WEDNESDAY Lesson Plan: Connected & Automated Vehicles

SUBJECT	TEACHER	GRADE	DATE
Connected & Automated Vehicles (CAV)			2/24/2021

OVERVIEW

Introduce students to automated vehicles and infrastructure to vehicle communication. Will include automated vehicle virtual field trips and demonstration videos.

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

PHASES	TEACHER GUIDE	STUDENT GUIDE
OBJECTIVES	• Explain what automated vehicles are. • Show how automated connected vehicles work on the road.	• Pay Attention to Videos • Ask Questions about how the car sees the road • Ask about how the car talks to road and vise versa.
INFORMATION	• **Video 1**: "Engineering Adventures: CAV" • **Audio 2**: "MDOT Connected & Automated Vehicle Program with Michele Mueller" • **Audio 3**: "Automated & Connected Trucking with Michele Mueller" • **Video 4:** "Autonomous Trucking by Locomotive"	• Voice over audio describes how cars connect to the road and what a autonomous vehicle is • Look for if you can see the difference between a active driver and a autonomous vehicle.
VERIFICATION	• Please ask students to pay attention how the automated vehicles "see" the road. • See if students can tell the difference between a automated vehicle and regular vehicle	• Be able to answer what lets the automated vehicles "see" the road. • Suggest what a automated vehicle might have trouble navigating through.

PHASES	TEACHER GUIDE	STUDENT GUIDE
ACTIVITY	• Virtual field Trip with videos • Discuss what students would in car if it was automated. • Ask if anyone has seen a vehicle in automated cruise control	• Engage in discussion of what they think was the hardest part perfecting automated vehicles might be. • Discuss what students would do while in a automated vehicle.
SUMMARY	• Show MDOT's involvement in automated vehicles	• Pay attention to videos and ask frequent questions

REQUIREMENTS	RESOURCES	ESTIMATE TIME
• **Requirement 1** Learn about MDOT's involvement in Automated Vehicles	• **Resource 1** Video 1: "Engineering Adventures: CAV" https://youtu.be/eV44Rxp7wKA	**Estimate Time:** 10-15 minutes
• **Requirement 2** Further explanation into MDOT's Connected & Automated Vehicle Program	• **Resource 2** **Audio 2:** "MDOT Connected & Automated Vehicle Program with Michele Mueller" https://youtu.be/DtSoPJDS7oY	**Estimate Time:** 10-15 minutes
• **Requirement 3** • Further explanation into MDOT's Connected & Automated Vehicle Program	• **Resource 3** **Audio 3:** "Automated & Connected Trucking with Michele Mueller" https://youtu.be/lOfvocgZZQw	**Estimate Time:** 10-15 minutes
• **Requirement 4** Demonstration of Automated Trucking	"Autonomous Trucking by Locomotive" https://youtu.be/QipOYVFzsg4	**Estimate Time:** 5-10 minutes

Total Time Frame: 45-60 Minutes

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.