Thursday Lesson Plan: Road Design & Women in Engineering

SUBJECT	TEACHER	GRADE	DATE
Road Design & Women in Engineering			02/25/2021

OVERVIEW

Introduce students to Road Design software and explain how it ties back to real world structures/construction (CAD to Concrete).

Women engineers & technicians describe their experiences at MDOT and their responsibilities.

Please send all collated student questions to Michigan Department of Transportation - Home | Facebook as a message

PHASES	TEACHER GUIDE	STUDENT GUIDE
OBJECTIVES	• Introduce Students to Road Design + Women in Engineering • Demo 2D/3D CAD Modeling • Show Women in Engineering	• Pay Attention to Videos • Ask Questions about using computer aided design (CAD) • Ask about Women's experiences in the workplace
INFORMATION	• Video 1: "A Day in the Life of a MDOT Design Team" • Video 2: "A Day in the Life, Redoing a Project" • Video 3: "Women in Transportation: Mary Lajko" • Video 4: : "Kim McClain's Career at MDOT"	• See how CAD is done in groups and what it looks like to completely design a road project. • Hear from women in engineering on how they effected a project.
VERIFICATION	• Pause videos for questions. • Ask questions about what it looks like the Design team is working on. • Ask what each women does in their career	• Pay attention to what the design team is working on and what problem arises in video 2. • Remember what each women does as their career

PHASES	TEACHER GUIDE	STUDENT GUIDE
ACTIVITY	• Have students try to create a map of their school from memory, working together and redesigning it based on who remembers what.	• Try to tie together different versions of their school map based around central locations like the cafeteria or gym.
SUMMARY	• Show students what designing is like as the beginning of a project and compare it with previous E-week days. Show that women are in the engineering field	• Recognize that it takes a team of designers to design a road • Know that women are equally present in the engineering field.

REQUIREMENTS	RESOURCES	NOTES
Requirement 1 Watch a MDOT design team at work	**Video 1:** "A Day in the Life of a MDOT Design Team" https://youtu.be/hZ3fX4frzDc	**Estimate Time:** 7-10 min
Requirement 2 Watch how MDOT teams work with re-doing old projects due to new information	**Video 2:** Youtube Title: "A Day in the Life, Redoing a Project" https://youtu.be/ar9rdoMPE1c	**Estimate Time:** 5-8 min
Requirement 3 Watch Mary's video on being a MDOT Technician and ask if the class knows other women in engineering	**Video 3:** Youtube title: "Women in Transportation: Mary Lajko" https://youtu.be/A546TglnSz8	**Estimate Time:** 5-10 min
Requirement 4 Watch Kim's video on being a MDOT Engineer and relate it to other women in science & engineering	**Video 4:** Youtube Title: "Kimberly Webb, MDOT Region Engineer: What MDOT is looking for in new Employees." https://youtu.be/PV9Pe3CCLOc	**Estimate Time:** 5-10 min

Time Frame: 45-60 min

Michigan K-12 Standards, Science:

GRADE	1	2	3	4
MDE SUBJECT	**Engineering Design**	**Structure and Properties of Matter** **Engineering Design**	**Forces and Interactions** **Engineering Design**	**Engineering Design**
MDE CODES	K-2-ETS1-1 K-2-ETS1-2	2-PS1-1 K-2-ETS1-1 K-2-ETS1-2	3-PS2-1 3-5-ETS1-1 3-5-ETS1-2	3-5-ETS1-1 3-5-ETS1-2

GRADE	5	6-8	9-12
MDE SUBJECT	**Structure and Properties of Matter** **Earth's Systems** **Engineering Design**	**Structure and Properties of Matter** **Energy** **Human Impacts** **Engineering Design**	**Structure and Properties of Matter** **Engineering Design**
MDE CODES	5-PS1-4 5-ESS3-1 3-5-ETS1-1 3-5-ETS1-2	MS-PS1-3 MS-PS3-2 MS-ESS3-2 MS-ETS1-1	HS-PS2-6 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4

Explanation of How Civil Engineering applies to the Above Curriculum Codes:

Structure and Properties of Matter: Concentrate on the hydrothermal nature of concrete curing and the chemical reaction of water + cement + gravel. This reaction creates silicone-based crystals within the cement, gives off heat from the hydrothermal reaction, and requires consuming water to keep the reaction constant. A

lot of MDOT projects use concrete and keeping the reaction constant through water fogging and temperature control is a high priority during construction.

Earth's Systems: Dams inherently effect the surrounding ecosystem and waterways for miles. To prevent yearly flooding and increase traffic access MDOT builds culverts, dams, and channels. Channeling waterways help give access to traffic and building development but may raise flooding risk if a structural failure occurs.

Energy: Water has inherent potential energy when being released from a high point. Equating water to electricity using the same mathematical equations is how MDOT bases the size of its waterway structures.

Human Impact: As more vehicle mobility is needed more waterway structures are needed. These structures are designed to minimally impact the surrounding ecosystem and waterway flow but structure failure causes sudden wide range impacts. Natural disasters will use the force of nature to revert waterways back to what they previously were, resisting or overtaking the structures in its path.

Roadways will also affect wildlife ecosystems, especially highways that may interrupt natural habitats. MDOT does many environmental studies and applies for DEQ permits to ensure minimal impacts to the surrounding ecosystem and habitats.

Engineering Design: MDOT uses numerous programs and engineering/tech teams to bring a project from design plans to a constructed structure. The most math and engineering intensive projects are usually for small renovations, emergency repairs, or long-standing travel issues. Simple questions such as "Can we had a extra traffic like on this cable without needing a stronger strain pole?" will lead into numerous calculations using physics and matched with construction specifications to a construction company bidding the job and ordering materials.

The most challenging issue is not the physics of the problem but what other structures or utilities are affected by the change. If you get larger aluminum or steel pole for more signals it will need a larger and deeper foundation that could impact utilities next to it. From here more calculations must be done to see if the utilities that may carry water/sewer pipes can be moved.