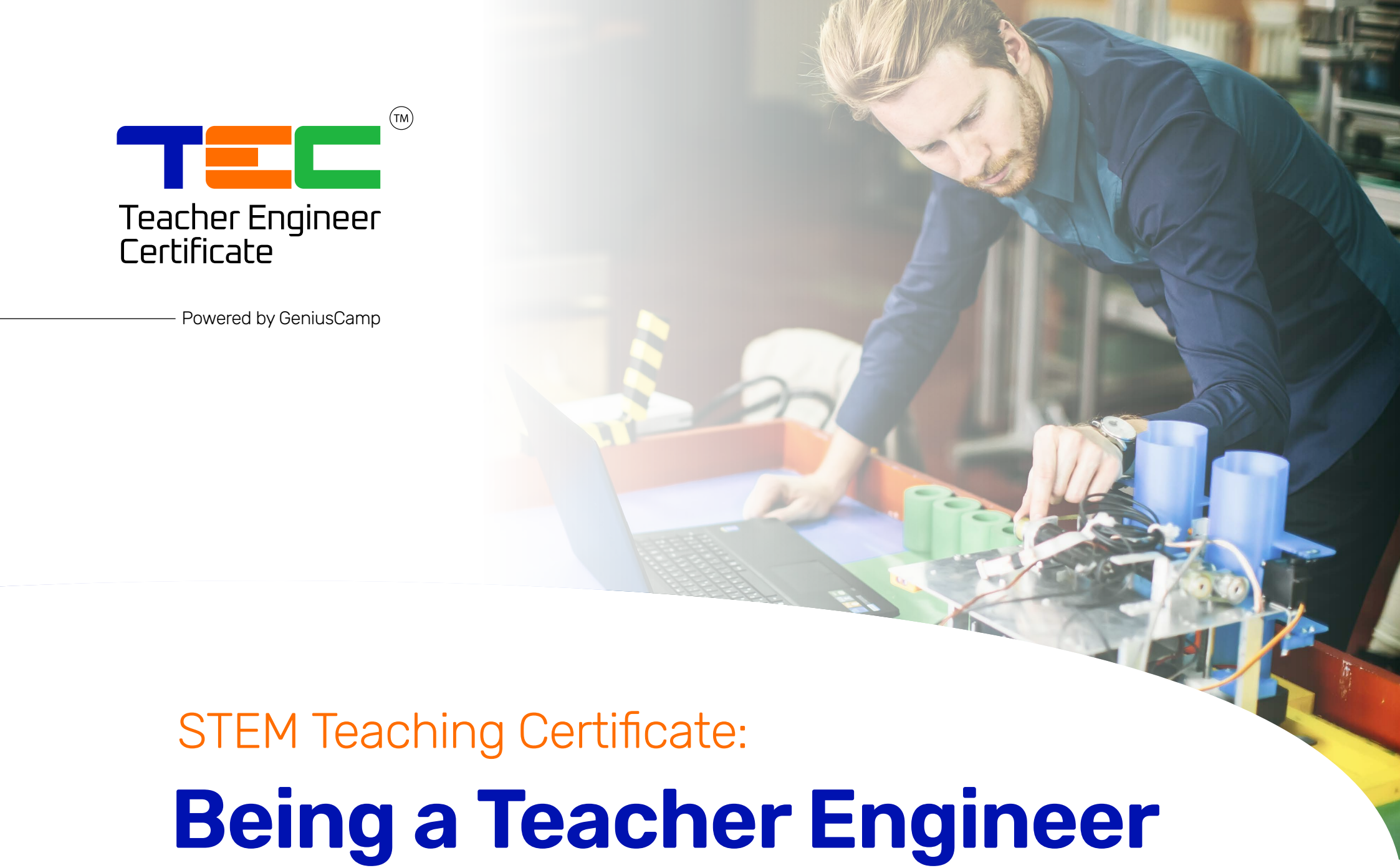
Teacher Engineer Certificate

Powered by GeniusCamp



STEM Teaching Certificate:

Being a Teacher Engineer

The world of work is rapidly changing with new technologies while **school education** (what to teach children? & how to teach it?) **has changed so little.**

Teachers and teacher education programs are even farther away from **the industry requirements.**

New Policy

Ontario government has revised the Grades 1 to 8 Science and Technology curriculum and developed a new de-streamed Grade 9 Science course to support STEM achievement in Ontario.

Ontario K-12 curriculum emphasizes STEM, application of scientific and mathematical knowledge to **solve real life problems** and through which to **enhance their transferable skills.**

Ministry of Education

"Among the transferable skills developed through STEM education are computational thinking, coding, design thinking, innovating, use of the scientific method, scientific inquiry skills, and engineering design skills. These skills are in high demand in today's globally connected world, with its unprecedented advancements in technology". (Ontario Curriculum Document)

Results from the province-wide consultation in fall of 2018 showed that **only 21%** of survey respondents believed that Ontario's schools were doing enough to promote STEM education in elementary school

80% think that Ontario is NOT doing enough on STEM

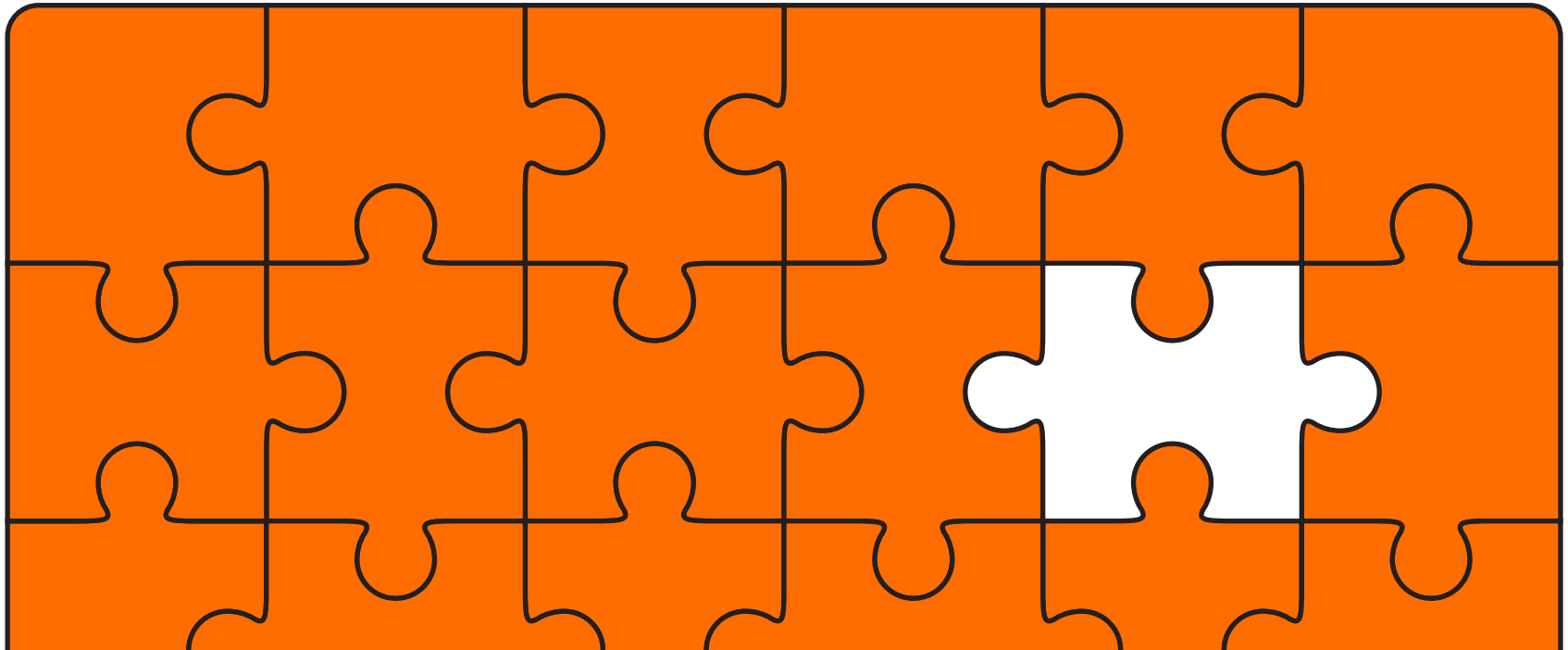
65 % of telephone town hall participants felt students should learn more about STEM earlier.

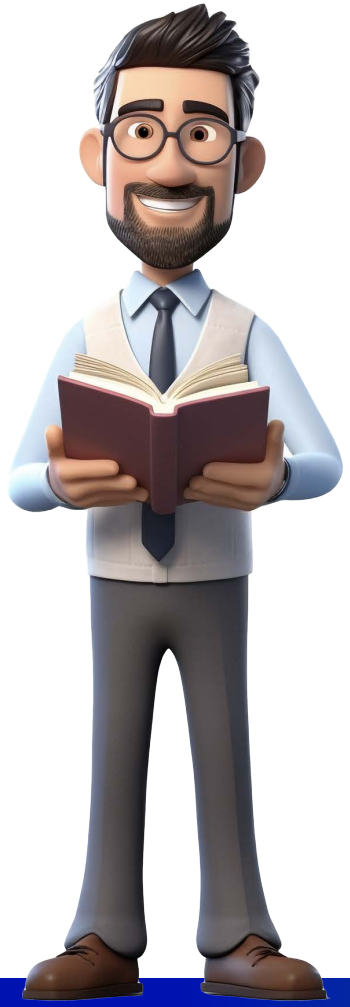
What is missing?

The assessment system

control the quality of the trainers

Provide updated information from reliable data





The Gap

Assessment

Training

Current
teacher quality
and teaching quality
to teach STEM to K-12 students

Desired
teacher quality
and teaching quality
to teach STEM to K-12 students

Current Operation to fill the gap

Extra-Curricular Programs

CPD Courses

Revising pre-service TEP

Kits based PD

Teacher Engineer Certificate

TEC™

Teacher Engineer Certificate

Why TEC™

Professions, including teaching generally promote quality practice in three ways:

- **professional accreditation of preparation programs**
- **state licensing of applicants to the profession**
- **certification of practitioners.**

There are many online and f2f STEM courses by different providers but their effectiveness is questionable, if not saying ineffective or little value for money and time. TEC™ directs the content and pedagogy of these various courses. It provides a benchmark for longitudinal effects on children becoming “student engineers”

Eligibility

- Minimum 3 years of teaching experience
- Bachelor in sciences, mathematics, engineering, education

Current teachers	The principals register teachers for the certification exam (quota)	Teachers prepare for the exam either on their own or by participating in state-funded preparation courses	Teachers take the 3 part TEC exam.
Student teachers	TE program coordinators register junior student teachers for exams.	Either self-study or participating in state-funded preparation courses	Taking the 3 part TEC exam by graduation
Extra-curricular educators and Science Museum docents	Either individuals or employers register for the TEC exam throughout the year	Either self-study or participating in state-funded preparation courses	Taking the 3 part TEC exam on specified dates

Applying on

TEC certification
E-assessment portal

Attending

In one of the 4 test centres in Ontario (for all 72 school districts)

All computerized but in supervised test centres

Scoring and reporting

One day
after the assessment

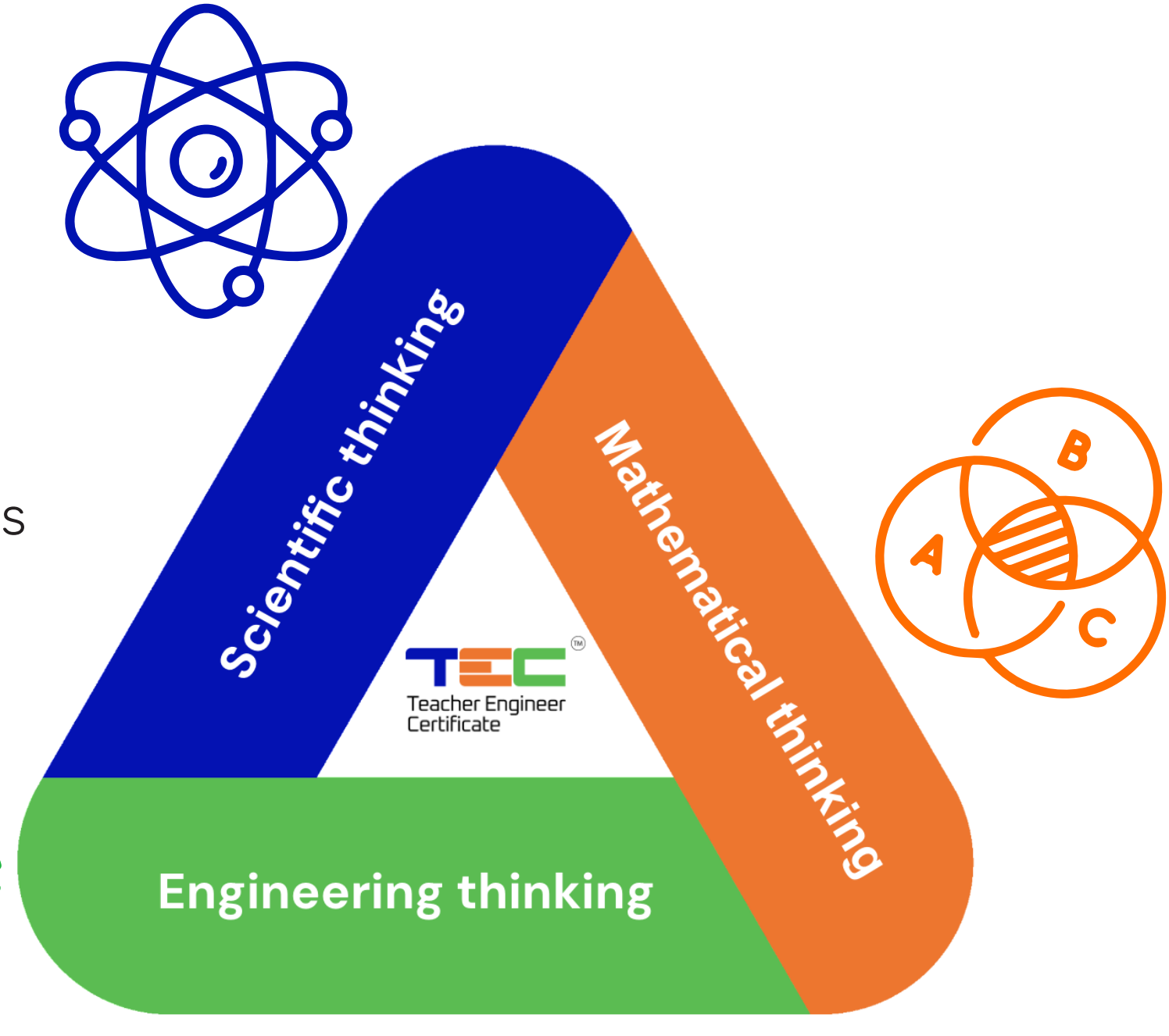
Certificate	Target group	Where to work?	Exam components	Exam Length (Min)
TEC I	ECE educators K-2 teachers	ECE centers, Kindergartens Lower elementary schools Playrooms ,Daycares After school clubs, Summer camps	Scientific literacy (Life, physical, earth and space sciences) Engineering Math Engineering Literacy (Engineering Design and thinking, Computational thinking)	90 40 50
TEC II	3-5 teachers	Upper elementary schools Science museums After school clubs Summer camps	Scientific literacy (Life, physical, earth and space sciences) Engineering Math Engineering Literacy (Engineering Design and thinking, Computational thinking)	120 60 90
TEC III	6-8 teachers	Middle schools After school clubs Summer camps	Scientific literacy (Life, physical, earth and space sciences) Engineering Math Engineering Literacy (Engineering Design and thinking, Computational thinking)	120 60 90
TEC IV	9-10 teachers	Lower high schools After school clubs Summer camps	Scientific literacy (Life, physical, earth and space sciences) Engineering Math Engineering Literacy (Engineering Design and thinking, Computational thinking)	120 60 90
TEC V	11-12 teachers	Upper high schools After school clubs Summer schools	Scientific literacy (Life, physical, earth and space sciences) Engineering Math Engineering Literacy (Engineering Design and thinking, Computational thinking)	120 60 90

Question types in the TEC exam:

AI-based assessment

- **Select response questions**
  (multiple choice, true/false, matching)
- **Constructed response questions**
  (short answers/essays/vignette/unfinished texts etc)
- **Simulated question items using computer software and multimedia**

TEC™
Exam
Components



Scientific Thinking

Mathematical Thinking

Engineering Thinking

Computing

characteristics of and relationships between celestial bodies, the sun-moon-Earth system, properties of rocks and minerals, factors that change Earth over time, features and patterns of weather and climate, the characteristics and interactions of Earth systems, the use of natural resources, and the impact of humans on the environment

Earth and space science

Collection, storage, presentation, analysis, and interpretation of data, Develop and apply computational thinking, algorithms and problem solving, and programming concepts associated with event triggers, variables, program control, modularity, and the program development cycle, cybersecurity

Physical science

atomic and molecular structure; the structures, properties, and states of matter; knowledge of physical and chemical properties and changes; principles of force and motion; collision; concepts of weight, volume, and mass; thermodynamics; energetics; properties and characteristics of waves (e.g., sound, light); and concepts of electricity and magnetism.

Life science

cells; photosynthesis and respiration; characteristics, classification, and life cycles of organisms; genetics and inheritance of characteristics; evolution over time; the relationships of organisms to each other and to their environment; and major characteristics of and factors affecting ecosystems and biomes

Scientific Thinking

Mathematical Thinking

Engineering Thinking

Understand and apply **measurement systems** and units; concepts related to geometric measurement; and tools, techniques, and formulas used to solve measurement problems

Understand and utilize **number** sense, number representations, number systems, and number theory

Understand and apply the concepts of **functions**; algebraic expressions, equations, and inequalities; and quantitative relationships between dependent and independent variables

Understand and apply the properties of mathematical **operations** and patterns, strategies for estimating and computing solutions, and methods and resources for modeling mathematical operations

Understand and apply attributes of **geometric figures** and the relationships between them; similarity, symmetry, formulas, and other geometric concepts used to solve geometry problems

Understand and apply principles related to **statistical variability** and data distribution, methods for representing and analyzing data and making predictions, and methods for determining probabilities

Understand and apply **ratios, proportional thinking**, and other methods for representing and solving mathematical and real-world problems and for evaluating solutions

Understand and apply processes and skills related to **reasoning and proof** (i.e., representing mathematical information, using mathematical language to communicate relationships and concepts, adaptive reasoning, strategic competence, procedural fluency, and productive disposition

Scientific Thinking | Mathematical Thinking | Engineering Thinking

1. Defining the Problem
2. Find Out the Reasons Behind the Problem
3. Generating Ideas for Solutions
4. Select the Most Fitting Solution
5. Taking Action

Teacher Engineer Certificate

Become a STEM certified teacher:

TEC™ (Teacher Engineer Certificate) Course Outline

Total Duration: 30 hours

Objectives:

After completion of this course, the educators should be able to:

Knowledge

Discuss trends and issues in integrated STEM education.
Create an integrated STEM lesson plan with a focus on engineering design, mathematical modeling, and technology integration.

Performance Skills

Demonstrate application of the materials and resources available for implementing an integrated STEM approach to the teaching and learning of STEM.
Create effective integrated STEM lessons that respect the diversity of backgrounds in a classroom.

Dispositions

Demonstrate a positive and professional attitude toward the teaching and learning of STEM education.

ASSIGNMENTS

1. Integrated STEM lessons and peer feedback (50 points) Students will develop three lessons with a focus of mathematical modeling, engineering design, and technology integration. Students will be given and provide peer feedback for the lessons and then make revisions. If a lesson is an application of content knowledge, then the prior lessons to develop the content knowledge should be summarized. If a lesson is a formative assessment, then the subsequent lessons to build on the student understanding should be summarized.

2. Annotated Bibliography and topic paper (20 points) Students will read 6 practitioner articles connected Integrated STEM education. Students will create a summary for each article including Introduction, things I learned, ideas that supported my teaching beliefs, questions that I still have or want more information about, idea that will directly affect my teaching in the future.

3. Lesson plan presentation (30 points): Students will develop an integrated STEM lesson that is aligned to mathematics and/or science standards. Each student will present the lesson to the class as if the class was the elementary/middle school class for which the lesson was designed. Each student will be expected to hand-in a word-processed lesson plan. A lesson plan format will be provided.

Course Outline

Module 1

What, Why and How of STEM (8 hours)

1. Background and history of the STEM movement (3h)

a. What is the role of science, mathematics, technology, and engineering?
b. What is the difference between science and technology?
c. Why is STEM important?
d. How is STEM different than traditional science and math
e. The role of problem solving and design
f. Barriers to STEM education
g. Strategies for effective STEM education
h. Problem-based learning

Read the following three articles about the importance of STEM education:

- Why STEM Education Matters
- Why is STEM Education Important?
- The Immediate Value of a STEM Education

In at least 500 words, answer the following questions:

1. What are some of the benefits for STEM education for our students?
2. What are some of the benefits of STEM education in the classroom for the United States, both in terms of the economy and its position as a world leader??
3. How does a STEM lesson differ from a traditional lesson in terms of the methodology of teaching the lesson and how students are engaged in the lesson?
4. Describe two examples of lessons or activities you have given students that integrate two or more STEM disciplines.

2. The power and promise of STEM education (3h)

a. Active learning and engagement
b. Understanding by design--backwards design
c. STEM and 5E teaching
d. The relationship between the standards and engineering
e. Delivering the standards through engineering and design
f. Using standards to develop curriculum

Read the following three articles about creating STEM lessons:

- Six Characteristics of a Great STEM Lesson
- 8 Ways to Make a Great STEM Lesson
- 12 Steps to Designing Great STEM Lessons

All three of these articles describe the characteristics or the methods to develop a STEM lesson. Create your own list of 10-7 steps with descriptions to create a STEM lesson. You do not need to create a lesson, simply describe what a teacher needs to consider and incorporate when creating such a lesson. To what degree did the STEM lessons or activities you mentioned in assignment #1 align with your list of STEM lesson attributes?

3. Samples of STEM projects and challenges (2h)

Take an in-depth look through the following websites (or websites that you have found in researching STEM education) that offer examples of STEM lessons and activities:

- Exploratorium
- STEM Lessons from Space
- STEM and the Ocean
- Teaching STEM: The Scoop on Earth Science

After reviewing multiple STEM lessons, select four (4) STEM lessons and in 500-250 words, summarize the lessons and comment on how they might be adapted to your teaching. (Again, you are not writing a lesson plan).

Course Outline

Module 2

Scientific and Mathematical Thinking (8h)

1. Science as a way of knowing (3h)

a. basics of life science, physical science, earth and space science, computing science

b. components of scientific thinking

c. features of a scientific inquiry

2. Mathematics as a way of knowing (3h)

a. Engineering mathematics

b. Mathematics as a way of knowing

c. Mathematical focal points

d. Mathematical thinking

e. Mathematical modeling

3. Wrap up (2h)

Course Outline

Module 3

Engineering Thinking (8h)

1.Engineering Design Process model (EDP) (3h)

a. Adhering to design parameters and constraints
b. Technological assessment
c. Questioning/clarifying the problem
d. Identifying constraints/limitations
e. Gathering research
f. Quantifying/mental modeling
g. Visioning and graphic representation
h. Drawing and modeling
i. Prototyping and assessment
i. Artifact development

2. Developing engineering projects based on science standards (3h)

a. Developing curriculum and activities
b. Instructional methods
c. Collaboration strategies and resources
d.web resources
e. updated areas of engineering for K-12

3. Wrap up (2h)

Capstone project:

This is a summative assessment activity in which candidates should develop a unit of STEM for a specific grade and a series of learning objectives.

Resources

Hallerman, S., Larmer, J., & Mergendoller, J. R. (2011). PBL in the elementary grades: Step-by-step guidance, tools and tips for standards-focused K-5 projects. Novato, CA: Buck Institute for Education

More readings:

Hutchison, J. & Karsnitz, J. R. (1994). Design and problem solving in technology. Albany, NY: Delmar Publishers Inc.

Mastascusa, E. J., Snyder, W. J., & Hoyt, B. S. (2011). Effective instruction for STEM disciplines: From learning theory to college teaching. San Francisco, CA: Jossey-Bass.

Petroski, H. (1996). Inventing by design: How engineers get from thought to thing. Cambridge, MA: Harvard University Press.

Petroski, H. (2003). Small things considered: Why there is no perfect design. New York, NY: Vintage Books.

Petroski, H. (1992). To engineer is human: The role of failure in successful design. New York, NY: Vintage Books.

Contact Us

For More Information

Teacher Engineer Certificate

Genius Camp

Your Brain Needs This

1 (800) 846 3608

1 (416) 565 7707

GeniusCamp.ca

info@GeniusCamp.ca