Western Sengineering Outreach

DIY Abacus Grade SK-2

Meet Today's ENG HERO!



Ana Luisa Trejos- Associate Professor at Western University Dr. Trejos's research focuses on the design, integration and evaluation of mechatronic devices that are aimed at providing medical care. This experience led Dr. Trejos to establish the Wearable Biomechatronics Laboratory in 2013, dedicated to the design of wearable mechatronic devices for upper body rehabilitation and motion assistance, including wearable devices for tremor suppression and smart orthotic devices for elbow, wrist, hand and neck rehabilitation. To learn more about Dr. Trejos please visit: <u>https://www.eng.uwo.ca/electrical/faculty/trejos_a/index.html</u>

Learning Goals:

- Students will learn about some basic mathematical concepts and about an abacus and why it is used
- Curriculum connections: Students will develop critically and creating thinking skills with the application of those skills on a technological platform, as recommended in the Ontario Science and Technology curriculum

Materials Needed:

- 10 different colours of beads (10 beads per colour, 100 beads in total)
- 10 pipe cleaners
- 8 Popsicle sticks
- Tape or hot glue





DN ABACUS

Engineering and Science Connections:

What is an abacus?

An abacus is a mechanical device used to assist a person in performing mathematical calculations and counting. That's why an abacus is alternatively referred to as the counting frame. Simply an abacus is used to help us count.

Why was the abacus used?

Way before computers, calculators, or even arithmetic using paper and pencil, the abacus was the most advanced device for doing simple mathematical operations with numbers such as addition, subtraction, division and multiplication. Before the abacus, the only methods people had to use for their mathematical calculations were their fingers, toes, or stones in the dirt.

Is the abacus still used nowadays?

Yes, even today in certain parts of the world the abacus is still used as a primary counting device or as a backup to more modern counting devices. An abacus could also be used in schools as a basic counting method in classrooms to help students visualize simple mathematical operations.

Should we learn/teach with the abacus?

Learning to use the abacus helps teach you a new way of counting and how to add and subtract using complementary numbers. By learning to solve problems in new ways, you can come up with better and often easier solutions to all sorts of problems.

Why is math so important?

Math helps us think analytically and have better reasoning abilities. Analytical thinking refers to the ability to think critically about the world around us. Analytical and reasoning skills are essential because they help us solve problems and look for solutions. For example, if you are buying something at the store you need to able to use math to count how much money you have and if you have enough to pay what you are purchasing.

The abacus in our present time

The abacus is still in use today by shopkeepers in Asia and "Chinatowns" in North America. The abacus is still taught in Asian schools and a few schools in the North America.

The very first abacus in our world!

The Greek abacus was a table of wood or marble, pre-set with small counters in wood or metal for mathematical calculations. A tablet found on the Greek island Salamis, which dates to 300 BC, is the oldest counting board discovered so far.





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Math and Computer Engineering

Simply mathematics is the heart of engineering! All engineering specialties, such as civil, software, chemical, electrical, computer, mechanical and many more, need math. Computer Engineering utilizes important concepts in math like counting, probability theory, calculus, algebra, numerical analysis and other concepts to help in the building and design of computers.

The Engineering Design Process

The engineering cycle or design process is a series of steps that engineers follow to come up with a solution to a problem. Many times, the solution involves designing a product (like a machine or computer code) that meets certain criteria and/or accomplishes a certain task. Computer engineers use the engineering design process to able to design and develop computers.



The Steps of the Engineering Design Process

- Define the Problem
- Do Background Research
- o Specify Requirements
- o Brainstorm Solutions
- Choose the Best Solution
- **Do Development Work**
- Build a Prototype
- Test and Redesign (ITERATE)



Engineers do not always follow the engineering design process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called iteration, and your process will likely do the same!

How does an abacus work?

An abacus is like a manual calculator with sliding beads to represent numbers. It has rows or columns of beads that represent the digits of your number. You'll have a ones place, a tens place, a hundreds place, a thousands place, and so on. You can use the beads to count or do simple operations such as (addition, substraction, multiplication, division).



Activity:

Today you are going to build your abacus to help you count and perform simple math operations.

Step 1: Creating the frames for the abacus

- Using 8 popsicle sticks, overlap the popsicle sticks as necessary to create a strong rectangle.
- The length of the rectangle should be almost 2 popsicle sticks long and the width should be about 1.5 popsicle sticks long. Tape the popsicle sticks together or use hot glue to create the rectangle.

Step 2: The beads

- Add 10 beads of the same colour to one of the pipe cleaners.
- Repeat for the remaining 9 pipe cleaners be careful that the beads don't slide off the pipe cleaners!
- You should have 10 pipe cleaners with 10 different colours.

Step 3: Tie the pipe cleaners on the frame

- Once all of the beads are on the pipe cleaners, twist it around one side of the length of the frame. Secure the other side on the opposite length of the frame.
- Repeat for the remaining 9 colours of beads. The order of colours does not matter!

Step 4: Test the Abacus

- The abacus can be used for practicing counting.
- It can be used for practicing addition & subtraction.
- You can use them to create letters and shapes!

Recommended Video:

Please try to solve the simple additions in this video with the abacus that you have built to test it! Simple Math for children: https://www.youtube.com/watch?v=eMKO1aSNNwQ









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What Did You Learn?

- The engineering design process and what it is
- The importance of math for all engineers
- The importance of maths in our lives
- Learning basic mathematical operations such as addition with an abacus

Future Learning

• Turn this design activity into a project! With the engineering design process start building a small prototype of an abacus but using different materials. You can use skewers for example instead of pipe cleaners.

We would love to see what you made. Email us at <u>discover@uwo.ca</u> or tag us on social media.

Instagram: @westernueng Twitter: @westernueng Facebook: @westernueng

Share your creations!

Thanks for discovering with us!