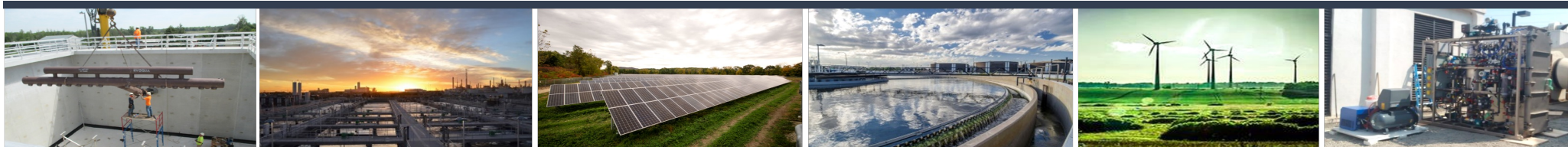


# Thank you to our Patrons

We will begin our presentation in a few minutes...



Leadership and Excellence in Environmental Engineering and Science

# Generational Perspectives on Generative Artificial Intelligence

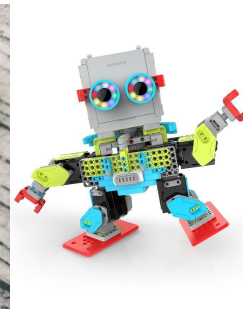
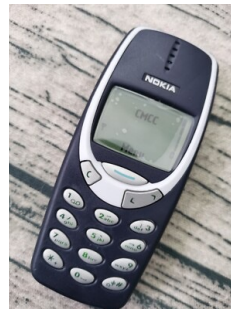
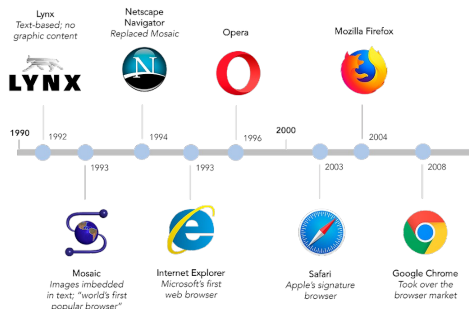
(D.B. Oerther) ^ 2



Gen X, b. 1972



Gen Z, b. 2010



# Outline

- Dan's use of models in Environmental Engineering
  - 1996, Database of molecular biotechnology information (OPD)
  - 2004, Comparing models of bacterial diversity with measures of bacterial diversity in activated sludge
  - 2013, Identifying critical links between human behavior of diarrhea disease in developing communities
  - 2022, Modeling financial risk to support human behavior change (COAST)
  - Teaching articles
- Dan's use of AI in teaching
- Barney's use of AI
- Opportunity for Q/A
- Dan's thoughts on engineering ethics and AI

# The Oligonucleotide Probe Database

ELIZABETH WHEELER ALM,<sup>1</sup> DANIEL B. OERTHER,<sup>1</sup> NIELS LARSEN,<sup>2</sup>  
DAVID A. STAHL,<sup>3</sup> AND LUTGARDE RASKIN<sup>1\*</sup>

*Environmental Engineering and Science, Department of Civil Engineering, University of Illinois,  
Urbana, Illinois 61801<sup>1</sup>; Department of Microbiology and Center for Microbial Ecology,  
Michigan State University, East Lansing, Michigan 48824<sup>2</sup>; and Department of Civil Engineering,  
Technological Institute, Northwestern University, Evanston, Illinois 60208<sup>3</sup>*

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The use of oligonucleotide hybridization probes and PCR primers has become widespread in microbial ecology and environmental microbiology (for reviews, see references 3, 5, 7, 17, and 21), and descriptions of probe applications are abundant in the literature. We have encountered, however, a number of difficulties when relying on the literature for information on probes and primers: (i) probe design, characterization, and application data are scattered throughout the literature and therefore are not easily available; (ii) probe nomenclature is not standardized, making it difficult to recognize a particular probe and evaluate results obtained with that probe; (iii) probes are often designed empirically and used without thorough experimental characterization, making it difficult to interpret experimental results; and (iv) information on the application of individual probes is often not published in detail in the original probe description since the value of some data becomes apparent only as a result of observations made subsequent to publication (e.g., hybridization buffer composition, formamide concentration, membrane supplier and lot number, target group specificity). We designed the Oligonucleotide Probe Database (OPD) to address these concerns.

1996

- Microsoft Access converted to csv datafile
- Hosted using a stand-alone server
- Web 1.0 interface
- User input delivered using CGI
- Data processed and displayed using Perl script language

# Bacterial Competition in Activated Sludge: Theoretical Analysis of Varying Solids Retention Times on Diversity

P.E. Saikaly and D.B. Oerther

Department of Civil and Environmental Engineering, University of Cincinnati, Box 210071, Cincinnati, OH 45221-0071, USA

Received: 19 February 2003 / Accepted: 19 June 2003 / Online publication: 3 May 2004

## Abstract

A mechanistic model for activated sludge sewage treatment was developed to predict exploitative competition of six aerobic heterotrophic bacterial species competing for three essential resources. The central hypothesis of the model is that in a multispecies/limiting resource system the number of coexisting bacterial species,  $N$ , exceeds the number of limiting resources,  $K$ , available for them. The explanation for this is that for certain species combinations, the dynamics of the competition process generate oscillations in the abundances of species, and these oscillations allow the coexistence of greater number of species than the number of limiting resources ( $N > K$ ). This result is a direct contradiction of an existing activated sludge steady state competition theory, “the principle of competitive exclusion,” which states that the competition process proceeds to equilibrium, allowing only  $N \leq K$  species to coexist. The model was used to investigate the effect of varying solids retention times on the diversity of species using the conventional, completely mixed activated sludge configuration. The results of model simulations showed that for a certain range of solids retention times (2.28–5.66 days) the competition of six species for three essential resources produces oscillations within the structure of the bacterial community allowing for the sustained growth of more than three species on three resources.

---

2004

- Kinetic and stoichiometric coefficients
- Organized according to mass balance
- Evaluated using Stella (a graphical user interface of a series of finite difference equations constructed using four building blocks, namely: stocks, flows, convertors, and connectors)
- Ultimately the modeling results were compared to experimental results

# Environmental Health and Household Demographics Impacting Biosand Filter Maintenance and Diarrhea in Guatemala: An Application of Structural Equation Modeling

Daniel William Divelbiss,<sup>\*,†</sup> Dominic Louis Boccelli,<sup>†</sup> Paul Allan Succop,<sup>‡</sup> and Daniel Barton Oerther<sup>#</sup>

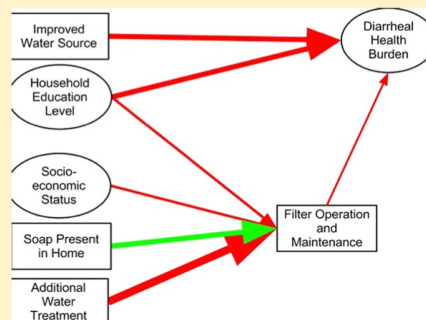
<sup>†</sup>School of Energy, Environmental, Biological, and Medical Engineering, College of Engineering and Applied Science, University of Cincinnati, Cincinnati, Ohio 45221, United States

<sup>‡</sup>Department of Environmental Health, Division of Biostatistics and Epidemiology, College of Medicine, University of Cincinnati, Cincinnati, Ohio 43219, United States

<sup>#</sup>Environmental Research Center, Missouri University of Science and Technology, Rolla, Missouri 65409, United States

## S Supporting Information

**ABSTRACT:** In rural health development practice, engineers and scientists must recognize the complex interactions that influence individuals' contact with disease-causing pathogens and understand how household habits may impact the adoption and long-term sustainability of new technology. The goal of this study was to measure the effect of various environmental health factors and household demographics on the operation and maintenance of the Biosand filter (Centre for Affordable Water and Sanitation Technology, Calgary, Alberta, Canada) and diarrhea health burden in the region. In July and August 2010, randomized household surveys ( $n = 286$ ) were completed in rural Guatemala detailing water access, sanitation availability, hygiene practice, socio-economic status, education level, filter operation and maintenance, and diarrhea health burden of the home. A hypothesized structural equation model was developed based on a review of published research and tested using the surveyed data. Model-derived parameter estimates indicated that: (a) proper personal hygiene practices significantly promote proper filter operation and maintenance; and (b) higher household education level, proper filter operation and maintenance, and improved water supply significantly reduce diarrhea health burden. Additionally, a high level of unexplained variance in diarrhea indicated the filter, though protective of health, is not the only factor influencing diarrhea.



2013

- The model consists of a system of equations, including both observed and latent variables
- Implemented in Mplus (simple linear regression coupled with path analysis)
- Solved in exploratory mode using longitudinal data collected from prior research surveys
- Solved in confirmatory mode using household data collected specifically for this project

# A Case Study of Community-Engaged Design: Creating Parametric Insurance to Meet the Safety Needs of Fisherfolk in the Caribbean

Daniel B. Oerther, Ph.D., P.E., M.ASCE<sup>1</sup>

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**Abstract:** The creation of the Caribbean Ocean and Aquaculture Sustainability facility (COAST) is used as a case study of community-engaged design addressing safety needs. COAST is a parametric insurance product, sold to national governments, which was designed to meet the food and nutrition security of small- and medium-scale fisherfolk. The design of COAST is an example of convergence research, where the discipline of engineering was integrated with another discipline to solve pressing societal needs of Caribbean fisherfolk. This case study demonstrates that community-engaged design helps to (1) identify and include historically underrepresented stakeholders, (2) emphasize the importance of professional responsibility for project implementation, and (3) achieve long-term sustainability of the design (i.e., COAST has been renewed for a third policy year, 2021/2022). DOI: [10.1061/\(ASCE\)EE.1943-7870.0001971](https://doi.org/10.1061/(ASCE)EE.1943-7870.0001971). © 2021 American Society of Civil Engineers.

**Author keywords:** Caribbean catastrophe risk insurance facility (CCRIF); Segregated portfolio company (SPC); Climate resilience; Ecosystem-based fisheries management; Food and nutrition security; Science diplomacy.

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2022

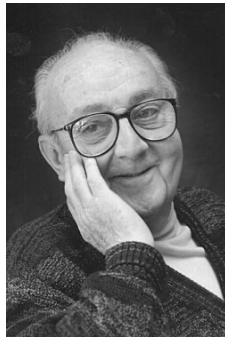
- Fishing assets from existing databases, confirmed and supplemented with data from Google Earth
- Historical storm data, shore-based infrastructure damage, and loss of income due to fishing warmings
- Attachment, ceding, and exhaustion all calculated (both “by hand” and “by machine”)

# Teaching articles

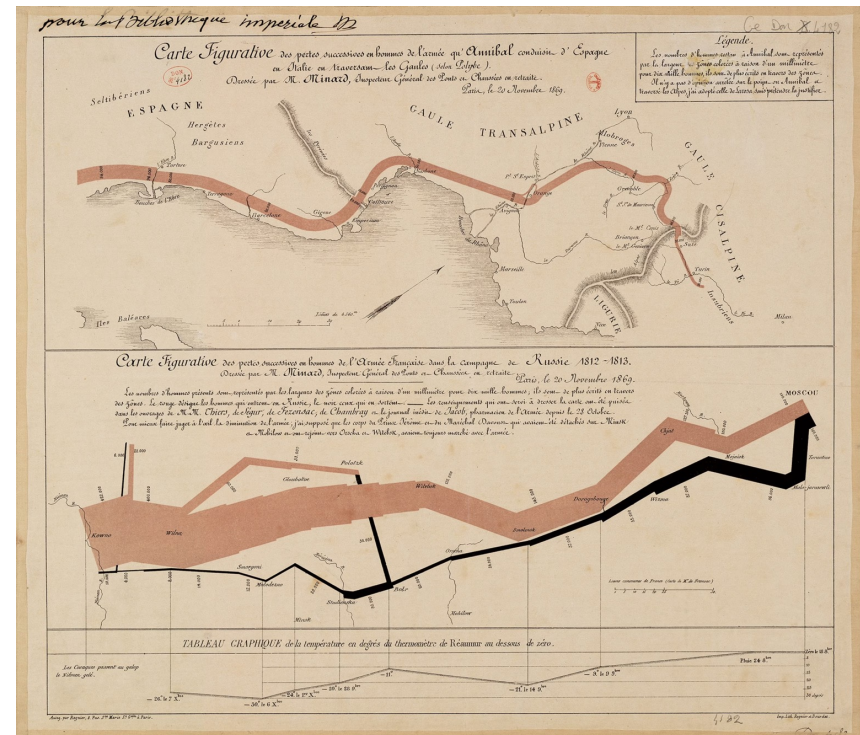
- 2025, Engagement in practice: Lessons learned from using COAST to teach environmental modeling
- 2024, Essentials of the Nurse+Engineer: Integrating systems engineering modeling
- 2022, Using modified mastery learning to teach sustainability and life-cycle principles as part of modeling and design
- 2019, Introduction to environmental modeling: Results from a three-year pilot

## 2 quotes and 1 example

- “All models are wrong, but some are useful.” George Box



- “Develop a concrete vision of the future, to which you cling loosely.” D.B. Oerther



By Charles Joseph Minard. See:  
<https://www.nationalgeographic.com/culture/article/charles-minard-cartography-infographics-history>

Application:

Identifying a true cancer cluster: Correlation isn't causation

- Plausible mechanism
- Statistical significance, including:
  - Cancer type/tissue
  - Location, time, population



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**GAI tools may be used to augment your learning process,  
not replace it.**

When GAI is allowed you must verify and cite all claims and information appropriately. GAI are known to hallucinate. Do not blindly trust the information an AI generates. You must also not adopt generated content without reflection and revision to make it your work.



**GAI tools may only be used under the guidance of the instructor  
for specific assignments and in a particular manner.**

When GAI is allowed you must verify and cite all claims and information appropriately. GAI are known to hallucinate. Do not blindly trust the information an AI generates. You must also not adopt generated content without reflection and revision to make it your work.




**No use of GAI is acceptable for use on any graded class activity.  
Use of GAI may result in a zero for the assignment.**

From: <https://cafe.mst.edu/teaching/gaiguideelines/>

# Google: “how should AI be used to support learning in higher education”

All News Videos Images Short videos Forums Shopping More ▾


## ◆ AI Overview

AI can support learning in higher education by **personalizing the learning experience, providing adaptive and accessible tools, and automating administrative tasks**. It can also be used to create engaging content, provide instant feedback, and help students develop critical thinking skills. 

Here's a more detailed look at how AI can be used:

### Personalized Learning:

#### Adaptive Learning:

AI can analyze student data to tailor learning content, assessments, and pacing to individual needs and learning styles. 

Show more ▾

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Databricks

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### MIT Report on Generative AI


MIT Global Survey of 600+ CIOs — Hear From Leading CIOs and Academics on How to Take Advantage of AI in Your Organization.

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### AI can transform education for the better

Meet the companies trying to make it happen | Business. The Economist's distilled global...



University of North Texas

<https://digitalstrategy.unt.edu/clear/theory-practice> 

### Using AI in the Higher Education Classroom


Generative AI tools boosting instructor productivity by freeing up time to focus on creative, complex student-focused goals as well as research.

## People also ask

How can AI be used in higher education? 

How can AI support student learning? 

How will artificial intelligence change higher ED? 

How do you think AI will shape the future of higher education? 

Feedback



AACSB

<https://www.aacsb.edu/insights/articles/2023/10/h...> 

### How AI Is Reshaping Higher Education

Oct 17, 2023 — The rise of AI will inspire the revision and rethinking of teaching and assessment methods. Faculty can use AI platforms to diversify student ...



University of St. Augustine for Health Sciences

<https://www.usa.edu/blog/ai-in-higher-education-ho...> 

### AI in Higher Education: How AI Is Reshaping ...

Apr 18, 2025 — One of the benefits of AI in higher education is that it can aid the grading process while also being used to offer personalized learning.



ACUE

<https://acue.org/blog/unlocking-human-ai-potential-...> 

### AI Tools & Assignments: 10 Best Practices for Higher Ed

# Gemini: “how should AI be used to support learning in higher education”

AI has the potential to profoundly transform learning in higher education by offering personalized experiences, automating administrative tasks, enhancing research, and improving overall student support. However, its integration requires careful consideration of ethical implications and a strategic approach to implementation.

Here's how AI can be used to support learning in higher education:

## I. Enhancing Learning Experiences:

- **Personalized Learning:**
  - **Adaptive Learning Platforms:** AI can analyze student learning patterns, strengths, weaknesses, and preferred styles to tailor content, difficulty, and pace. This ensures students receive the right level of support and resources when needed, facilitating deeper understanding and engagement.
  - **Intelligent Tutoring Systems:** AI-powered tutors can provide real-time feedback, answer questions, explain complex concepts, and offer individualized guidance, acting as a valuable supplement to human instructors.
  - **Personalized Content Recommendations:** AI can suggest relevant articles, videos, and other learning materials based on a student's progress and interests.
- **Interactive and Engaging Content:**
  - **Generative AI for Content Creation:** Professors can leverage generative AI to create innovative teaching materials, simulations, and virtual labs, making learning more immersive and hands-on, especially for fields like healthcare and engineering.
  - **Gamification:** AI can be used to create personalized gamified learning experiences that increase student motivation and engagement.
- **Accessibility and Inclusion:**
  - **Assistive Technologies:** AI can power tools like speech-to-text, text-to-speech, and language translation, making educational content accessible to students with disabilities or non-native speakers.
  - **Addressing Diverse Learning Styles:** AI can identify a student's preferred learning style and adapt course content accordingly, promoting inclusive education.
- **Assessment and Feedback:**
  - **Automated Grading:** AI can grade assignments and exams, particularly in subjects like math and coding, providing instant feedback to students and freeing up instructor time.
  - **Plagiarism Detection:** AI tools can efficiently detect plagiarism, upholding academic integrity.

- **Formative Feedback:** AI can provide targeted feedback on drafts, helping students identify areas for improvement in their work.

## II. Streamlining Administrative and Faculty Tasks:

- **Automating Routine Tasks:** AI can automate tasks such as admissions, scheduling, attendance tracking, email follow-ups, and managing academic records, reducing administrative burden and allowing staff and faculty to focus on more strategic activities.
- **Course Design and Management:** Generative AI can assist faculty in designing courses, creating learning outcomes, sequencing topics, aligning content with objectives, and developing accessible course materials.
- **Data Analysis for Student Success:** AI can analyze large datasets to identify students at risk of falling behind or dropping out, enabling early interventions and improving student retention. It can also provide insights into learning patterns and optimize resource allocation.
- **Meeting Support:** AI tools can automate note-taking in meetings, summarize discussions, and analyze documents, increasing efficiency for administrators and faculty.

## III. Enhancing Research Capabilities:

- **Data Analysis:** AI can quickly process and analyze vast datasets, aiding researchers in various fields.
- **Research Assistance:** AI tools can help researchers by summarizing articles, generating hypotheses, and even drafting research papers, accelerating the research process.
- **Literature Review:** AI can assist in finding and summarizing relevant literature, saving researchers significant time.

## IV. Ethical Considerations and Challenges:

While the potential benefits are immense, the integration of AI in higher education also presents critical ethical considerations and challenges:

- **Data Privacy and Security:** AI systems often rely on collecting and analyzing sensitive student data, raising concerns about how this data is stored, accessed, and used. Institutions must ensure robust data protection and compliance with privacy laws (e.g., FERPA in the US).
- **Bias and Fairness:** AI algorithms can perpetuate existing biases if trained on biased data. This could lead to discriminatory outcomes for certain student groups. Institutions must actively work to identify and mitigate such biases.
- **Academic Integrity and Misconduct:** The ease with which generative AI can produce content raises concerns about cheating and plagiarism. Universities need clear policies and educational initiatives to guide responsible AI use.

- **Human-AI Interaction and the Role of Educators:** Over-reliance on AI could potentially diminish human interaction between teachers and students, impacting social-emotional development. AI should augment, not replace, the human element of teaching and mentorship. Educators need to be trained to effectively integrate AI tools into their practices and adapt their roles to focus on higher-order thinking and critical evaluation.
- **Cost and Accessibility:** Implementing advanced AI systems can be expensive, potentially exacerbating the digital divide between institutions and students with varying access to technology.
- **Transparency and Explainability:** Many AI systems are "black boxes," making it difficult to understand their decision-making processes. Transparency is crucial for building trust and allowing for critical evaluation of AI outputs.
- **"Hallucinations" and Inaccuracy:** AI models can sometimes generate plausible but incorrect or nonsensical information. Students and faculty need to develop critical evaluation skills to discern reliable information.
- **Skill Development for the Future:** Higher education needs to prepare students for a future workforce where AI is prevalent. This includes not just technical skills but also critical thinking, creativity, and ethical AI literacy.

## Conclusion:

The effective integration of AI in higher education requires a balanced approach. Universities should embrace AI's potential to personalize learning, increase efficiency, and enhance research, while simultaneously addressing the ethical concerns and challenges through robust policies, faculty training, and a focus on developing critical AI literacy among students. The goal should be to leverage AI to create a more engaging, equitable, and effective learning environment that prepares students for the complexities of the 21st century.

 Sources

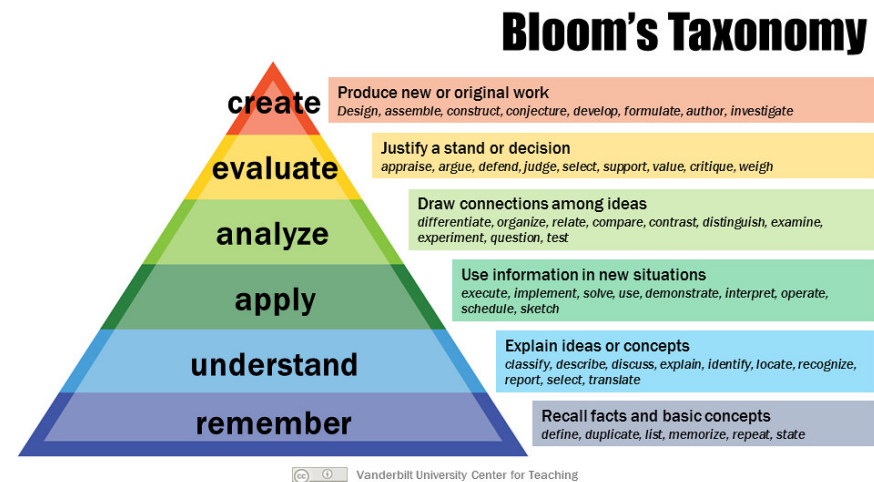
    

# Gemini: “how should AI be used to support learning in higher education” (trimmed by Dan)

- **Enhancing learning experiences:**
  - Personalized learning: Adaptive learning platforms; Intelligent tutoring systems; Personalized content recommendations
  - Interactive and engaging content: Generative AI for content creation; Gamification
  - Accessibility and inclusion: Assistive technologies; Addressing diverse learning styles
  - Assessment and feedback: Automated grading; Plagiarism detection; Formative feedback
- **Streamlining administrative and faculty tasks:**
  - Automating routine tasks; Course design and management; Data analysis for student success; Meeting support
- **Enhancing research capabilities:**
  - Data analysis; Research assistance; Literature review
- **Ethical considerations and challenges:**
  - Data privacy and security; Bias and fairness; Academic integrity and misconduct; Human-AI interaction and role of educators; Cost and accessibility; Transparency and explainability; “Hallucinations” and inaccuracy; Skill development in the future
- **Conclusion:** The effective integration of AI in higher education requires a balanced approach. Universities should embrace AI's potential to personalize learning, increase efficiency, and enhance research, while simultaneously addressing the ethical concerns and challenges through robust policies, faculty training, and a focus on developing critical AI literacy among students. The goal should be to leverage AI to create a more engaging, equitable, and effective learning environment that prepares students for the complexities of the 21st century.

# Dan's coaching for students

- What to learn (information)
  - Generate informative, instructional content from curated information
- How to learn (knowledge)
  - Leverage the flipped classroom to engage content prior to meeting with peers (and the instructor)
  - Leverage think-pair-share to identify/correct mistakes and (re)enforce knowledge
- Why to learn (wisdom)
  - Focus on the rationale for human judgement



# Cognitive; Psychomotor; Affective (Bloom)

Create

Evaluate

Analyze

Apply

Understand

Remember

Origination (new movement)

Adaptation (improvisation)

Complex/Expert (tacit)

Mechanism

Set (readiness)

Perception (awareness)

Internalize (morals)

Organize (ethics)

Value (worth)

Respond (participate)

Receive (listen)

# Cognitive; Psychomotor; Affective (Bloom)

Create  
Evaluate  
Analyze  
Apply  
Understand  
Remember

**READ A COOKBOOK**

Origination (new movement)  
Adaptation (improvisation)  
Complex/Expert (tacit)

**BAKE A CAKE**

Mechanism  
Set (readiness)  
Perception (awareness)

**FEED THE POOR**

Internalize (morals)  
Organize (ethics)  
Value (worth)  
Respond (participate)  
Receive (listen)

# Are you prepared for the disruption that's coming...

- [https://www.instagram.com/reel/DKE2S7UOB8X/?utm\\_source=ig\\_web\\_copy\\_link&igsh=MzRlODBiNWFlZA==](https://www.instagram.com/reel/DKE2S7UOB8X/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA==)

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# My use of Artificial Intelligence

Being only a freshman in Highschool, I don't use AI that much for very important things, but what I do use it for is things like:

1. asking a question;
2. making pictures to learn AI comprehension; and
3. using it as tool and not a crutch.

# Asking a question

I ask questions about things that may be unimportant, but are very interesting to me. I will do some examples now from both ChatGPT and Google Gemini

<https://chatgpt.com/>

<https://gemini.google.com/>

# Making pictures to learn AI comprehension

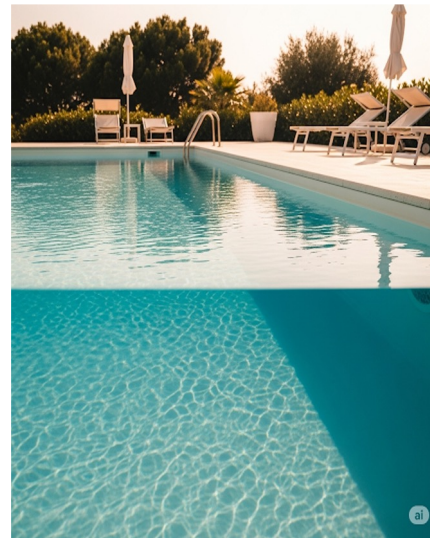
I love to see how AI can create images and sometimes fail at image creation. Here are some examples. If you are wondering more about this, I got this information from:

<https://www.youtube.com/watch?v=160F8F8mXlo>

Create a full glass of wine



Create a half full pool



# Using AI as a tool and not a crutch

Being in 8th grade has taught me how to use AI as a tool and not as a crutch. I even used it in helping me with my Research Plan for my science fair project

## The Effect of Different Surfaces on the Height a Bouncy Ball Reaches

### Research Plan

The Effect of Different Surfaces on the Height a Bouncy Ball Reaches

Barney Oerther

### Rationale

When you drop a bouncy ball gravity takes control of it until it reaches the ground and when that happens the ball deforms and the energy from the ball and the ground goes into the deforming ball and when the ball goes into its original form, the energy pushes the ball back up into the air. And depending on what surface the ball falls on, the energy will be more or less which will push the ball's height to different heights. Knowing what elasticity is and how it works can be important in things such as engineering when designing structures such as bridges that can give a little leeway so when a bridge is at maximum weight it doesn't collapse immediately. The amount of kinetic energy can be important in how much high a ball will bounce when it has a high elasticity. Different surfaces can cause the ball to bounce higher or lower depending on the surface. With these 2 things being used, you can find out how high a ball can bounce depending on what surface it lands on.

### Question

If I drop a ball from 3ft, then how will different surfaces determine how high the ball bounces back?

### Hypothesis

If I drop a ball from 3ft, then a concrete surface will give the ball the highest bounce and the dirt surface will give the ball the lowest bounce

### Independent Variable (IV)

Different Surfaces

### Dependant Variable (DV)

The Height a Bouncy Ball Reaches

### Constants

The bouncy ball  
The height the ball is dropped at  
The person dropping the ball

### Control

A wooden surface

### Method of data collection

I am going to collect my data by using a video recorder to see the highest the ball is in the air.

### Materials

- Bouncy ball
- 3 different surfaces
- A yardstick
- A video recorder

### Procedure

1. Get bouncy balls
2. Find 3 different surfaces
3. Get a yardstick
4. Take the yardstick a place vertical while one side of the yardstick is touching the ground
5. Start your video recorder
6. Drop the bouncy ball from 3 feet in the air
7. Use the video recorder to find how high the ball bounced
8. Repeat steps 1-7 four more times on the same surface
9. Repeat steps 1-8 two more times with 2 different surfaces

### Risk and Safety

There are no risks in this experiment

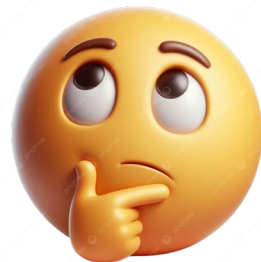
### Data Analysis

I will use a phone camera to see the very top height of when the ball reaches its top height and I expect that out of all the surfaces I will bounce the ball on, the concrete surface will make the ball bounce the highest.

### Bibliography

<https://chatgpt.com/>  
<https://languages.oup.com/google-dictionary-en/>  
[https://annex.exploratorium.edu/sports/ball\\_bounces/ballbounces2.html#:~:text=The%20energy%20goes%20into%20deforming, and%20rub%20across%20each%20other.](https://annex.exploratorium.edu/sports/ball_bounces/ballbounces2.html#:~:text=The%20energy%20goes%20into%20deforming, and%20rub%20across%20each%20other.)  
<https://www.sciencedirect.com/topics/physics-and-astronomy/elasticity#:~:text=Elasticity%20is%20a%20fundamental%20quality,role%20in%20designing%20structural%20materials.>  
<https://www.childrensmuseum.org/blog/saturday-science-bouncing-basketballs#:~:text=A%20hard%20surface%20like%20concrete, and%20it%20bounces%20pretty%20badly.>

Any Questions?



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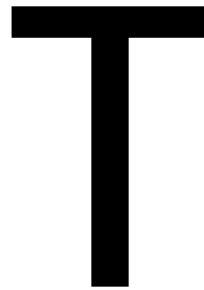
# NSPE Code of Ethics

- Engineers, in the fulfillment of their professional duties, shall:
  - Hold paramount the safety, health, and welfare of the public.
  - Perform services only in areas of their competence.
  - Issue public statements only in an objective and truthful manner.
  - Act for each employer or client as faithful agents or trustees.
  - Avoid deceptive acts.
  - Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

# Competencies of I-shaped, T-shaped, and V-shaped professional (engineers and scientists)



Deep, expert knowledge



Who also have business sense



And collaborate among disciplines

**Google:** “head loss through a pipe network”

- See: <https://www.youtube.com/watch?v=h9HWWhH8Afrw>

# Google: “using CAD to calculate head loss”

CAD software can be used to calculate head loss by incorporating relevant equations and models into the system, allowing for more accurate and efficient calculations, according to ResearchGate and CAD and Applications. This can be done by using the Darcy-Weisbach equation or other relevant equations for friction and minor losses. CAD models can also help visualize the system and identify potential sources of head loss. [🔗](#)

## How CAD is used to calculate head loss:

### 1. CAD modeling:

Create a detailed 3D model of the piping system, including pipe lengths, diameters, fittings, and any other relevant components. [🔗](#)

### 2. Data extraction:

Extract relevant data from the CAD model, such as pipe lengths, diameters, roughness, and flow rates. [🔗](#)

### 3. Head loss calculation:

Apply the appropriate head loss equations (Darcy-Weisbach, Hazen-Williams, etc.) and incorporate the data extracted from the CAD model. [🔗](#)

### 4. Visualization and analysis:

Use CAD software to visualize the head loss distribution within the system and analyze the impact of different parameters. [🔗](#)

### 5. Simulation and optimization:

Perform simulations to test different scenarios and optimize the system design to minimize head loss. [🔗](#)

## Benefits of using CAD for head loss calculation:

### Accuracy:

CAD models allow for more precise calculations by incorporating detailed geometry and data.

### Efficiency:

CAD software can automate the calculation process, reducing the time and effort required for manual calculations.

### Visualization:

CAD models provide a visual representation of the system, making it easier to understand and analyze head loss patterns.

### Optimization:

Simulations and analysis tools can help optimize the system design to minimize head loss and improve efficiency. [🔗](#)

### Example:

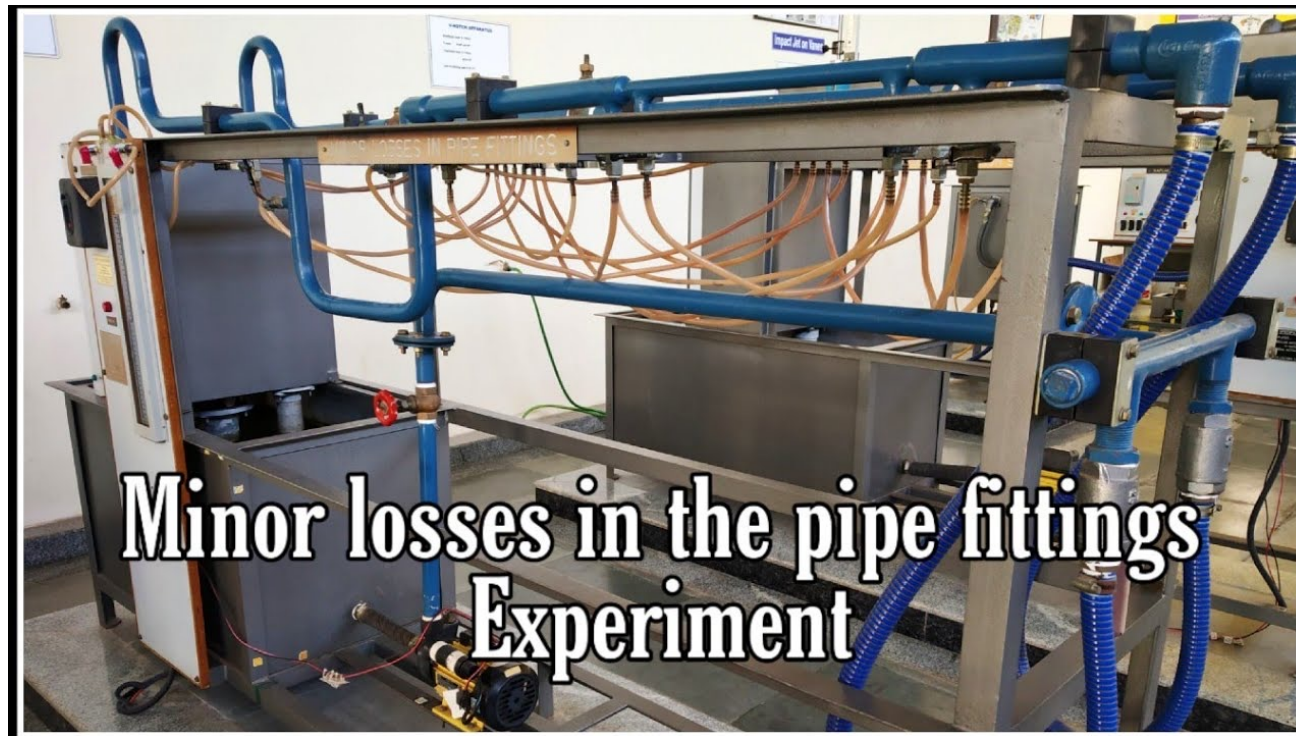
The Darcy-Weisbach equation is a common formula used to calculate head loss in pipes: [🔗](#)

$$h_f = f \cdot (L / D) \cdot (V^2 / (2 \cdot g))$$
[🔗](#)

In a CAD system, the length (L) and diameter (D) of the pipe can be easily obtained from the model, and the friction factor (f) can be determined based on the pipe material and flow characteristics. The velocity (V) can be calculated based on the flow rate, and the head loss (hf) can then be determined using the Darcy-Weisbach equation. [🔗](#)

Note: This information is for general understanding and may require further research or consultation with relevant experts for specific applications. [🔗](#)

**Google:** “experimental set up to measure head loss”



# NSPE Code of Ethics

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  - Avoid deceptive acts.
  - Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

# It's not exactly brain surgery...

- [https://www.instagram.com/reel/DHuZglul32P/?utm\\_source=ig\\_web\\_copy\\_link&igsh=MzRlODBiNWFlZA==](https://www.instagram.com/reel/DHuZglul32P/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA==)

# Ethically Understanding The Role of Computer Software In Engineering Calculation

By Ken Maschke, M.ASCE

ASCE's Daniel W. Mead Prizes for Younger Members and Students—established and endowed in 1939 by Daniel W. Mead, a former president and honorary member of ASCE—are awarded annually to the authors of papers that explore the topic of professional ethics in civil engineering. The question posed this year was, is it ethical to use an engineering software program to solve a problem if you cannot complete the calculations manually? The essay presented here, by Ken Maschke, M.ASCE, who works in Chicago with the LZA Technology Division of the Thornton-Tomasetti Group, won in the younger member category.

**T**he newest generation of engineers has matured within the information age. Computer familiarity, introduced by console gaming and Web searching, has overcome the typical human resistance to nontactile information sources. This exuberance for technology provides the potential for considerable growth within the engineering profession as well as a new set of ethical questions. As computers redefine the engineer's moral compass, the following question is paramount: is it ethical to use an engineering software program to solve a problem if you cannot complete the calculations manually?

This ethical quandary encompasses two distinct questions. Is it ethical to use computers to solve problems that could not otherwise be solved accurately or in timely fashion by hand? Yes, responsibilities to employers, clients, and the standard of care create a reality that precludes the regular use of complex hand calculations. Conversely, is it ethical to use computer software to solve problems in which the user is not otherwise competent? No, engineers must use their technical knowledge and intuition to create designs in which they are fully confident.

These conclusions require the responsible engineer to take inventory of his or her professional relationship with computer methods. Engineers need to consider why computers are used, how closely computer programs capture the complex nature of the real world, and what kind of

## ETHICS OF USING COMPUTER SOFTWARE IN CIVIL ENGINEERING DESIGN<sup>a</sup>

By Mary Lee Dereske-Jones<sup>1</sup>

**ABSTRACT:** As civil engineers use computer software for design, they must be aware of their responsibilities. They have a responsibility to maintain competency in their field and to be aware of existing software limitations. Through awareness and wise use, engineers can uphold their responsibility to the public to deliver safe and effective designs.

### INTRODUCTION

What are the ethical responsibilities of design engineers as they utilize computer software in the preparation of their engineering designs? Engineers must maintain a high level of competency in their field; to do so, they must take care not to stray from their specific discipline and be lured by user-friendly software into other disciplines. They have a responsibility to know and understand the limitations of the software used in design. By upholding high levels of excellence in their work, and by being aware of the limitations imposed by computer software, engineers can uphold their responsibility to the public in delivering safe and effective designs.

### COMPETENCY

In any discussion of the ethical responsibilities of the civil engineer, it is advisable to refer to the ASCE Code of Ethics (1). Canon 2 states that "Engineers shall perform services only in areas of their competence." There is good reason for this canon. It would be impractical and unwise for an engineer with experience in designing transportation facilities to attempt to design structural systems. Not only would it waste valuable expertise, it could also endanger human life. This same argument can be extended into the field of using computer software. Computers and software may be one of the most exciting and valuable tools to come our way in this century, but in the hands of the wrong person, it may be one of the most dangerous. Before an engineer uses a software package, he should ask himself, "Do I have the background to use this package?"

The volume of civil engineering software available has increased dramatically in recent years. A quick glance through the latest *Civil Engineering* magazine reveals numerous packages available, from storm sewer

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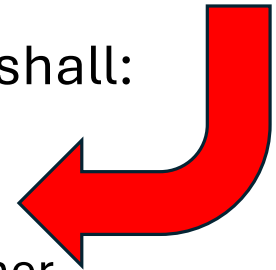
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And isn't that  
EXACTLY the purpose of  
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  - Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.



# Board Certification by AAEEES

- USBLS Env Eng: 41,300 practitioners
- BCEE:
  - Air Pollution Control
  - Environmental Sustainability
  - General Environmental Engineering
  - Industrial Hygiene Engineering
  - Radiation Protection Engineering
  - Site Remediation (Hazardous Waste Management and Site Remediation)
  - Solid Waste Management
  - Water Supply/Wastewater Engineering
- USBLS Env Sci: 84,600 practitioners
- BCES:
  - Air Resources
  - Environmental Biology
  - Environmental Chemistry
  - Environmental Microbiology
  - Environmental Toxicology
  - Groundwater and the Subsurface Environment
  - Site Remediation (formerly known as Hazardous Waste Management and Site Remediation)
  - Solid Waste Management
  - Surface Water Resources
  - Sustainability Science

## Board Certification by CEC Inc (subsidiary of ASCE)

- USBLS Civ Eng: 341,800 practitioners
  - BC Coastal Engineering
  - BC Navigation Engineering
  - BC Pipeline Engineering-Water
  - BC Water Resources Engineering (BC. WRE)
  - BC Geotechnical Engineering
  - BC Ocean Engineering
  - BC Port Engineering

## For comparison... and a parting thought.

- $2,000 \text{ BCEE} / 40,000 \text{ practitioners} = 5\% \text{ Board Certified}$
- $340,000 \text{ practitioners} \times 5\% = 17,000 \text{ Board Certified with CEC Inc}$
- The “gold standard” in engineering Board Certification is the BCEE from AAEES
- The BCES provides a tremendous credential to validate the credibility of environmental scientists
- A possible goal for AAEES – in a world with increasing use of AI – is ensuring “all” engineering work “requires” Board Certification

# Outline

- Dan's use of models in Environmental Engineering
  - 1996, Database of molecular biotechnology information (OPD)
  - 2004, Comparing models of bacterial diversity with measures of bacterial diversity in activated sludge
  - 2013, Identifying critical links between human behavior of diarrhea disease in developing communities
  - 2022, Modeling financial risk to support human behavior change (COAST)
  - Teaching articles
- Dan's use of AI in teaching
- Barney's use of AI
- Opportunity for Q/A
- Dan's thoughts on engineering ethics and AI