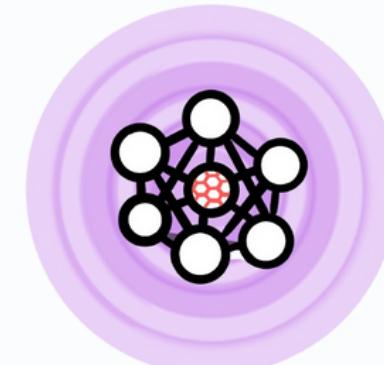
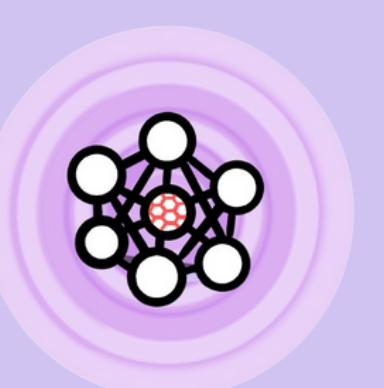


# Nano-Sugars: Nanotechnology Benefitting Diabetes Patients

*PREPARED BY JUNA GREGERSEN & AMY CHAN*



# problem

In the United States alone, there are around **1.7 million adults aged 20 years or older—or 5.7% of all U.S. adults** have been diagnosed with type 1 diabetes.

This is a serious health issue because it can cause...

- Heart and blood vessel disease
- Nerve damage (neuropathy)
- Kidney damage (nephropathy)
- Pregnancy complications
- And so much more...

# How Type 1 and Type 2 Diabetes Differ

## Type 1 Diabetes

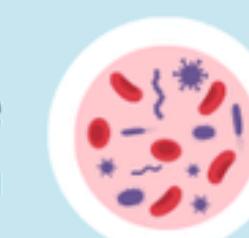
VS

## Type 2 Diabetes

Body Doesn't Make  
Enough Insulin



Caused by Immune  
System Reaction



Often Starts in  
Childhood



Symptoms Come  
on Quickly



Treated With  
Insulin Injections



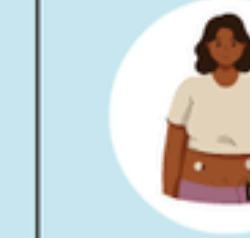
Body Doesn't  
Respond to Insulin



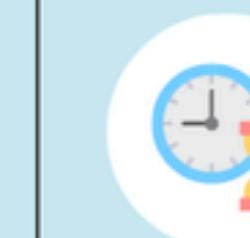
Lifestyle Factors and  
Genetics Contribute



More Common  
in Middle Age



Symptoms  
Develop Slowly



Managed With Drugs  
and Lifestyle Changes



# what is type 1 diabetes?



- Aka juvenile diabetes or insulin-dependent diabetes
- The **pancreas makes little or no insulin**. Insulin is a hormone the body uses to allow sugar (**glucose**) to enter cells to produce energy
- **Genetics and some viruses** = cause of Type 1 diabetes
- Has no cure
- **ONLY TREATMENT IS INSULIN**

## Diabetes Medical Facts

---



1 Out of Every 3 Dollars  
in HealthCare is Spent  
on Complications of  
Diabetes.

Type 1 Diabetes is the Only  
Disease Which Requires  
Medication to Be Taken  
24-Hours a Day That Has The  
Potential Kill You.



43% of Hospital  
Costs are Associated  
with Diabetes.

Diabetes is a Major  
Cause of Blindness,  
Kidney Failure,  
Heart Attacks, Stroke  
and Lower Limb  
Amputations.

E 01

# target market

## **Californians (Later)**

- Around **10% of the population** has Type 1 diabetes (>400,000 individuals)

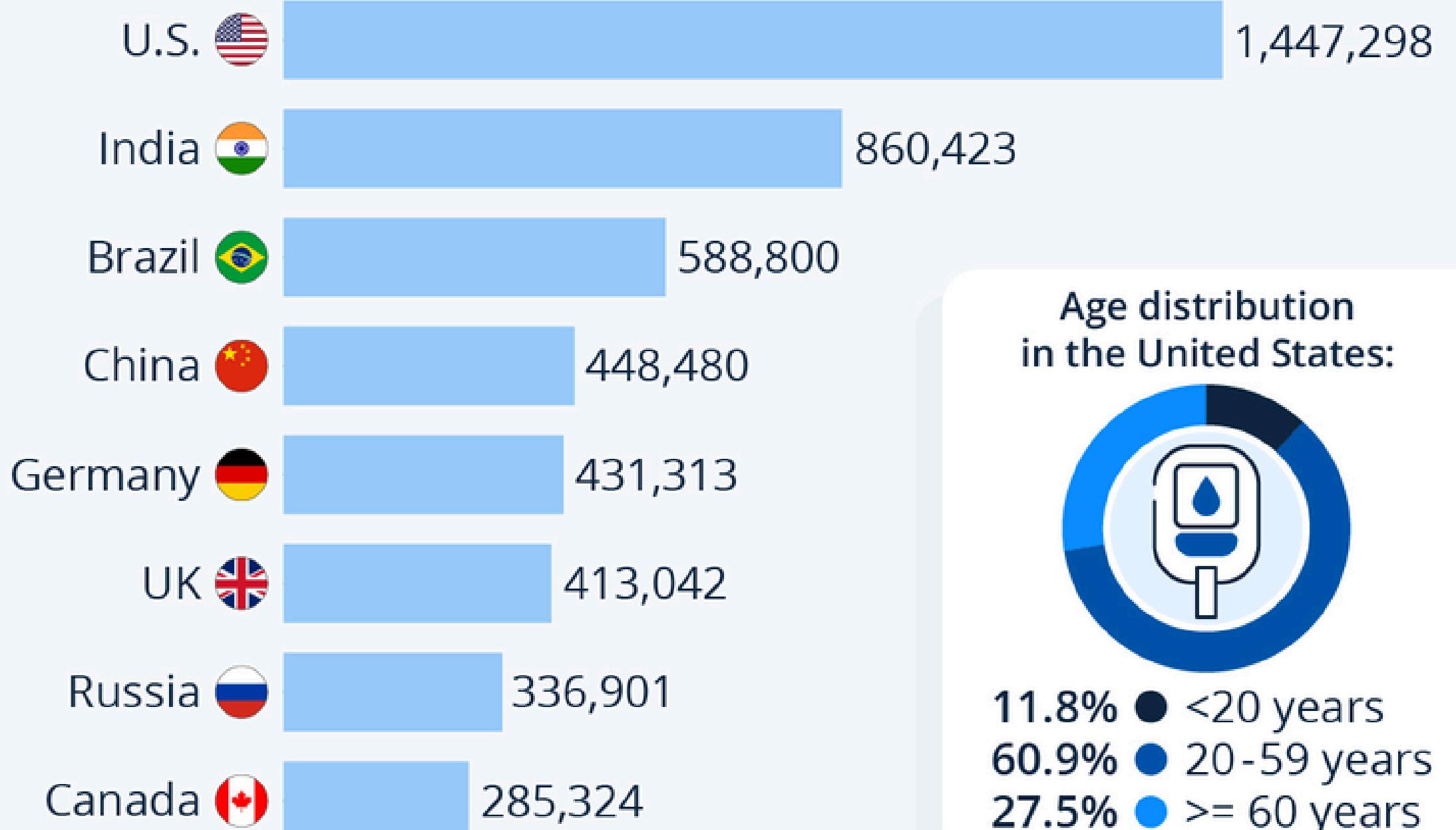
## **San Jose/Los Angeles**

Total population is 4,869,980

We want to be able to reach out to our communities and help out. We know type 1 diabetes can be hard to deal with and prices of insulin can be high, but we want to be able to find an affordable and effective solution.

# Who Has Type 1 Diabetes?

Estimated number of people with type 1 diabetes,  
by country



Age distribution  
in the United States:

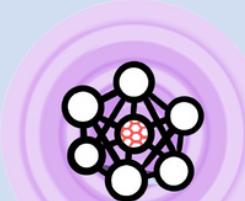


11.8% ● <20 years  
60.9% ● 20-59 years  
27.5% ● >= 60 years

Source: International Diabetes Federation



# size of the diabetes I market



**\$15.95 Billion**

Global Market

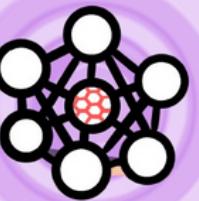
**\$24.36 Billion**

Projected Growth  
(2031)

Highly Competitive  
(15 Leading Companies)

**Novartis, Biocon Ltd**

# size of the nanotech nology market



Humans are interested  
in nanotechnology!

**\$193.6 billion**

Global Market

Highly  
Competitive  
(26 Leading  
Companies)

**\$445.2  
billion**

Pfizer inc.

# RESEARCH AND SOLUTION PROPOSITION

## innovation

We want to create a nanotechnology that permanently replaces damaged beta cells to convert glucose to insulin for diabetes type I patients!

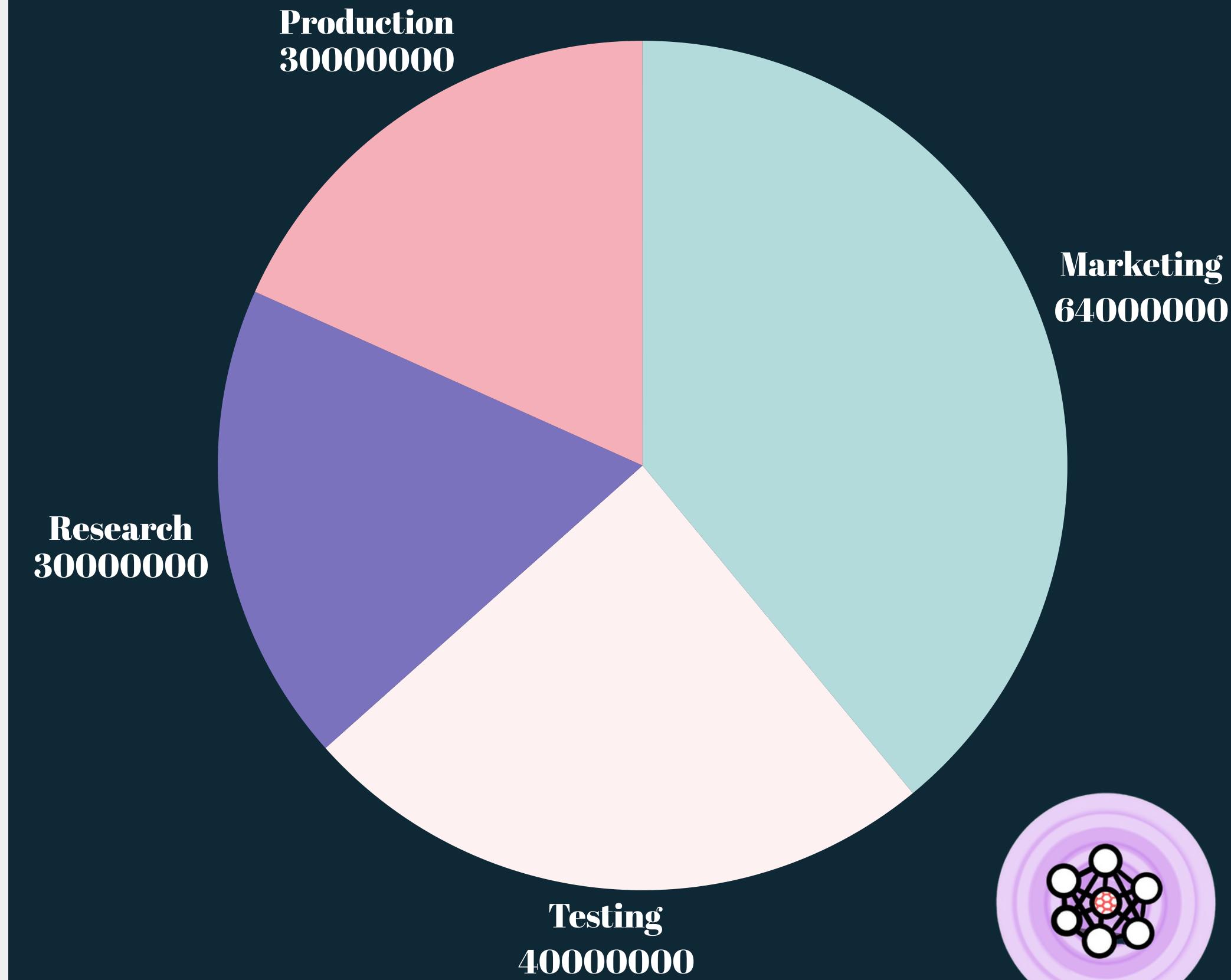
**Unique** because we are looking into nanotechnology separate from dendrimers and gold nanoparticles that more slowly decompose. Also, it's fairly new since mainly prestigious universities and the National Library of Medicine have information on it, calling it a "future advance."



Total amount: \$164,000,000

our  
projected  
materials  
(\$)

● Marketing   ● Testing   ● Research  
● Production



United States Market Annual Gross Revenue

**\$800,000,000**

**our  
projected  
revenue**



**selling cost per product  
(each effective for 6 months)**

**\$2,000**

**total revenue (-  
material cost)**

**\$636,000,000**

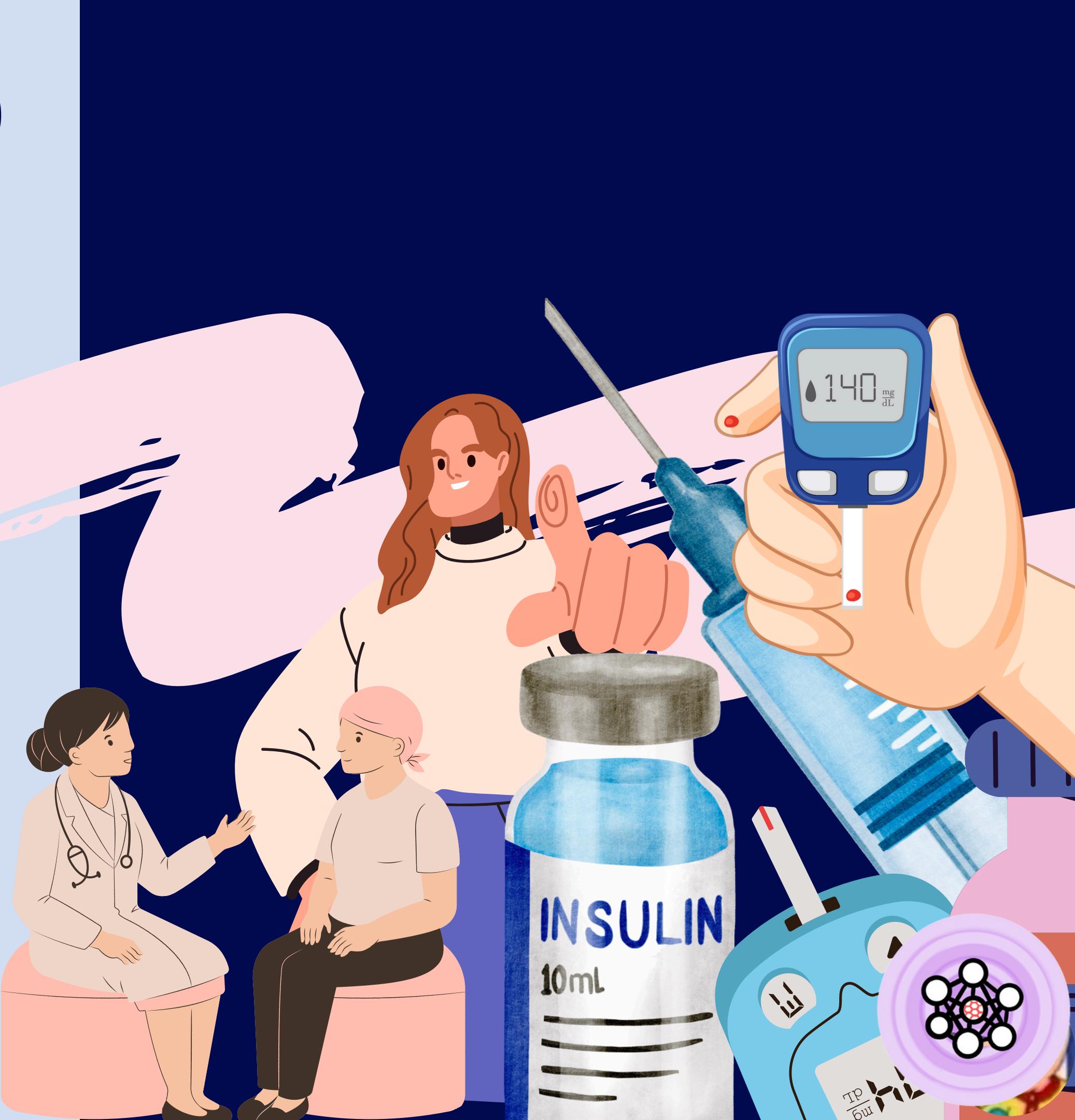
# RESEARCH AND SOLUTION PROPOSITION

## creativity

While there is developing nanotechnology for diabetes type I, they are **not completely effective** depending on the patient and nanomaterial. Therefore, our proposal is a permanent solution to type I diabetes and more cost-effective long-term without the frequent need to replace insulin. Our competitors are medications, insulin pumps, and syringes, which are more expensive overall and painful.

Competitive advantages:

- Patient cost
- New and permanent
- Lowers risks for other diseases



# monthly



**Without insurance**  
A vial of insulin  
can cost around **\$250**

Someone with T1D may  
use between two and  
four vials **every month.**

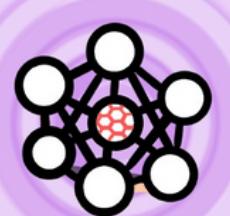
That means they  
could be paying  
**\$500 to \$1,000**  
for a medication that is  
critical to their survival.



**TYP**



III



## What is nanotechnology?

- It incorporates STEM, especially engineering, to change **molecular structures**, like optics (light reflection) and mechanics, in nanometer measurements.
- These measurements are smaller than a human hair (80,000 nanometers).

### Interest Points:

- **Dendrimers** are shaped like cages with three areas that can send medication to human cells and evaluate whether the transportation was successful.
  - Successful with cerebral palsy treatment



# nanotechnology: dendrimers

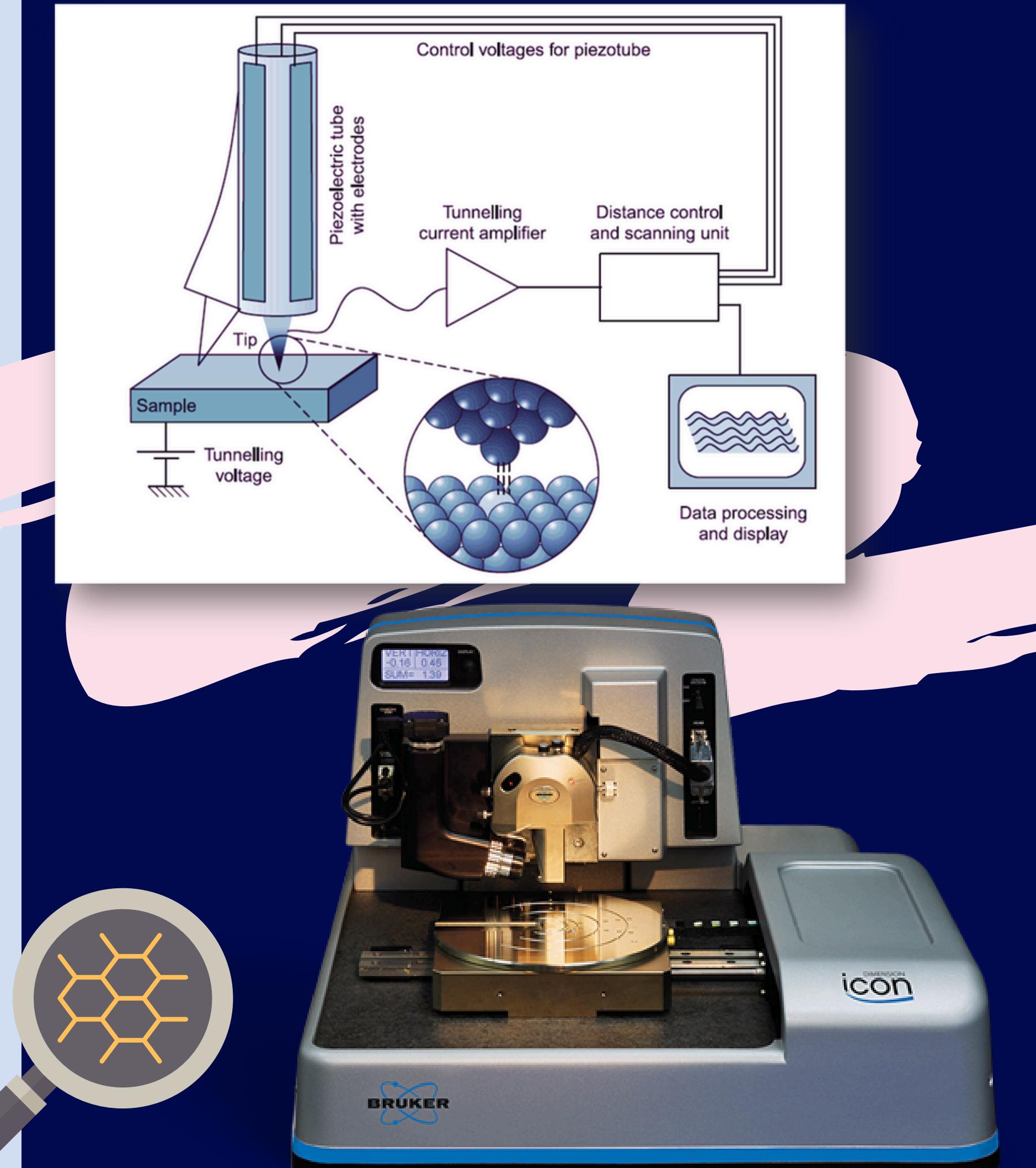


# Equipment

- **Scanning Tunneling Microscope:** has a thin stick that travels vertically to maintain their electrical connection
- **Atomic Force Microscope:** has a thin stick that adjusts to nanoparticle forces
- Can transport nanoparticles

What are its benefits?

- We are in the position to start utilizing nanotechnology realistically.
  - Scientists have applied quantum dots to solar photovoltaic cells and other nanomaterials to exhaust.
  - **Gold nanoparticles** stop cholesterol deaths by interacting with lymphoma (blood cancer) cells.



- It can benefit objects' surface areas, strengthening the object.
- Hemoglobin consists of nanomaterials, expanding the bounds of nanotechnology

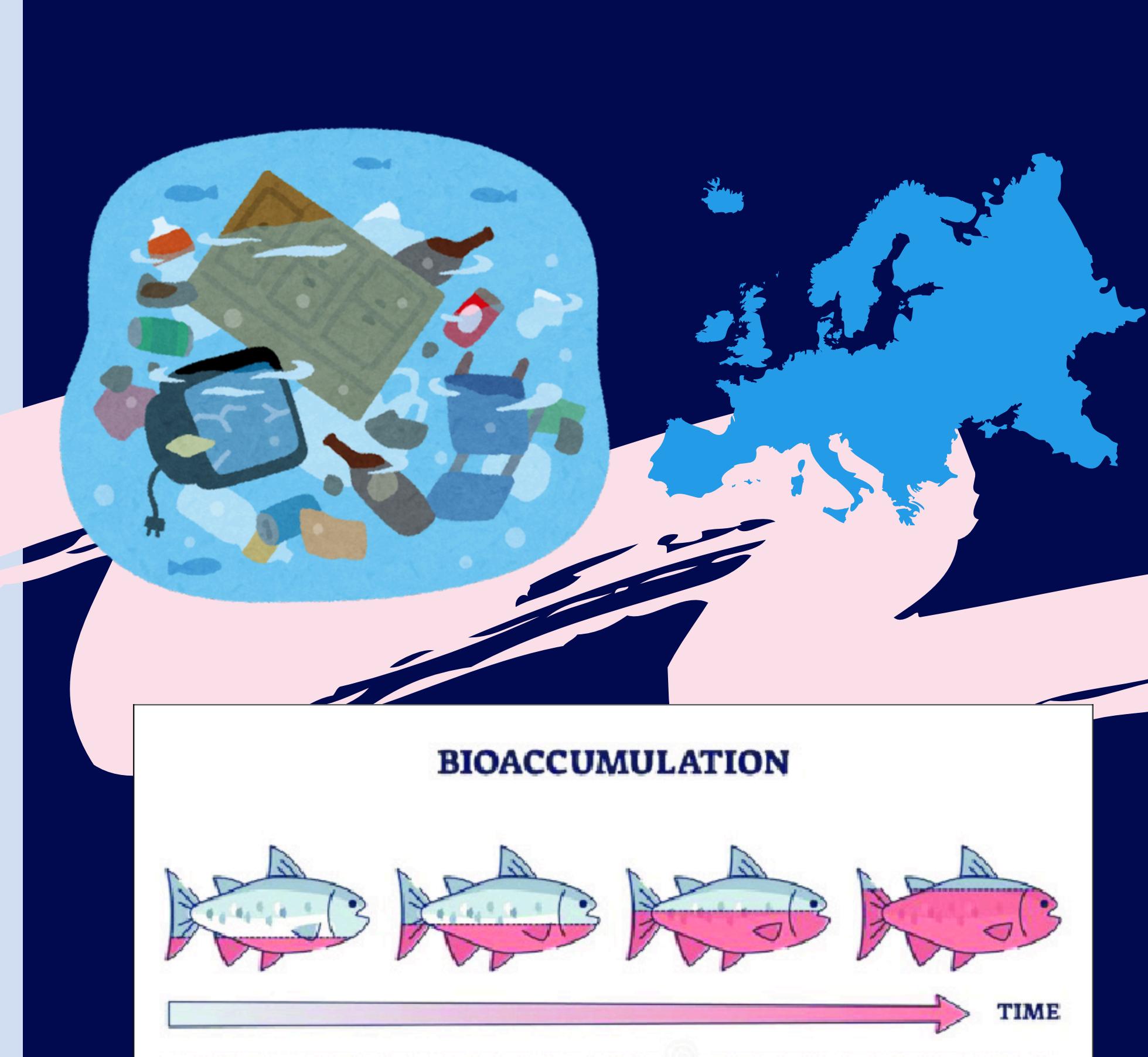
What are its problems, and how can we address them?

- **Health risks**, such as pollution and inadequate inflammatory responses
  - A nanoparticle, **Fullerenes**, can pause inflammatory issues
    - Innovation: Our project can be a stepping stone that funds researchers in exploring these nanoparticle types and solves these health risks



- Scientists have already created nanomaterials that cause nanopollution but are addressing this bioaccumulation and water pollution WITH nanotechnology

**“The applications of nanotechnology can be very beneficial and have the potential to make a significant impact on society” - entire Europe Commission**



# practicality

- **Effective** way to inject insulin into the body **quickly and efficiently**
- Can be **cheap** with time as nanotechnology becomes **imbedded more into society**
- “Control over various organizational aspects of R&D and their adjustment in the direction of challenging the commercial and competitive grounds for scientific innovation emerges as another route through which **nanomedicine could heal the social inequality divide**”  
(Uskoković, Vuk).



# roadmap

August  
2034

product  
release/  
marketing

August  
2035

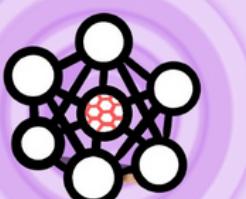
type I nano  
research



type II  
nano  
human  
studies

Decem  
ber  
2034

>100,000  
Sales



# WORKS CITED

- <https://www.mayoclinic.org/diseases-conditions/type-1-diabetes/symptoms-causes/syc-20353011>
  - <https://newsroom.heart.org/file/diabetes-2024-statistics-infographic?action=#:~:text=Type%201%20diabetes%20is%20a%20chronic%20disease%20that%20occurs%20when%20the%20body%20fails%20to%20produce%20enough%20insulin%20or%20cannot%20use%20it%20properly.>
  - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8120867/>
  - <https://www.bccresearch.com/market-research/healthcare/nanotechnology-medical-applications-market.html>
  - <https://www.coherentmarketinsights.com/industry-reports/type-1-diabetes-market#>
  - [https://ec.europa.eu/health/scientific\\_committees/opinions\\_layman/en/nanotechnologies/1-2/1-introduction.htm#:~:text=Nanotechnology%20is%20the%20science%20of%20engineering%20at%20the%20nanoscale%20and%20its%20application%20in%20various%20fields%20such%20as%20medicine%2C%20electronics%2C%20and%20environmental%20protection.%20It%20involves%20the%20creation%20of%20tiny%20structures%20with%20unique%20properties%20that%20can%20be%20used%20to%20improve%20existing%20products%20or%20create%20new%20ones.](https://ec.europa.eu/health/scientific_committees/opinions_layman/en/nanotechnologies/1-2/1-introduction.htm#:~:text=Nanotechnology%20is%20the%20science%20of%20engineering%20at%20the%20nanoscale%20and%20its%20application%20in%20various%20fields%20such%20as%20medicine%2C%20electronics%2C%20and%20environmental%20protection.%20It%20involves%20the%20creation%20of%20tiny%20structures%20with%20unique%20properties%20that%20can%20be%20used%20to%20improve%20existing%20products%20or%20create%20new%20ones.)
  - <https://education.nationalgeographic.org/resource/nanotechnology/>
  - <https://news.mit.edu/2013/nanotechnology-could-help-fight-diabetes-0516>  
<https://pubs.acs.org/doi/10.1021/acsphtsci.3c00218>
  - <https://www.fda.gov/news-events/press-announcements/fda-approves-first-cellular-therapy-treat-patients-type-1-diabetes>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8120867/>

thank you  
for  
listening

## our team

AMY

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JUNA

@juna\_346



# supporting specific research

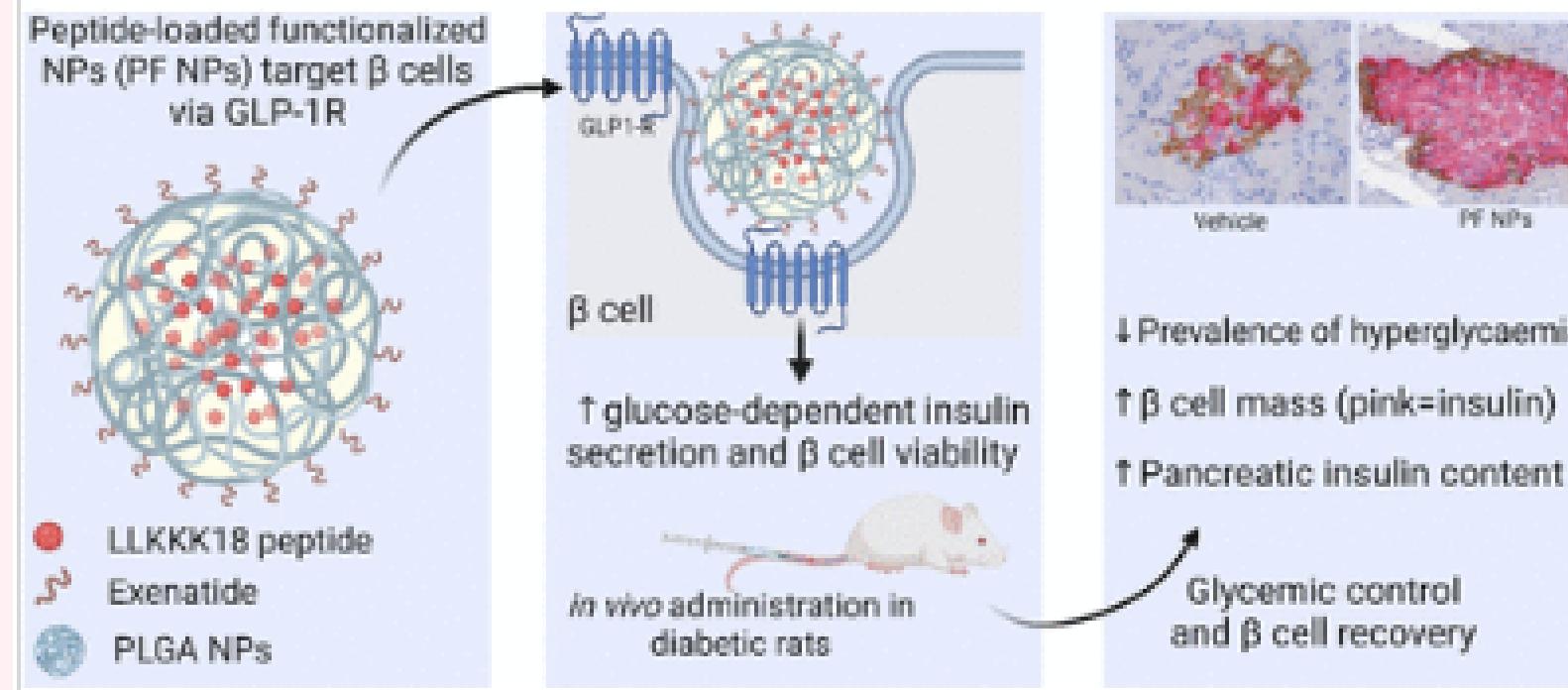


## 2013 NANOTECHNOLOGY COULD HELP FIGHT DIABETES - MIT NEWS

- Checks blood glucose concentrations, releases insulin like pancreatic islet cells
- "With this system of extended release, the amount of drug secreted is proportional to the needs of the body" - Daniel Anderson
- Options:
  - Hydrogels, though they may not respond in respect to the blood levels and release insulin correctly
  - MIT's gel-similar nanotechnology with polar interactions to maintain its form
    - Dextran polysaccharide makes glucose gluconic acid as the glucose distributes in the gel
    - The acid makes these dextran insulin: glucose → glycogen
    - **One insertion lasts 10 days**
    - Remaining Issues:
      - They decompose and don't release insulin as fast as they can, meaning MIT must adjust these dosages.

# 2023 TARGETING B CELLS WITH CATHELICIDIN NANOMEDICINES IMPROVES INSULIN FUNCTION AND PANCREAS REGENERATION IN TYPE 1 DIABETIC RATS

A targeted delivery system to improve glucoregulation and  $\beta$  cell mass recovery for diabetes treatment



Cathelicidin-based peptides are necessary to save beta cells.

LLKKK18, poly(lactic-co-glycolic-acid), and GLP-1 make up 100 nm and have maintained in vitro releases.

INS-1E can release insulin with this peptide

Results:

- less hyperglycemia, more insulin in the pancreas for rats
- therapeutic
- glucoregulatory effect

helps REPLACE beta cells