



Educator Resource Guide



CATERPILLAR
VISITORS CENTER
CATERPILLAR

Please use this resource guide to plan your visit. There are several interactive activities for students, complete with questions, to engage students throughout your self-guided tour.

Internet Resources

Caterpillar Visitors Center Educator Resources: <http://www.caterpillar.com/en/company/visitors-center/resources.html>

Company, Investors, News, Careers: <http://www.caterpillar.com/>

Products, Parts, Support, Company: http://www.cat.com/en_US.html

Caterpillar worldwide network of dealers: <https://dealer.cat.com/cda/layout>

Official Caterpillar YouTube channel: <https://www.youtube.com/user/CaterpillarInc>

Tier 4 videos:

http://www.cat.com/en_US/support/operations/technology/tier-4-technology.html

<https://www.youtube.com/watch?v=Zv7zgze9Do8>

<https://www.youtube.com/watch?v=qx2oGrgo-Cw>

Illinois Common Core Standards College and Career Readiness Skills Self-Guided Tour for Teachers and Chaperones

12 English/Language Arts Standards Met

The Caterpillar Visitors Center is committed to energizing students in the areas of Science, Technology, Engineering and Mathematics. Below you will find curriculum that is aligned to the Illinois Common Core Standards.

- ◇ Common Core Standards are addressed through self-guided tours of the Caterpillar Visitors Center.
- ◇ Caterpillar Visitors Center hosts are available throughout the galleries to answer questions and help guide students and chaperones.
- ◇ Standard fulfillment may be reached by visiting multiple galleries.
- ◇ Teachers are encouraged to ask students to bring a pencil and paper or print an activity booklet for students prior to the visit.

CCS.K-12.SL Comprehension and Collaboration

1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively and orally.
3. Evaluate the speaker's point of view, reasoning and use of evidence and rhetoric.

CCS.K-12.SL Presentation of Knowledge and Ideas

4. Present information, findings and supporting evidence such that listeners can follow the line of reasoning and the organization, development and style are appropriate to task, purpose and audience.
5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

CCS.K-12.L Vocabulary Acquisition and Use

6. Apply knowledge of language to understand how language functions in different contexts to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
7. Demonstrate understanding of word relationships and nuances in word meanings.
8. Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

CCS.K-12.R Key Ideas and Details

9. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
10. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

CCS.K-12.R Integration of Knowledge and Ideas

11. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

CCS.K-12.R Range of Reading and Level of Text Complexity

12. Read and comprehend complex literary and informational texts independently and proficiently.

Caterpillar Visitors Center Lobby



Welcome to the Doug Oberhelman Caterpillar Visitors Center!

The Caterpillar Visitors Center opened on October 20, 2012. At the grand opening our Chairman and CEO, Doug Oberhelman, placed many items in the time capsule to commemorate the grand opening. The items included items like machine blueprints, a Caterpillar stock quote, and other important information.

In 2014, the Caterpillar Visitors Center achieved LEED Gold status for its many sustainable features that reduce the building's environmental impact. Examples of the sustainable features are solar panels that provide up to 75% of the visitors center's power needs at any given time, external sunshades, automatic daylight controls, enthalpy wheels, heat recovery chillers, rain water retention, high efficiency irrigation, and drought tolerant native plantings.

Student interactive: Ask the students to identify all of the continents on the globe.

Critical thinking: What would you place in a time capsule of your own? How do the sustainable features of this building benefit the community?

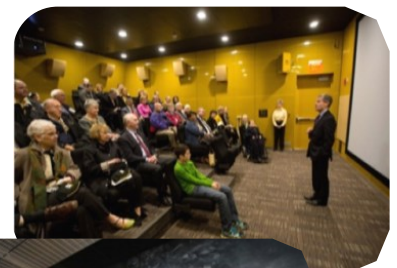
797F Mining Truck Theater

Your self-guided tour will begin with a 10 minute video in the bed of a Cat® 797F Mining Truck.

The 797F is one of the world's largest mechanical drive mining trucks, standing more than two stories tall and carrying up to four hundred tons of material.

Student interactive: What different types of job sites did you see in the video? What types of goods or materials are produced from the various work sites?

Critical thinking: Why is it important for operators to have reliable equipment?



Heritage Gallery

Caterpillar got its start from two men on the west coast with a similar dream. Benjamin Holt and C.L. Best both began manufacturing track-type tractors in the early 1900s.

Along the walls of the Heritage Gallery is a timeline that shares many dates that are important to Caterpillar, such as the introduction of new products, facility openings, and the service dates of our chairmen. The dark brown panel below highlights important dates from our acquired brands (such as Bucyrus, Perkins, Solar, etc.) since their beginning in the 1870s.

Student interactive: What year was the first Cat tractor, the Model Twenty, introduced? What countries had Caterpillar the Model Twenty working in them?



D8 Tractor Simulator

This is a 1930s tractor used mostly for agricultural and road work purposes. It weighed 33,000 lbs. and moved at 3 - 4 miles an hour.

Operators would spend up to 10 hours a day on this tractor, plowing and planting in their fields.

Critical thinking: After working the controls on the vintage D8 tractor, what differences can you identify between this 1930s model and current track-type tractor models? How has technology improved?



Historical timeline — projects around the world

This wall depicts many of the major global projects where Caterpillar equipment and power systems have been involved.

Student interactive: Tell one fact you know about one of the projects on this wall.



Product Development

A Legacy of Customer Focus

Caterpillar was founded by two innovators from the agriculture industry, Benjamin Holt and C.L. Best, whose mission was to provide better solutions for their customers' business needs. Both were among the first to introduce steam- and gasoline-powered farm equipment. After joining forces to form Caterpillar, they were first to market the diesel-powered track-type tractors. Over the years, Caterpillar employees have followed in our founders' footsteps, introducing breakthrough solutions such as turbo charging technology, electronic controls, fuel systems, drive systems and more for the purpose of enhancing our customers' success.

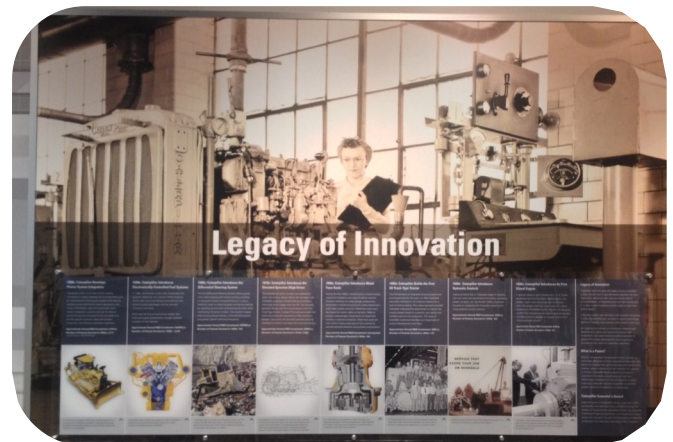
Critical thinking: Think of a time you were in a store and needed help from a salesperson. Did they help you? How did you feel?

Legacy of Innovation

Product development begins with research and development.

This timeline is broken down by decades and highlights the major Caterpillar innovations for each period. One of the great things displayed on this wall is the investment in research and development through the years.

- ◇ In the 1930s Caterpillar invested \$1 million dollars per year into research and development resulting in 127 patents for Caterpillar.
- ◇ Historically, Caterpillar spends an average of 4% of annual sales and revenue on research and development.
- ◇ Caterpillar currently has about 8,000 active patents globally.
- ◇ More than 5,000 employees have earned a patent during their career at Caterpillar.
- ◇ More than 80 Caterpillar employees have been recognized with an Innovators Award, granted to those who have received at least 12 patents.



Around the World, Around the Clock

At any given moment, Caterpillar engineers are researching new technology, designing new products and configuring new assembly lines.

The development of products and services never stops, or slows down. At the end of a work day in the U.S., the work that was done is transferred to offices around the world for continued development.

Critical thinking: What benefits are there to working on a project non-stop? How does collaboration with team members around the world improve a project?



Similitude

Displayed are soil and core samples from around the world.

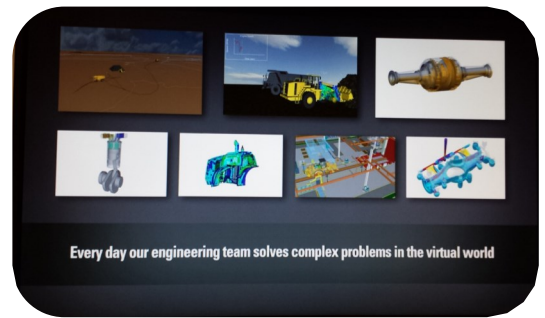
Because earth moving is a large portion of our customers' business, it is important that Caterpillar has a large focus on improving equipment and work tools to make their earth moving business more successful. A technology called Similitude is used to study soil and rock from all over the world in order to understand how Cat machines interact with the earth on a jobsite. How buckets, blades, bowls or beds function in relation to the material it handles impacts fuel consumption, operation comfort and overall productivity.



Caterpillar engineers use scale model technology to recreate dozing and hauling applications in a lab. This way, they can see how the work tools interact with the earth materials and what the wear on the ground engagement tools looks like, before incurring the major cost of building the actual applications.

Virtual Product Development

Caterpillar started using virtual product development in the 1970s to explore work site layouts, machine and system alternatives, assembly paths and manufacturing processes in the virtual world before building and testing in the physical world. With this technology, Caterpillar gains insight before anything goes to iron.



Critical thinking: What benefits are there to designing products in a virtual world before building and testing in the physical world?

Ergonomics

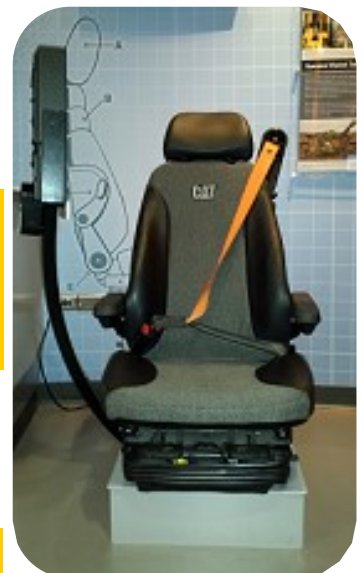
Ergonomics is a large part of Caterpillar's product development and product quality. Our customers spend many hours in these machines thus it is important we make them as comfortable and safe as possible in their work place.

There is a collection of the joystick controls from various machines in this area. They demonstrate how easy the joysticks are to use and how comfortable they are to the human hand. They are Ergonomically correct. Well designed joystick controls reduce fatigue for the operator and provide comfort when operating for long periods of time.

Critical thinking: Use this opportunity to reference the Model Twenty or the D8 from Heritage gallery. Have students compare how the joysticks of the older model felt and looked to the modern day versions. Discuss how things have improved in terms of comfort and practicality.

The seat shows the major pressure points when an operator sits in one of our pieces of equipment. Engineers look at the data collected on where that weight distribution is and then tailor the seat to provide optimal support and safety for our customers.

Critical thinking: Why is it important that operators are comfortable in their seat?



Immersive Visualization

Caterpillar began using new virtual technology in the 1990s called Immersive Visualization. This technology has improved the quality of Caterpillar products over the years by providing operators and technicians with the opportunity to "test" a product before it goes to production.

Caterpillar uses immersive visualization to evaluate product designs for safety, serviceability, quality and manufacturability. With the help of a head and handset, the participants are able to operate the machine in a 3D virtual sense and provide feedback before incurring the cost of the machine prototype. At this stage, we can make changes to the machine design before we physically build the machine.

This technology is also used with technicians. They can look inside a machine from a maintenance perspective and give feedback about how hard or easy it is to service.



Student interactive: 3D Glasses - Have students take turns looking through the 3D glasses to show the Immersive Visualization technology that is used in new product development at Caterpillar.

Structural Dynamics Validation

Once the machines have gone through the virtual product development process, the designs are put to iron and endure a number of durability tests. Engineers predict how the machines will perform based on their simulation analysis, and the prototype is used to prove or disprove this prediction.

Multi-access simulation tables or "shake tables" accelerate durability testing to significantly reduce field testing. More than 20 hours of machine operation damage can be replicated in one hour of shake testing on these tables.

Cold cells are also used in this validation process to ensure that the engines and equipment will be able to run even in the harshest temperatures. Machines are literally put in freezing conditions for hours at a time to test the durability of the components and test that fluids continue to flow at a constant rate.

Sound development is focused on meeting customer expectations and regulatory requirements related to sound levels and sound quality. Specialized test facilities provide unique acoustic environments with minimal or complete absorption of sound that allow for specialized testing of sound materials, engines, engine enclosures and cabs.

These test chambers are lined with foam so the sound levels can be measured and custom machines can be adjusted to meet specific sound regulations for different parts of the world. Some countries have very strict sound regulations because so much of their construction is demolition and rebuild within city limits. It is vital for Caterpillar to provide a very quiet machine to remain competitive in these areas.



Proving Grounds

The final step in machine validation at Caterpillar takes place at one of the proving grounds. The proving ground provides an environment for pilot machine testing in a variety of applications and physical conditions, most of which are more extreme than any typically found on customer job sites.

Cat customers need machines that will withstand the test of time. Many Cat machines are designed to last 10,000 hours or more—the equivalent of driving a car 500,000 miles. Proving ground endurance testing makes sure machine systems and structures will last for the life of the machine.

Caterpillar has proving grounds all over the world - three in the United States located in Illinois, Arizona and North Carolina, and others in China and Japan. The East Peoria, Illinois Proving Grounds opened in 1951 and is approximately 2,500 acres while the Tucson, Arizona Proving Grounds was established in 1949 with a new facility opened in 1990 is 6,400 acres! Each of those two sites only uses 250 to 300 acres; the rest is a nature preserve.



Critical thinking: Using the information above, answer the following: how many acres of the East Peoria and Tucson proving grounds are used for nature preserves?

Design Your Own Cat Machine

Student interactive: Students are invited to design their own piece of Cat equipment. Once you complete your design, you are welcome to email your design to yourself or a parent.



Caterpillar Production Systems

The Caterpillar Production System (CPS) continuously improves processes through waste elimination. By making CPS part of how business is done, Caterpillar delivers superior value to customers, shareholders and employees.

Suppliers - Caterpillar has more than 23,000 suppliers in more than 90 countries.

Caterpillar Robotics and Automation - Caterpillar was one of the first companies in the United States to use an industrial robot for manufacturing in the 1970s. Today, there are a wide range of robots in use, primarily in four areas: material handling, assembly, arc welding and painting. The speed, reliability and efficiency that industrial robots provide allow Caterpillar to improve safety, increase productivity and quality while reducing costs.



Critical thinking: What kinds of skills do you think it takes to operate these robotic systems?

Prime Product Assembly

Assembly is a key manufacturing process at Caterpillar. It involves the accumulation of all the individual parts, components and modules and joining them together to make the final product that is delivered to the customer. During assembly, every joint or connection is completed using controlled torque equipment. Once assembled, the product will have all fluids added and will then go through an extensive test to check all required systems and parameters.



Time-lapse Production Videos

Medium Wheel Loader – Aurora, Illinois
Perkins 1100 Series Engine – Wuxi, China
797F Transmission – East Peoria, Illinois
797F Mining Truck – Decatur, Illinois and Morenci, Arizona.

Caterpillar People at Work

Attracting and developing the best team possible enables Caterpillar to maintain its position as an industry leader and serve its customers in diverse environmental, political and cultural landscapes.

Student interactive: Look through the careers listed in the kiosks while discussing career interests. Have students find an employee whose position matches their interest. Using the map image on the kiosk screen as a guide, ask the students to find the listed location on the global map carpet.

Students can see more specific job titles on the gray wall, which lists more than 1,000 job titles at Caterpillar.



Our Values in Action

Caterpillar's Worldwide Code of Conduct, first published in 1974, defines what we stand for and believe in, documenting the uncompromisingly high ethical standards our company has upheld since its founding. Caterpillar employees put the values and principles expressed in our Code of Conduct into action every day by providing detailed guidance on the behaviors and actions that support our values of *Integrity*, *Excellence*, *Teamwork*, *Commitment*, and *Sustainability*.

Critical Thinking: Have students discuss what each of the Values means to them and how they can apply their own Values in Action in their everyday situations. What Values does our school have?

Power Systems

MaK Engine

Student interactive: As you enter the Power Systems gallery, note that the engine mural where you enter is a true-to-size image of a MaK engine. These engines are typically found in the largest marine vessels.



Caterpillar is an industry leader in the following power systems:

Industrial Engines and Power Solutions
Railway Solutions
Marine Power Systems
Gas Turbine Technology
Oil and Gas Power Solutions
Global Electric Power Systems

Student interactive: Push the button found at the Global Electric Power Systems display to simulate a power outage. Discuss whose power comes back on first and why.

Marine Propeller Display

Since being founded in a small Swedish shipyard in 1912, Caterpillar Propulsion has become a full-scale global operation with expertise in innovative hydrodynamics—ensuring heavy-duty, reliable performance.

- Caterpillar Propulsion offers skilled craftsmanship and an unbroken chain of customized control systems, thrusters and propellers that are large and solid, yet delicately fine-tuned and calibrated.
- This attention to detail—from the micron of tolerance in the blades to its feathering, the stream of water and the turbulence—boosts performance and ensures customers increased uptime.



Performance Customers Can Rely On

Caterpillar Propulsion uses a simple dimensioning principle to ensure maximum uptime—using more material. Caterpillar propellers are built to last and are able to withstand even the most extreme conditions. Caterpillar Propulsion systems provide customers with the ability to have total integration of their vessel propulsion, all the way from the engines and propellers to monitoring and controls, at the vessel or at the customer's office. In conjunction with engines, vessel monitoring equipment and optimization systems, complete vessel solutions are also offered with each tailored to maximize vessels' uptime while minimizing operating costs. All solutions are sold and serviced through the global Cat dealer network ensuring each customer's success independent of their vessel location, design or application.

Caterpillar Propulsion supplies propellers, thrusters and control systems that are individually tailored to specific vessels and sold and serviced through the Caterpillar network. In combination with Cat and MaK engines, Caterpillar Marine is now able to offer integrated vessel systems to all marine customers.

Student interactive: Show your students the marine specific diorama and point out the various types of vessels powered by Cat engines.

Cat C15 ACERT Tier 4 Final Engine Display

In 1996 the U.S. EPA issued new emission standards reducing NOx (oxides of nitrogen) and PM (particulate matter or soot). Caterpillar introduced different tiers working towards the Tier 4 Final Engine.

The final engine was rolled out in early 2014.

Tier 4 Final provides an additional 80% reduction in oxides of nitrogen (NOx) compared to Tier 4 Interim, which makes the levels of NOx and particulate matter (PM, or soot) near zero.

Key Points:

- *Simple* - The system is fully automatic, designed to allow operators to focus on work and not on handling emissions technology
- *Proven* - With 85% of engine content unchanged from Tier 4 Interim, we improve on the record reliability and field population of over 135,000 units in the field doing work today.
- *Low Operating Costs* - Consistent with our business model, our engines are designed to optimize fuel consumption without sacrificing the performance, reliability, or durability that our customers expect.



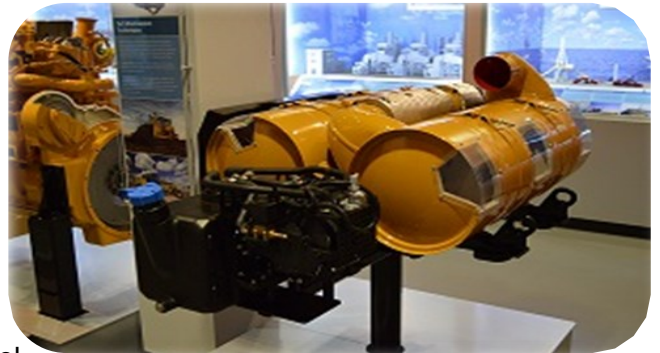
After Treatment Components

Tier 4 Interim introduced the first canister containing diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF).

The Cat Regeneration System automatically regenerates the DPF and optimizes system efficiency.

Tier 4 Final adds a second canister with the selective catalytic reduction (SCR) system.

The pump electronics tank unit (PETU) stores and delivers diesel exhaust fluid (DEF) to the system via the injector and mixing tube.



***To see Tier 4 in action, see Internet Resources located at the beginning of the Educator Resource Guide.*

Cat Dealers

CAT Dealer Video

Student interactive: Have students watch the Cat dealer video. Caterpillar has 53 dealers in the United States and more than 180 dealers world-wide.

Critical thinking: Discuss the places noted in the video. Review the services depicted in the video – engines, power generation and equipment. Ask what qualities and services were important to customers that the dealers provided .



Global Dealer Locator

Student interactive: Show students how many Cat dealerships and service centers there are around the world. Double-tap with one finger to zoom in on an area. Tap on the yellow flag to reveal the name and location of the Cat dealer. Tap "Reset" in the upper right corner to reset the map.



Cat Reman Certified Rebuild

Cat Certified Rebuild

Caterpillar provides a unique service to customers that enables them to take an end-of-life piece of equipment and submit it for a **Cat Certified Rebuild (CCR)**, which is basically the complete rebuild of the machine. After its entire disassembly, it is rebuilt according to the CCR quality standards. Through this program, customers receive a renewed product at a fraction of the cost of the new machine.

The CCR process takes 6 to 12 weeks to complete. The repair requires the replacement of and reconditioning of approximately 7,000 parts. Also, thorough inspections are performed to restore every component to pristine condition. Each machine is completely repainted and receives new graphics, including a new CCR product identification number that entitles customers to a like-new warranty.



Remanufacturing

Caterpillar designs and builds products for more than one service life. **Remanufacturing** is the process of returning end-of-life products to same-as-when-new condition in a manufacturing environment. Cat Reman parts are remanufactured to strict quality standards and carry a same-as-new Cat parts warranty. Our components have proven themselves in demanding applications delivering the reliability, performance and long-service life equal to new Cat parts.

Critical Thinking: Ask students to name benefits of these two programs offered by Cat. Ask them what items they/their families own that have a warranty (video game consoles, TVs, vehicles).

Caterpillar Jobsite Theater

Student interactive: Students can choose from 6 videos that showcase more about Caterpillar's history, technology and the services we provide our dealers and customers.

From the back wall of the theater, use the touch screen to choose from the following video options:

Caterpillar Brand Heritage

Product Link™

Accugrade™

Cat® Grade Control

Around the World, Around the Clock

Cat Construction Rocks

There is an additional feature video in conjunction with our special display exhibits in the Heritage Gallery.



Critical thinking: Discuss the benefits of the different technologies discussed in the Product Link™, Accugrade™ and Cat® Grade Control videos.

Cat Product Floor

Safety first!

Please instruct students to stay with their assigned groups. Ask them to walk and not run in the product floor area and caution them against climbing anywhere other than the designated staircases leading up to the cab of the machine. Please allow only one student in the cab of a machine at a time.

Exhibit hosts are available to assist and answer questions.



Student interactive: There are several pieces of Cat equipment on the product floor for students to explore.

Each piece of Cat equipment has a kiosk which shows the equipment working in various applications and also has interesting stats and facts about the machine. Make sure your students read the kiosks and watch the short videos. Also, be sure to watch the video displayed on the large screen overhead. This video shows some of our larger equipment at work in unique applications.

The front of the 797F Mining truck makes a great backdrop for a class photo.

Chevrolet Impala Race Car

In 1993, Caterpillar entered the world of NASCAR racing as an associate sponsor in the Sprint Cup Series. Today, Caterpillar is the primary sponsor of the No. 31 car, driven by Ryan Newman.

Since the early days of NASCAR, Cat machines have aided in mining and necessary materials for building the cars, as well as participated in the paving, construction, maintenance and renovation of NASCAR tracks.

As a sponsor, Caterpillar has won races like the Daytona 500, while also providing the on-site power for NASCAR TV broadcasts through Cat Entertainment Services.

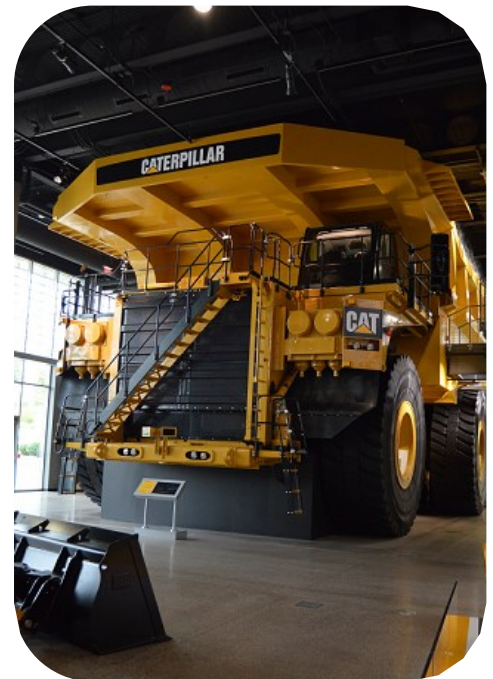


797F Mining Truck

Standing 5 stories tall with the body raised, the 797F Mining Truck is the largest ultra-class mechanical drive truck in the world.

Manufactured in Decatur, IL, this truck leaves the factory on 13 separate trucks for delivery and assembly on the jobsite. The tires and bed of the truck are shipped separately to the jobsite. This truck is primarily used for hauling materials such as copper, coal, iron ore, gold, oil sand and overburden. The 797F is matched with the advanced engine technology of the Cat C175-20 that contributes fewer emissions to the environment while maintaining fuel efficiency and horsepower.

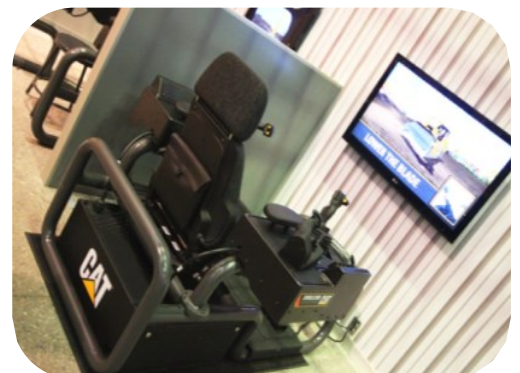
It takes 25 gallons of Cat Yellow paint to cover this truck. The 797F body has enough volume to place 19 Honda CRVs plus 1 SMART Car inside it. The 797F meets U.S. EPA Tier 2 emission standards.



Cat Simulators

Investing in Cat equipment pays even greater dividends when the equipment is put to skillful and safe use. Virtual simulators are part of an integrated operator training program and enable operators to practice without risk to themselves or their equipment. Simulators use no fuel, save wear and tear on machines and provide a safe environment to learn the basics of equipment operation.

Student interactive: Have students take turns on the excavator and bulldozer simulator. Instructions on how to operate the simulator will play, and the simulation will begin by pressing the horn.



Future Theater

Caterpillar consistently improves the way the world works, while focusing on the potential of the environment in which Caterpillar customers operate. Partnering with industry, government and academic institutions allows Caterpillar engineers to leverage expertise, increase the speed of progress and look ahead to the possibilities of new ideas and continuous development of the planet.

Autonomy - Combining the Fleet, Terrain, Detect and Health capabilities of the Cat® MineStar™ System, Command enables you to implement remote control, semi-autonomous or fully autonomous mining equipment systems - offering unprecedented improvements in operator safety, equipment availability and site productivity.

Command for drilling enables fully autonomous drilling to enhance safety, increase drill pattern accuracy and improve the overall efficiency of drilling operations. The system executes drill plans more safely, keeping operators out of the pit and away from areas where explosives are being used.

Command for hauling is a fully autonomous system, and it takes advantage of the most sophisticated perception and on-board intelligence technologies available, enabling Cat trucks to work safely and productively without human operators in the cab.

Command for dozing is a remote control system that is available for Cat D10T and D11T Track-Type Tractors. Mining applications include stockpile feeding, leach pad construction, high wall and edge operation. An over-the-shoulder line-of-sight console enables an operator to control of the machine from a safe distance.

Command for underground is a semi-autonomous system that automates the tramming function of Cat Load Haul Dump (LHD) machines. The operator has the ability to control the machine from an office or remote location away from the hazards of the underground mine. One or more machines can be controlled at once, enhancing operator safety and optimizing production between multiple machines.



Critical thinking: Ask students to list reasons why Caterpillar Mining is moving towards autonomy. What remote control or autonomous objects have they worked with?

Caterpillar Foundation

Caterpillar supports the philanthropic efforts of the Caterpillar Foundation. Founded in 1952, the foundation has contributed more than \$500 million to help make sustainable progress possible around the world by providing program support in the areas of environmental sustainability, education, basic human needs and disaster relief.

Critical thinking: Ask students to name causes they think the Cat Foundation would support. Use the photos and captions to discuss areas that could benefit from the monetary donations Caterpillar makes.

