GUIDE TO **UNIVERSAL DESIGN FOR LEARNING** IN

ADVANCED MANUFACTURING

Engineering and Producing Tomorrow's Solutions

CTE TECHNICAL ASSISTANCE CENTER OF NY

ABOUT THIS GUIDE

Universal Design for Learning (UDL) is a framework for designing learning experiences that are inclusive, accessible, and engaging for all students. UDL is not a checklist of required practices, but a mindset of continuous improvement. By increasing flexibility and options, UDL helps teachers proactively remove barriers, meet students where they are, and provide everyone with an equal opportunity to learn.

This document is part of a series that illustrates how UDL principles can be applied in each of Advance CTE's 14 career clusters. The series extends and tailors the tips provided in two prior publications, Supporting All Students in New York State CTE Programs [PDF] and Supporting Special Populations in New York State CTE Programs [PDF], available on the CTE TAC's website.

Photo: Herkimer-Fulton-Hamilton-Otsego BOCES

With its emphasis on relevant, authentic, hands-on learning, UDL is a natural fit for CTE classrooms!

5 REASONS WHY UDL WORKS FOR CTE ADVANCED MANUFACTURING

1. **Flexible learning strategies** help students develop key skills sought by advanced manufacturing firms, including the ability to think critically, work in teams, and adapt to new challenges.
2. UDL's emphasis on supporting **multiple pathways to achieve goals and solve problems** enhances students' ability to tackle complex challenges in a fast-paced, rapidly evolving industry.
3. Advanced manufacturing tasks can be physically demanding and technically complex. UDL ensures that students **with disabilities or other barriers to learning are appropriately included and involved**.
4. UDL encourages the use of **hands-on**, **project-based learning**. This authentic approach allows students to develop their technical expertise in real-world contexts, helping them become career-ready.
5. Advanced manufacturing is all about innovation. By **emphasizing choice**, UDL encourages students to follow their passions, think outside the box, and unleash their creativity.

QUICK REFERENCE GUIDE TO UDL FOR CTE

Universal Design is the process of creating objects, environments, and experiences that can be accessed, understood, and used to the greatest extent possible by people with a wide range of abilities, needs, and characteristics. Universal Design for Learning (UDL) applies the concept of Universal Design to learning contexts.

UNIVERSAL: UDL is a framework for **creating learning experiences that work for *everyone***. Proactively identifying and removing barriers to learning creates a more inclusive environment where all students have equitable opportunities to learn.

DESIGN: There is no one approach to learning that is optimal for every student in every situation. The UDL principles guide teachers to **plan for learner variability by offering flexibility and options**.

FOR LEARNING: Rather than a one-size-fits-all approach, **UDL empowers students to tailor the learning experience** for their individual needs, goals, and preferences. By discovering how they learn best, students develop into self-directed, resourceful, and skillful learners.

THE UDL PRINCIPLES*

	ENGAGEMENT	REPRESENTATION	ACTION & EXPRESSION
What is it?	The **WHY** of learning	The **WHAT** of learning	The **HOW** of learning
Why is it important?	Students differ in **what interests them** and **what motivates them to learn**.	Students differ in how they **perceive and make meaning from information**.	Students differ in how they **navigate learning environments and express what they know**.
What does it look like in practice?	Students engage in authentic, hands-on learning. Learning is relevant to students' identities, personal interests, and career goals. Students collaborate, co-create, and build community with peers. Students feel safe, included, and welcome. Fun and creativity are encouraged.	Course materials are accessible for all learners. Multiple media are used to present information. Language and symbols are clarified and decoded. The curriculum and course materials represent diverse individuals and perspectives. Learning is structured to help students build knowledge.	Learning activities and assessments are accessible for all learners. Students are guided to organize information, manage time, set goals, and plan their learning. Students communicate and express themselves in different ways. Students participate in class activities and demonstrate their learning in different ways.

** Abridged and adapted from the CAST UDL Guidelines.*

SAMPLE LESSON

Let's look at a sample lesson to see how the general principles described on page 2 can be applied in a CTE classroom.

Examples abridged and adapted from "Rube Goldberg — Kinetic Machines, Lesson 1" by Jim Burnham: https://ctetac.us/advmanufacturing.

Key to abbreviations:
R = Representation, **A = Action & Expression**, **E = Engagement**

Photo: WSWHE BOCES

ELEMENT	WHY DOES IT WORK?	GO FURTHER WITH UDL
Learning goal: *Students will learn about kinetic machines and design one using switches, sensors, and a microcontroller (Arduino). This lesson will set the stage for coding, the use of sensor inputs, and activation.*	Allows teachers to envision multiple ways students can achieve and demonstrate learning **(A)**. Identifies the prior knowledge and skills students will need to complete the lesson **(R)**.	The teacher shares the learning objective, prerequisite prior knowledge, and learning outcomes with students to **set expectations and short-term goals (A)**. The teacher might also share the academic, Common Career Technical Core, and cluster-specific standards to **illustrate the lesson's relevance** to students' career goals **(E)**.
Hook/"Entry ticket" Students analyze an image to determine "How do you get from moving the Hot Wheel car to the really creepy monkey clapping?" Students brainstorm independently before collaborating with a peer then sharing with the class ("think-pair-share").	Novelty, fun, and creativity promote engagement **(E)**. Focuses attention and sparks curiosity **(E)**. Testing ideas with peers builds confidence and reduces anxiety **(E)**. "Think-pair-share" allows students to process information verbally and in writing **(A)**.	The teacher shares his teaching materials so students can **preview or review the material (A)** or **customize the display of information (R)**. The teacher provides the image in **multiple formats (R)**. The teacher could add text labels to each component to **ensure recognition and comprehension across languages (R)**. The teacher **demonstrates a solution** by showing his finished kinetic machine **(R)**.
Lesson-specific vocabulary terms *(e.g., kinetic machine, microcontroller)*	Supports comprehension and provides essential background knowledge **(R)**. Proactively addresses language barriers **(R)**.	The suggested ungraded vocabulary quiz **provides insight into students' prior knowledge (R)**. The teacher could present the quiz as a game to **make learning (even more!) fun (E)**.

ELEMENT	WHY DOES IT WORK?	GO FURTHER WITH UDL
Arduino microcontroller introduction	Ensures all students have the requisite background knowledge to complete the hands-on activity successfully **(R)**. Promotes a psychologically safe and inclusive classroom environment **(E)**.	The teacher **represents the information in multiple formats (R)**. Materials are provided in advance so students can review and process information **at their own pace (A)**. The lesson suggests a live demonstration of Arduino and/or Tinker CAD as an **alternative activity for experienced students (A)**. Students upload and edit the BLINK program to **apply what they learned (A)** and **receive immediate feedback (E)**. The teacher explains how this information will be used in the hands-on activity to **support planning and goal-setting (A)**.
Hands-on team activity "Design and Draw Your Own Rube Goldberg Contraption"	Supports collaborative learning, both in pairs and among teams **(E)**. Novelty, fun, and creativity promote student engagement **(E)**. Engages critical thinking and evaluation skills **(A)**. Varies demands and resources to optimize challenge **(A)**.	The teacher reviews key components using both text and photos to **provide information in multiple formats** and **activate or supply background knowledge (R)**. Students **research their own examples (A)** to use as **visual models (R)** of a finished product. Entries in the engineering notebook help students **process and reflect upon what they have learned** and **record notes in a structured format (A)**.
Closure The teacher previews the next lesson and highlights connections to the current lesson.	Prepares students for what to expect and helps them set short-term goals **(A)**. Helps students understand the "big picture" **(R)**.	The teacher reviews each student's engineering notebook entry to **identify any learning gaps** that should be addressed before introducing the next lesson **(R)**.

TRY-IT ACTIVITY 1

Apply the framework above to a supplemental activity of your choice. Identify examples of UDL principle(s) and/or practices the activity addresses and propose two or three ways you could adapt the activity to go even further with UDL. Refer to the **UDL Principles** in the **Quick Reference Guide** on *page 2* for ideas.

EXTENSION ACTIVITY (CHOOSE 1)	UDL PRINCIPLES/PRACTICES ADDRESSED	WAYS TO GO FURTHER WITH UDL
Research activity on the life and art of Rube Goldberg [see lesson plan] Bonus activity: "Where Can You Get Lots of Electronic Parts Free?" [see lesson plan] Guest speaker from robotics industry Contribute to a digital gallery of kinetic machine examples Field trip to an advanced manufacturing facility Other:		

TRY-IT ACTIVITY 2

How could you make the lesson and/or extension activity more meaningful for the students in your CTE Advanced Manufacturing course by:

Tip: Refer to the table on page 6 for information on student demographics and special populations within CTE and CTE Advanced Manufacturing in New York State.

Ensuring students see images and examples of people like themselves working in advanced manufacturing?

Addressing specific barriers they might encounter (e.g., disabilities, access to resources, language skills)?

Making the lesson or activity more relevant to their identities, interests, local context, and/or career goals?

WHO ARE OUR STUDENTS IN CTE ADVANCED MANUFACTURING?

POPULATION	All U.S. CTE	All NYS CTE	NYS CTE MANUFACTURING
Female	46.7%	42.6%	**23.8%**
Nonbinary	*no data*	0.1%	***no data***
Students of Color	51.0%	59.0%	**58.9%**
American Indian or Alaskan Native	*0.9%*	*0.8%*	***1.4%***
Asian	*4.6%*	*12.3%*	***18.6%***
Black or African American	*13.1%*	*13.9%*	***11.7%***
Hispanic/Latino	*28.0%*	*29.4%*	***24.8%***
Native Hawaiian or Other Pacific Islander	*0.4%*	*0.3%*	***0.6%***
Two or More Races	*4.0%*	*2.3%*	***1.9%***
Individuals from Economically Disadvantaged Families	45.3%	59.7%	**59.9%**
Individuals Preparing for Nontraditional Fields	24.3%	18.0%	**23.8%**
Individuals With Disabilities (ESEA/IDEA)	10.7%	18.6%	**18.4%**
Homeless Individuals	1.4%	3.5%	**3.0%**
English Learners	5.4%	3.5%	**1.9%**
Youth in Foster Care	0.2%	0.2%	**0.2%**
Youth With Parent in Active Military	1.0%	0.3%	**0.3%**
Migrant Students	0.3%	0.02%	**0.02%**

Sources: PCRN National Enrollment Profile, 2021-22; NYSED Enrollment Data, Secondary CTE Concentrators, 2022-23

GUIDED APPLICATION
GETTING STARTED WITH UDL IN CTE

Implementing UDL doesn't require special pedagogy or training. In fact, you're probably using UDL principles in your teaching without even knowing it! Here are a few ways you can build upon the good teaching you already do.

Complete a printed worksheet by hand or populate a digital copy to share with your principal, consultant teachers, or others who can support your UDL journey. If you share the sheet, don't forget to fill in your information below!

My name:

My CTE program(s) or course(s):

STRATEGY 1: IDENTIFY OPPORTUNITIES

For ***each*** of the three UDL principles, list one or two examples of strategies you're not currently using in your teaching, but you'd like to learn about or try. Indicate any resources, information, or support you need in order to be successful.

Refer to the **UDL Principles** in the **Quick Reference Guide** on page 2 for ideas.

ENGAGEMENT	REPRESENTATION	ACTION & EXPRESSION
[Example: I want to use polls or games to introduce lessons]	*[Example: I want to learn how to enable auto-captions in Google Slides]*	*[Example: I want to create graphic organizers to help students take notes]*
Resources required:	**Resources required:**	**Resources required:**

Remember that UDL is not a checklist! You don't need to implement every practice to have a positive impact. Start with one or two small changes. See how they work for you and your students before adding others.

STRATEGY 2: THE PLUS ONE (+1) APPROACH

Plus one (+1) means adding one option to each resource, activity, or assignment in a lesson or course, as appropriate. Start with options that require a minimal investment of your time and effort to build your momentum.

Choose a specific lesson or learning activity from your course. List each element of the lesson or activity, then propose a +1 for each element. Identify which UDL principle your +1 reflects and briefly explain how that principle is reflected.

Photo: Eastern Monroe Career Center

Tip: Refer to the examples in the row What Does It Look Like in Practice? in the table on page 2 to help you explain how your +1 represents one or more UDL principles.

For example:

- Add a short video to a traditional lecture for **multiple means of representation**.
  Bonus: *Make sure the video you select has captions or a transcript to double your impact!*
- Allow students to submit a video, podcast, infographic, or other creative product instead of a written essay, lab report, or research paper to provide **multiple means of action and expression**. Or, offer a choice of a multiple-choice quiz or an open-ended essay question to check students' comprehension.
  Bonus: *Foster critical thinking by inviting students to co-create assignment guidelines and grading criteria, propose quiz questions, and/or participate in peer assessment activities.*
- Offer **multiple means of engagement** by allowing students to choose whether to complete some learning activities individually or in teams. Or, let them choose their own topics and/or formats for assignments.
  Bonus: *Permitting a choice of formats is a UDL double-dip of boosting engagement AND providing options for action and expression!*

Lesson or activity title/topic:

WHAT YOU DO NOW	YOUR +1	WHICH UDL PRINCIPLE(S) DOES YOUR +1 REFLECT? HOW?