Integrated Math 3: Across CTE Pathways

This Open Education Resources (OER) textbook and teacher professional development support ecosystem align with the CA 2023 Math Framework Revisions and are fully accessibility compliant.

Content themes explore CTE Pathways with work-based learning. We all know and appreciate youth who excel as makers, tinkerers, and part-time employees. Their strengths in creative thinking may not transfer to more traditional classroom activities and tests. In Integrated Math 3: Across CTE Pathways, each unit consists of the following:

- A business use case where students experience career explorationand learn about an industry sector
- Tasks and terms to practice industry-relevant use of technology with mathematics
- Milestone check-in meetings to collaborate and contribute to business practices utilizing mathematics
- Deliverables projects and assessments for Big Ideas and CA Common Core Standards competency demonstration

The sample units challenge, engage, and support all students in deep and relevant math content learning, as addressed in the CA 2023 Math Framework Revisions.
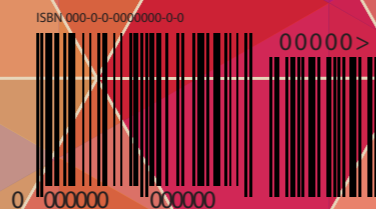
Downey Unified
SCHOOL DISTRICT

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Sample Units for Review

Integrated Math 3: Across CTE Pathways

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Sample Units for Review

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PUBLISHER

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Integrated Math 3: Across CTE Pathways

Thank you for exploring three sample units from the textbook Integrated Math 3: Across CTE Pathways. The textbook and teacher professional development and support ecosystem align with the CA 2023 Math Framework Revisions and are fully accessibility compliant.

In Integrated Math 3: Across CTE pathways, each unit consists of:

A **business use case** where students experience career exploration and learn about an industry sector.

+

Terms and tasks to practice industry-relevant use of technology and relevant CORE.

+

Milestone check-in meetings to collaborate and contribute on business practices utilizing mathematics.

+

Deliverables projects for Big Idea and CORE competency demonstration.

The sample units challenge, engage, and support all students in deep and relevant math content learning, as addressed in the CA 2023 Math Framework Revisions.

Unit 1 Big Idea:	Transportation logistics for a distribution warehouse

Unit 1 CORE:	Geometry

❖ Geometric Measurement and Dimension (G-GMD)
  ▪ Visualize relationships between two-dimensional and three-dimensional objects.
    • 4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Unit 2 Big Idea:	Modeling operations for a distribution warehouse

Unit 2 CORE:	Geometry

❖ Modeling with Geometry (G-MG)
  ▪ Apply geometric concepts in modeling situations.
    • 1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder.)
    • 2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot.)
    • 3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Unit 3 Big Idea:	The business of online fake reviews

Unit 3 CORE:	Statistics

❖ Interpreting Categorical and Quantitative Data (S-ID)
  ▪ Summarize, represent, and interpret data on a single count or measurement variable.
    • 4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
❖ Making Inferences and Justifying Conclusions (S-IC)
  ▪ Understand and evaluate random processes underlying statistical experiments.
    • 1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Teacher PD

This graphic addresses the collaborative nature of the class and support for teachers:

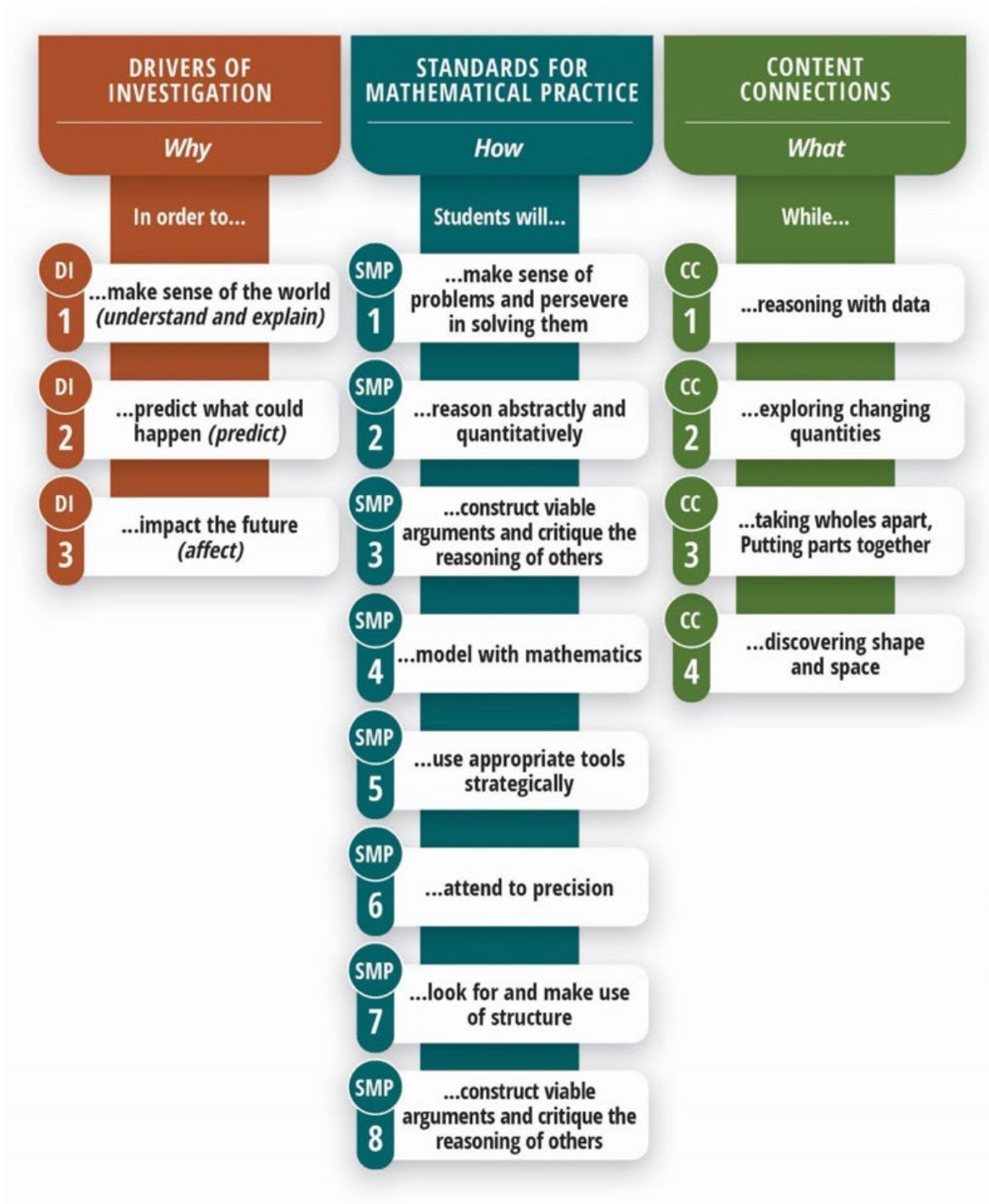Office Hours for 1-1 & Forum ← Technical Support

Fully Accessibility Compliant → Screen Reader Version (.docx) & Accessible PDF

Industry Sector Peer Reviewed ← Website, Canvas & Google Classrooms for Import

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Textbook: Teacher's and Student Editions

Teacher Support ← Online Community of Practice

Pilot Fall 24 → Presentations Content

Teacher PD ← Integrated Math 3: Across CTE Pathways → Classroom

Unit Industry Sector Quick Onboarding ← CTE Focused IM3

Collaboration Guides → Group Activities

Collaboration Guides → Bonus Activities

Supplemental Materials

Reflection Surveys → Peer Review Surveys

Deliverable Projects Instructions → Completed Sample Deliverable Projects

Assessments → Quizzes/Tests

Assessments → Project Rubrics

Selected Highlights of the CA 2023 Math Framework Revisions

These highlights inform a quick glance into the many framework elements:

❖ Structure the teaching of the state's math standards around "big ideas" that integrate rather than isolate math concepts. Avoid organizing around the detailed content standards and instead organize around the most important mathematical ideas.

❖ To apply the mathematics, practice solving problems arising in everyday life, society, and the workplace.

❖ Connect learning to the "real world" through authentic examples and use of data, prompting students to ask and answer meaningful questions. Adding authenticity to lessons helps teachers answer students' questions around "why do I need to learn this?"

❖ Allow students to "see themselves" in curriculum and in math-related careers by making math instruction culturally relevant and empowering.

❖ Stimulate deep learning by sparking student curiosity through lessons that encourage inquiry and problem-solving.

❖ Ensure that students develop both appreciation of math concepts and fluency in using math efficiently through the productive use of algorithms and mastery of math facts they have come to understand.

❖ Encourage students across age spans to become proficient at understanding and using data—a key skill in the 21st century job market.

❖ Help students to identify misleading uses of data and use data to make decisions in their roles as global citizens.

❖ Instill confidence in learners by dispelling myths about who can and cannot learn math.

❖ Develop instruction and curriculum that is "multi-dimensional" and employs the use of visuals, graphics, and words in addition to numbers and equations.

Lesson ideas that drive design of instructional activities will link one or more Standards for Mathematical Practice (SMPs) with one or more Content Connections in the context of a Driver of Investigation:

DRIVERS OF INVESTIGATION	STANDARDS FOR MATHEMATICAL PRACTICE	CONTENT CONNECTIONS
Why	*How*	*What*
In order to...	Students will...	While...
DI 1 ...make sense of the world *(understand and explain)*	**SMP 1** ...make sense of problems and persevere in solving them	**CC 1** ...reasoning with data
DI 2 ...predict what could happen *(predict)*	**SMP 2** ...reason abstractly and quantitatively	**CC 2** ...exploring changing quantities
DI 3 ...impact the future *(affect)*	**SMP 3** ...construct viable arguments and critique the reasoning of others	**CC 3** ...taking wholes apart, Putting parts together
	SMP 4 ...model with mathematics	**CC 4** ...discovering shape and space
	SMP 5 ...use appropriate tools strategically	
	SMP 6 ...attend to precision	
	SMP 7 ...look for and make use of structure	
	SMP 8 ...construct viable arguments and critique the reasoning of others	

Highlights Specific to High School - from framework Chapter 8

Mathematics: Investigating and Connecting, High School

Plan Teaching Around Big Ideas:

Mathematics is a subject made up of important ideas and connections. Curriculum standards and textbooks tend to divide the subject into smaller topics, but it is important for teachers and students to think about the big ideas that characterize mathematics at their grade level and the connections between them.

Use Open, Engaging Tasks:

Open tasks allow all students to work at levels that are appropriately challenging for them using a range of strategies within the content of their grade.

Teach Toward Social Justice:

Teachers can take a justice-oriented perspective while broadening access to and interest in math at any grade level, kindergarten through grade twelve, by:

a) creating opportunities for students to both see themselves, as well as people from all backgrounds, as capable and successful doers of mathematics; and

b) empowering learners with tools to highlight inequities and address important issues in their lives and communities through mathematics.

Invite Student Questions and Conjectures:

One of the most important yet neglected mathematical acts in classrooms is that of students asking or posing mathematical questions. These are not questions to help students move through a problem; they are questions that are sparked by wonder and intrigue (Duckworth, 2006). Students' questions should be valued, and students should be given time to explore them. Questions are important in the service of creating active, curious mathematical thinkers.

Center Reasoning and Justification:

Reasoning is fostered when students talk about mathematics with each other. Through the acts of reasoning and justifying, more students can begin to see mathematics as a tool to ask questions about and make sense of their world, rather than as a static set of rules. When students have opportunities to reason and justify while engaging with open tasks, their engagement in math increases and they strengthen their identities as members of the mathematics community.

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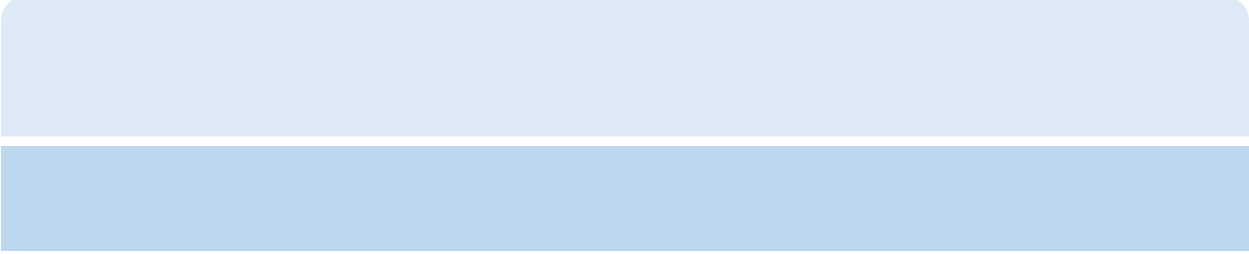
The book's website (in progress)
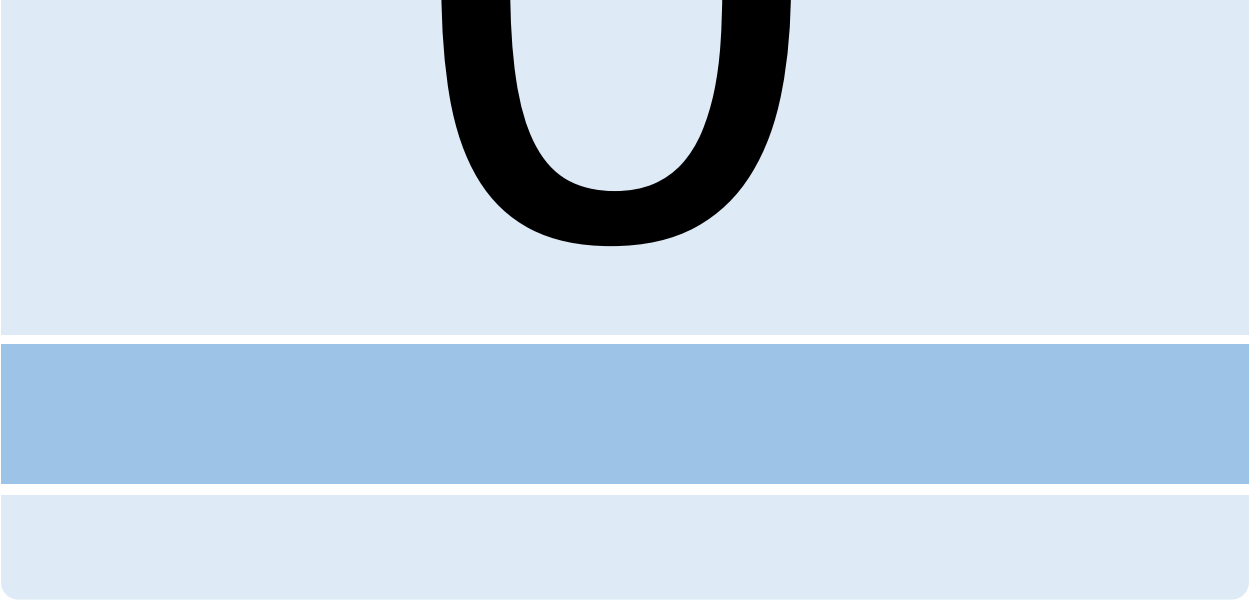
https://IntegratedMath3.com

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UNIT 0

Onboarding

This class guides you through Integrated Math 3 using work-based learning and onboards you into industry sector career exploration as an intern. Each Unit begins with a use case and supports you contributing to product design, development, or improvement as you learn and practice.

Terms

Business Use Case

A **business use case** focuses on the potential financial and operational benefits of a product, process, project, or initiative by analyzing benefits, costs, and potential risks that support making informed decisions. A business case outlines the potential value of a product and may include an analysis of market trends, customer demand, or competitor offerings to assess financial returns.

Use Case

A **use case** describes how a user (customer) interacts with a system or product to meet their goals **and** create value for the use case organization.

Use Case	=	how a user (customer) interacts with a system or product to meet their	+	how a user (customer) creates value for the use case organization
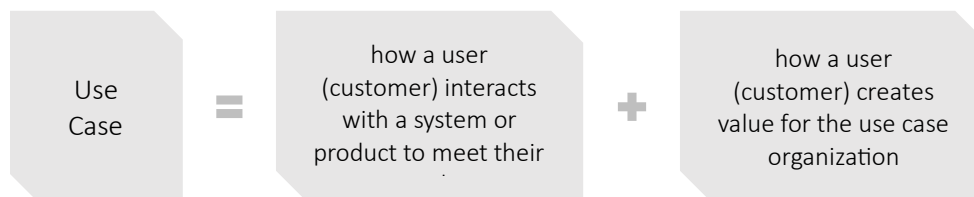
Companies and organizations across industry sectors develop use cases to establish success and failure scenarios. A use case focuses on the practical application of the product. Use cases analyze how products can be used in the work environment, typically to solve problems or save time. Use case benefits:

Simplifying complex projects	Viewing project priorities from the client or customer's point-of-view	Streamlining project tracking	Identifying and avoiding expensive errors

Each use case is unique to the company, client, or customer described and includes:

USE CASE		
A User or Actor	**A Goal**	**A System**
the viewpoint of the company, client, or customer priority in the use case	what the company, client, or customer wants to achieve	the process that supports the company, client, or customer to achieve their goal
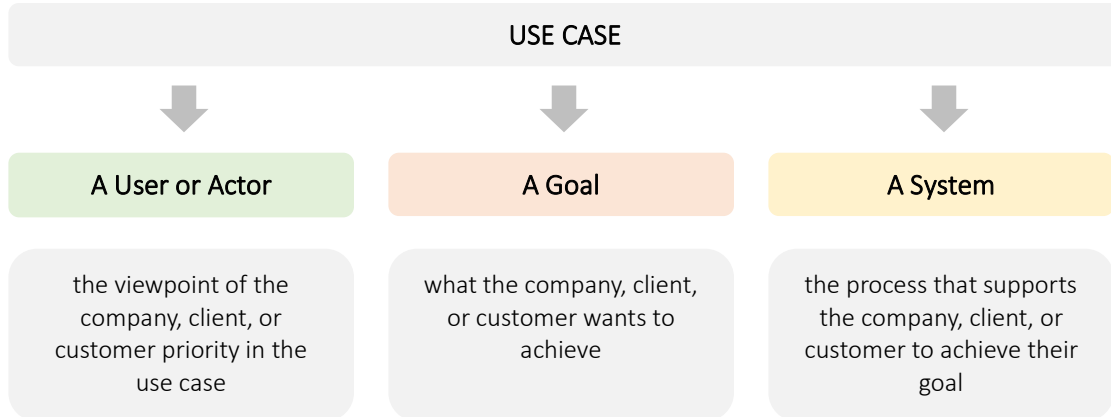
Clients and Customers

Clients receive goods and services**. Customers** buy goods and services from clients. For example:

- Grocery stores (clients) receive food and other products from wholesale vendors. The stores then sell the food and products to their customers.

- Home centers (clients) purchase lumber, tools, and supplies from manufacturers and vendors. The home centers then sell the materials to their customers - contractors, small businesses, and individuals.

Projects

Projects are an organized series of tasks that need to be completed to reach a specific outcome. A project is temporary, it has a defined beginning and ending time.

Project milestones

Project milestones mark specific points along a project's timeline. They serve as checkpoints to identify when activities or groups of activities are complete. Milestones keep projects on track. In your class, project milestones also address completion of CORE mathematics standards that undergird this class.

	Project tasks

Project tasks are work items or activities you'll be assigned with a specific purpose related to the larger goal. Tasks need to be accomplished within a defined period or by a deadline to move toward the project goals.

	Project deliverables

Project deliverables refer to outputs you'll submit with each milestone.

Big Idea Math

The California Math Framework supports learning with big ideas in mathematics, connected to each other and to authentic, real world contexts taught in multidimensional ways.

You will explore, practice, and work with project management terms used in industry throughout the class. Unit 1 begins with a business use case on selecting a location for a distribution warehouse in southern California.
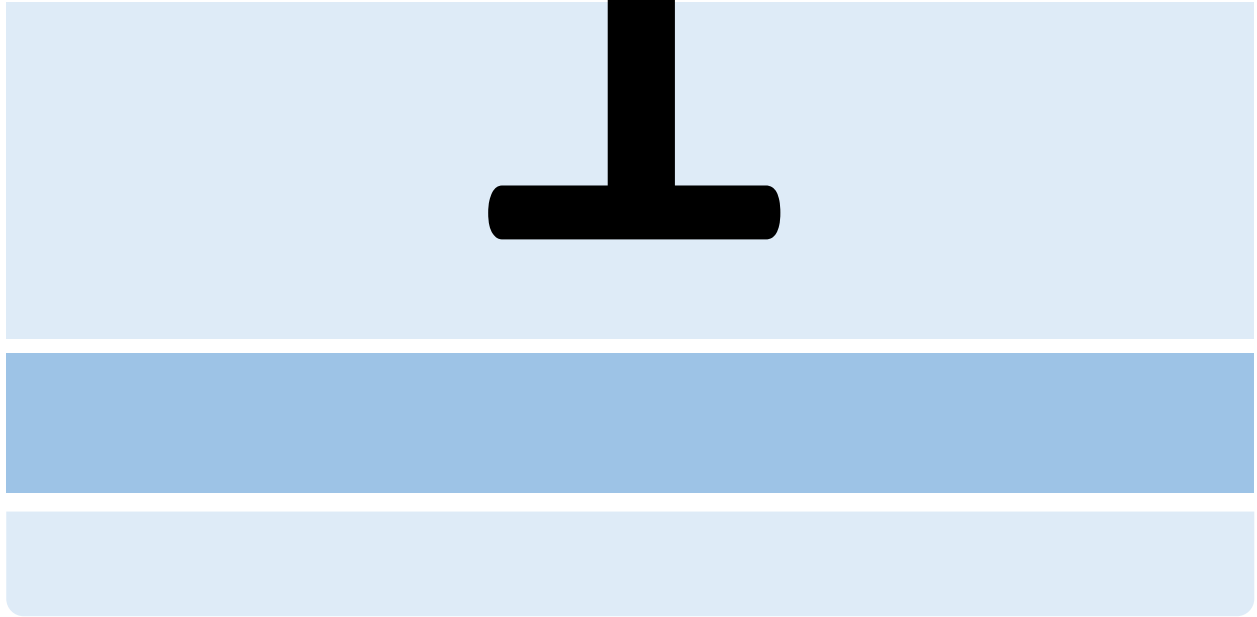
UNIT 1

A Billion Square Feet of Warehouses—And Growing

If 41 million square feet (ft²) of warehouse space in a city of about 215,000 people seems like a lot, it is. The ambitiously named World Logistics Center in Moreno Valley, California, cleared regulatory hurdles and environmental challenges over several years to become a construction-ready reality for commercial developer Highland Fairview.

With the construction of buildings envisioned over 15 years, the project creates options for tailored industrial spaces to store and transfer consumer goods. New warehouses are approved to be 80 feet high and connect corporate campuses via skywalks amid massive water features, day care centers for workers' children, subsidized electric bikes for employees, and hundreds of electric vehicle chargers on-site across 2,610 acres (Olalde). Highland Fairview completed a 1.8-million ft² distribution hub for Skechers USA as an anchor tenant, opened a second Skechers project on-site in 2022, and markets the center as the country's largest zero-emissions greenhouse gas project.

Thirty miles away, Prologis, a logistics real estate firm, is building a 4.1-million ft² warehouse for Amazon in Ontario, with 97-foot-tall ceilings, estimated to be almost as big in volume as two 73-story hotel skyscrapers in downtown Los Angeles. Warehouse floor space, at 4,055,890 ft² measures around 93 acres and, as one publication notes, would "hold all of Disney's California Adventure theme park with 21 acres to spare." The site plans to employ 1,500 people working with robotic devices designed to sort, pack, and transport contents around the facility. Packages are destined for points across North America by truck, freight train, and air cargo (Collins).

The number of warehouses sharply increased in the U.S. in the early 2000s, with retailers seeking places to stash the crates of goods streaming into U.S. ports, which they expect to sell quickly to online consumers. Between 2020 and 2023 alone, about 1.6 billion ft² of new warehouse space was built nationwide. Another 825 million ft² was in development as of 2023, a sum analytical firm CoStar Group Inc. likened in size to the city of Boston (King).

As more people flock online to buy household goods, retailer demand for storage and distribution sites comparable in size to multiples of football fields. In 1990, the average size of a Southern California warehouse was 143,000 ft². By 2023, that grew to 455,000 ft² (Newton and Osborn).

Milestone 1

Introduction

BUILDERS USA

The client for this business use case is Builders USA. They source and import building equipment and supplies from international manufacturers. Builders USA sells and distributes the equipment and supplies they buy internationally to home centers, like Home Depot, Lowes, Ace Hardware, and smaller hardware stores and lumber yards in California, Nevada, and Arizona.

Your role in this business use case is as an intern assigned to support project data gathering tasks that will contribute to informed team and company decision making in selecting and setting up a Builders USA distribution warehouse facility.

Milestone 1 assesses The Port of Long Beach and compares cargo container truck traveling times from the port to two potential warehouse locations. You will map a selection of transportation logistics to the warehouses detailed in the business use case, using Google Maps and Google Earth. Your purpose is to assess data and recommend one of two locations for Builders USA to select as their new distribution warehouse. First, preparing for this milestone includes understanding some project management, shipping, transportation, and mapping terms.

Milestone 1 Big Idea Math:

❖ Learning about the transportation industry sector and how geometry drives millions of products across millions of miles every day

❖ Utilizing latitude and longitude to assess Builders USA location options

biG iDEa

Terms

Builders USA imports products primarily from Asia and the Americas. **Cargo ships** bring products to ports in **cargo containers** where they are unloaded by **port cranes**. The image shows an example of unloading cargo containers with cranes in most major shipping docks around the world.
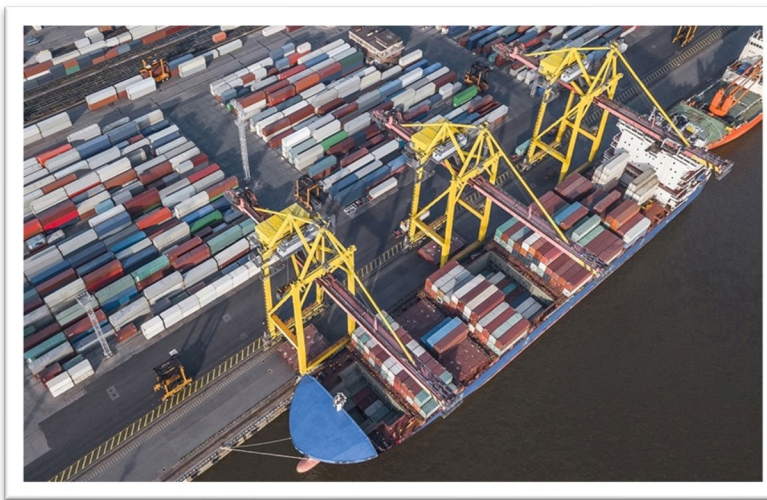
After unloading from ships, the containers travel on trucks to a warehouse for Builders USA distribution to home centers.
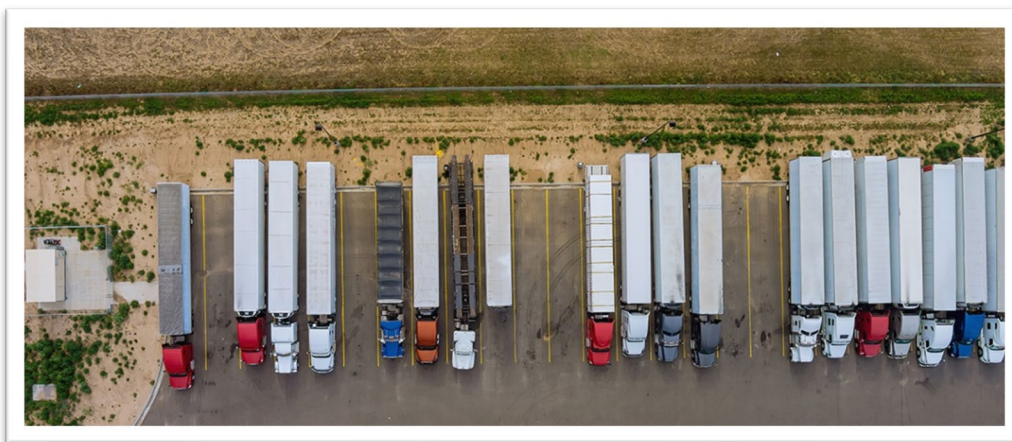
The cargo containers arrive at their pre-assigned warehouse dock where pallets are unloaded, stacked, and stored until selected for delivery.

Two-dimensional Objects

Two-dimensional objects are flat plane figures that display two dimensions on an x- and y-axis (width and length). Two-dimensional objects do not show depth (z-axis).

the plural of axis is axes
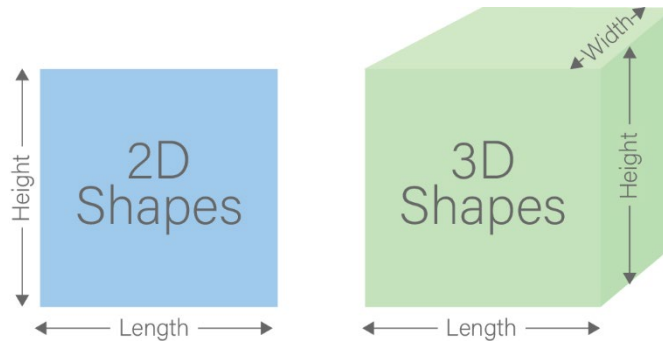
Here's a two-dimensional map of The Port of Long Beach, from a Google Map search. The Port of Long Beach is the nearest port to the Builders USA use case warehouse options.
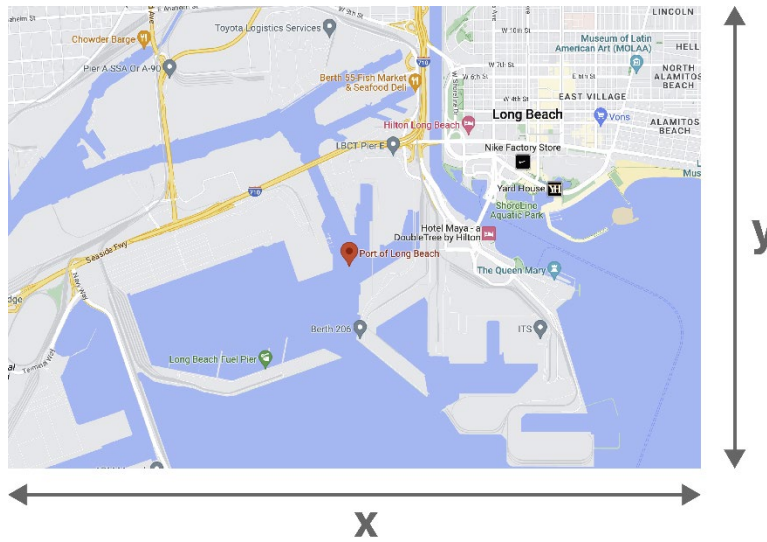
Two-dimensional objects in warehouse contexts are often maps, blueprints, and potential layouts for docks.
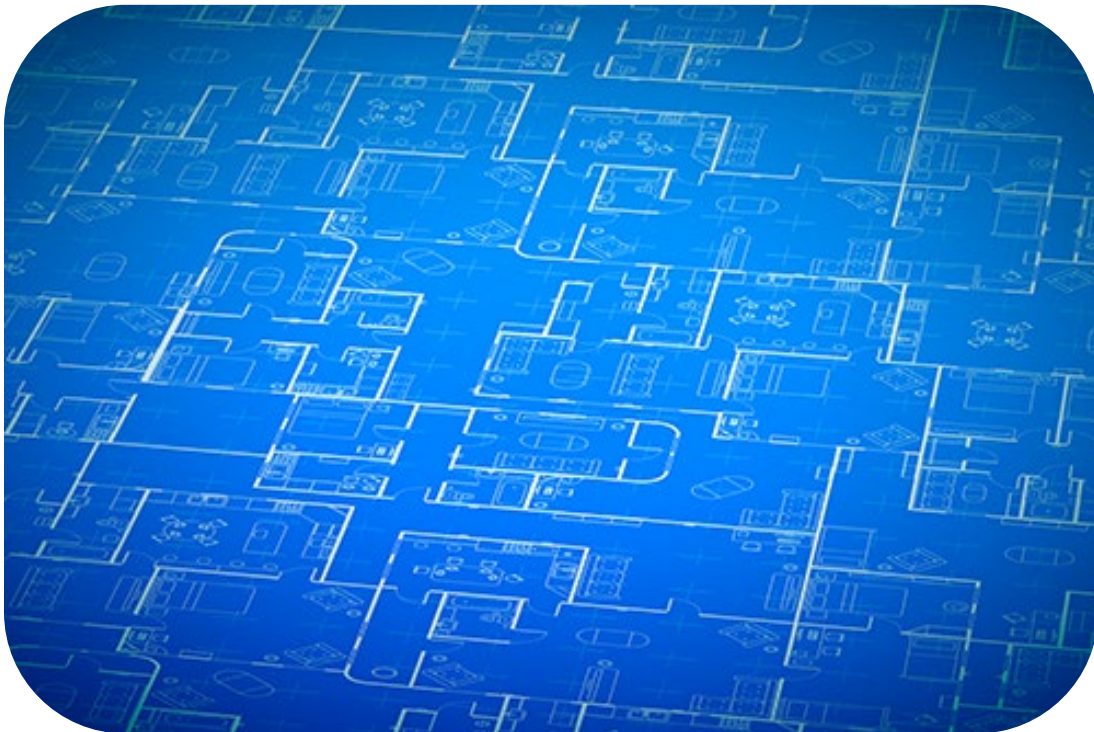
Two-dimensional Isometric Objects

Two-dimensional isometric objects are two-dimensional objects that appear to have depth (z-axis). You may have seen them in video games. Isometric drawing presents objects with 30-degree angles.

For example, the following images appear to be three-dimensional because you have an impression of width, length, and depth. However, they are two-dimensional images that add color, shadow, and perspective to appear as though they are three-dimensional. For Builders USA to make a major warehouse decision and investment, isometric illustrations don't support viewing x-, y-, and z-axes enough to inform running a business in the space.

You can gauge an isometric image based on the angle of your viewpoint.
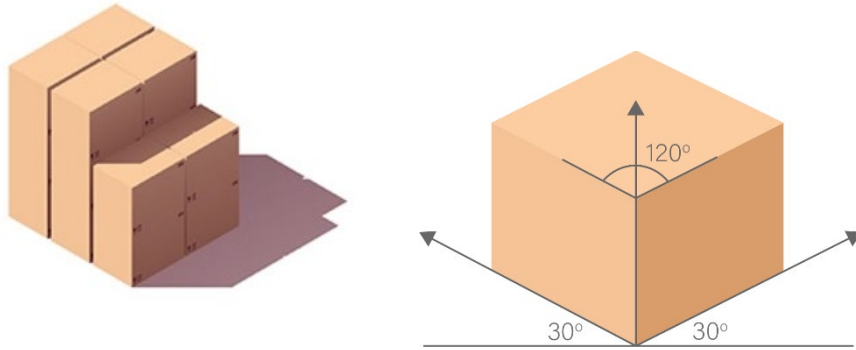
Three-dimensional Objects

Three-dimensional objects display x-, y-, and z-axes (width, length, and depth). Three-dimensional objects can be rotated in space. The Port of Long Beach, in a three-dimensional map, from the top view displays width, length. The image offers a general idea of depth through layering of sea, port, highway, etc. Three-dimensional images occupy greater physical space and can be viewed and interpreted from all sides and angles.

Zooming closer to view cargo containers, offers some amount of depth, conveying more three-dimensions than two-dimensions.
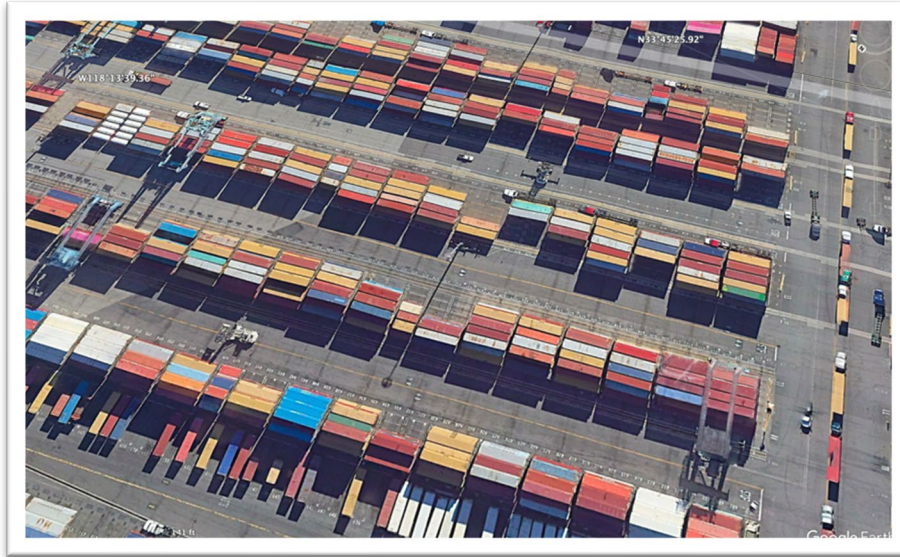
You've engaged with two- and three-dimensional graphics through gaming, comics, apps, and more. In the context of mathematics, your focus is identifying x-axis (width), y-axis (length), and z-axis (depth).

Tasks

Review the following images and identify which are two-dimensional, two-dimensional isometric, and three-dimensional. Identify the width (x-axis), length (y-axis), and depth (z-axis) of one object in each image.

Examples

Three-dimensional image
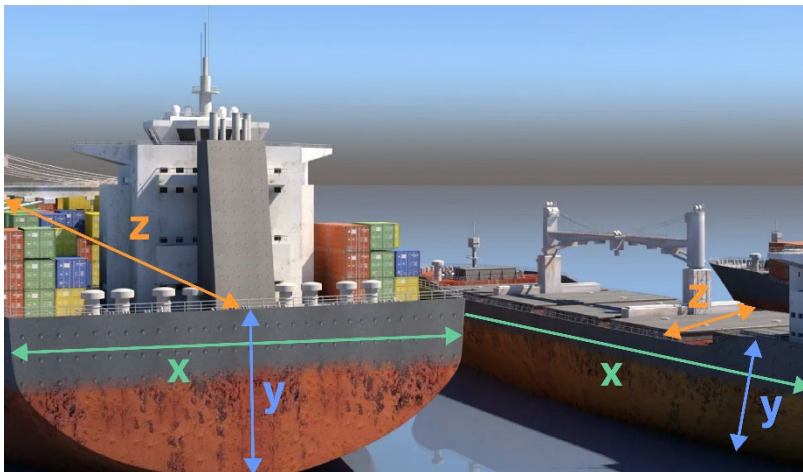
Two-dimensional isometric

Two-dimensional image

Your turn

Please draw in the width (x-axis), length (y-axis), and depth (z-axis) in the following images.

IMAGE 1

IMAGE 2

IMAGE 3

IMAGE 4

IMAGE 5

IMAGE 6

Do you notice the two-dimensional isometric images look toward the images from the same angle?

Hopefully, you'll now easily spot the differences between two-dimensional and two-dimensional isometric images. The first, two-dimensional, utilizes the width (x-axis) and length (y-axis). The second, two-dimensional isometric, utilizes 30 degrees to imply depth.
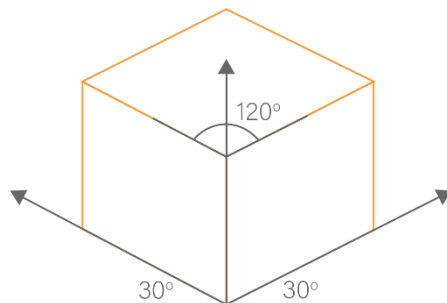
For Builders USA, two-dimension isometric images do not provide a true enough representation to assess which warehouse location supports their priority logistics from The Long Beach Port. And in the Builders USA planning processes, you can expect a combination of two-dimensional, isometric two-dimensional, and three-dimensional images as information for informed decision making. You'll want to recognize and utilize all three options for your best effort work.

Curious about the current statistics of cargo containers (amazing data) at The Port of Long Beach?
See this link: https://polb.com/business/port-statistics/#latest-statistics for impressive logistics.

Incorporating data for Milestone 1 requires understanding methodologies used for commercial development across all industry sectors. There's no need to memorize these terms, they're here as introduction, you'll see them in your tasks.

Terms

| GIS | Geographic information systems, are computer-based tools that store, visualize, analyze, and interpret geographic data. GIS is used to record information on to maps that combine different data sets together. GIS creates graphical representations to analyze situations, write reports, track changes, make decisions, and plan. |

| GPS | Global positioning systems are used to find the exact location of things. A GPS unit is a receiver that collects signals from satellites. Global Positioning System satellites transmit signals to GPS receivers on the ground. Receivers require a clear view of the sky, so they are used outdoors and do not perform well near tall buildings. |

| GIS or GPS? | The difference between GIS and GPS technologies is how they gather data. GIS is used for mapping and geospatial analysis of data and GPS is used for navigation. |

| Geographic data | The series of standards with a location relative to Earth. |

| Latitude and Longitude | The units that represent the geographic coordinate system, a spherical system for measuring and communicating positions directly on the earth as latitude and longitude, given as two numbers, called coordinates. |

Prime Meridian
0° Longitude

Equator
0° Latitude

Latitude: positive coordinates
Longitude: negative coordinates

Latitude: positive coordinates
Longitude: positive coordinates

Latitude: negative coordinates
Longitude: negative coordinates

Latitude: negative coordinates
Longitude: positive coordinates
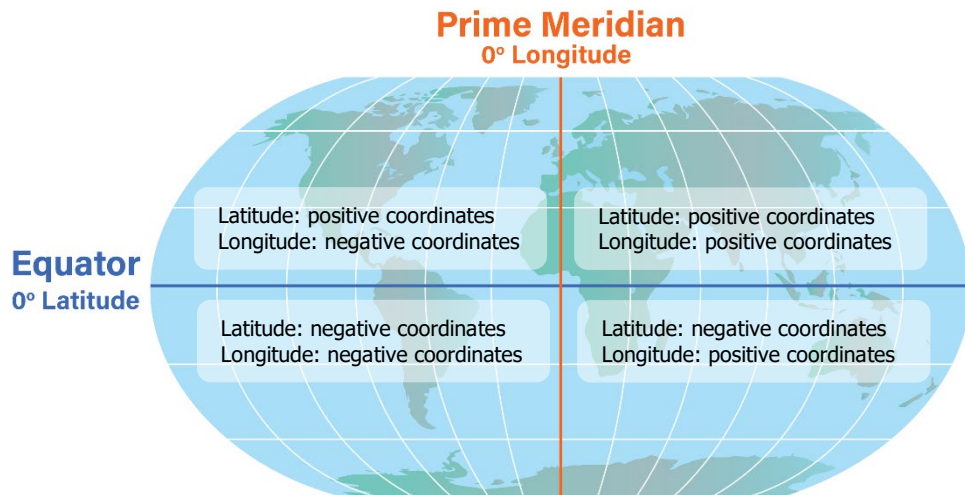
Latitude

Latitude lines run **east** and **west** and serve as a numerical way to measure how far north or south of the Equator your warehouse is located. Lines of latitude start at 0° degrees at the Equator and end at 90° degrees and the North and South Poles (for a total of 180° degrees of latitude). The higher the degree of latitude, the closer it is to the North or South Pole.
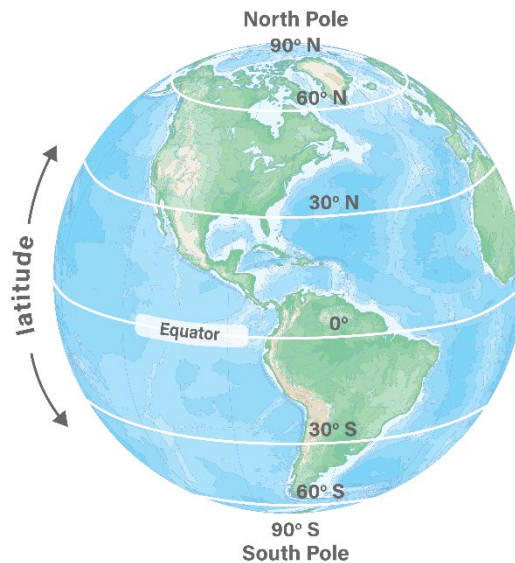
A location's latitude is expressed in degrees (°), minutes ('), and seconds (").

A positive latitude value is in the Northern Hemisphere. A negative latitude value is in the Southern Hemisphere.

Lines of latitude are called parallels. The distance between each degree of latitude is about 69 miles (110 kilometers).

Longitude

Longitude lines run **north** and **south** and mark the position east or west of the Prime Meridian (0° longitude), which passes through Greenwich, England.
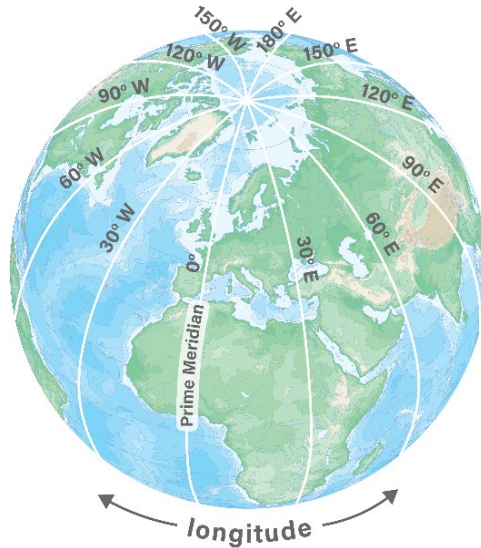
A location's longitude is expressed in degrees (°), minutes ('), and seconds (").

A positive longitude value indicates a location in the Eastern Hemisphere. A negative value indicates a location in the Western Hemisphere.

Lines of longitude cross the equator at right angles, all are of equal length, and each is one half of a circle.

Lines of longitude are called meridians and converge at the North and South Poles.

There are 360° degrees of longitude (+180° east of the Prime Meridian and -180° west of the Prime Meridian).
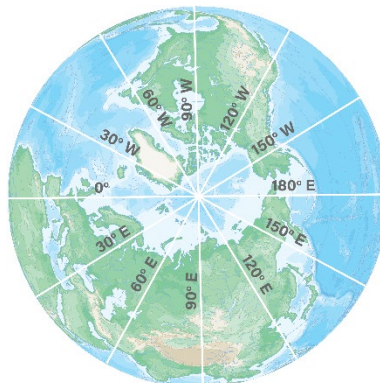
Tasks

Your role is to provide a series of images, with documentation, utilizing Maps and Google Earth, that will contribute to inform the client on transportation logistics between The Port of Long Beach and the use case warehouse offerings locations.

Milestone 1 also addresses the mathematics objectives:

Analyze images of

❖ two-dimensional objects
❖ three-dimensional objects

Common CORE Standards

Identify relationships between

❖ two-dimensional and three-dimensional objects
❖ two-dimensional cross-sections of three-dimensional objects
❖ three-dimensional objects generated by rotations of two-dimensional objects

Milestone 1 begins with Google Earth.

You can use Google Earth without a Gmail account; however, to save your work, you will need one. The link to set up a Gmail account is https://accounts.google.com/signup

With your Gmail account open, key this link into your browser window to launch Google Earth: https://earth.google.com/web/

Task 1	Skechers Distribution Warehouse

This task, a Skechers distribution warehouse, mirrors the steps you'll follow for your Milestone deliverable.

The Skechers USA 1.8 million ft² distribution warehouse, located in Moreno, California, sits on approximately 85 acres. The building is more than 40 acres in size and was awarded a Leed Certification Gold by the U.S. Green Building Council (a big deal accomplishment).

The Skechers warehouse address is:

29800 Eucalyptus Avenue

Moreno Valley, CA 92555

However, it's common for street addresses to not provide enough information for clients before a building is constructed. Often, street addresses don't exist in early stages of property development and an Assessor Parcel Number (APN) is used. GPS and GIS are used internationally to identify exact locations anywhere in the world (land or sea).

In Google Earth key:

29800 Eucalyptus Avenue
Moreno Valley, CA 92555

View the Skecher's Distribution Center. First, as a 2D image (in the bottom right legend, toggle between 2D and 3D).
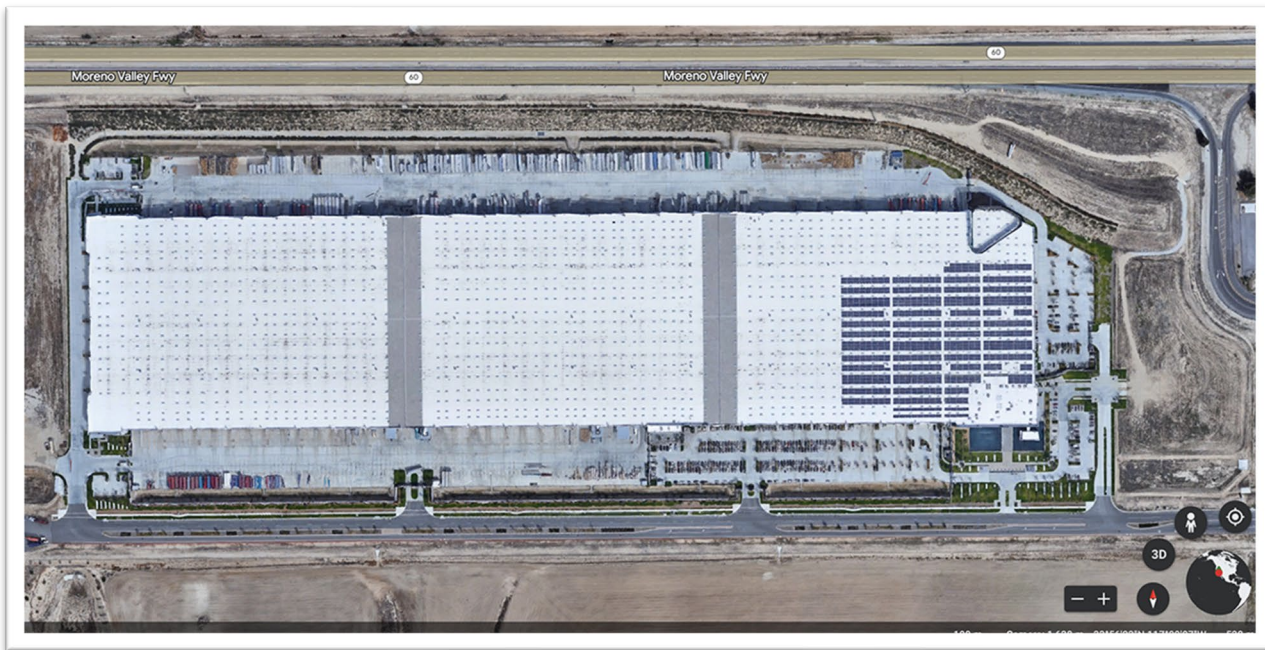
Next, as a 3D image.

In the bottom-right corner, is the latitude and longitude

100 m   Camera: 1,112 m   33°56'02"N 117°08'44"W   523 m
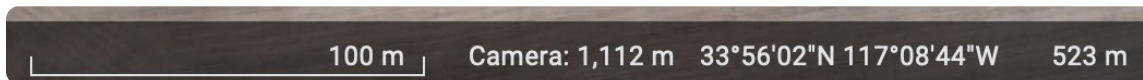
If you click into the warehouse and move your cursor around the screen, latitude and longitude change because the point of measurement is your cursor. The numbers represent coordinates of the point on the ground directly below your cursor. You're at a different degree (°), minutes ('), and seconds (") at different locations over and around the warehouse.

The legend area of your screen shows several icons
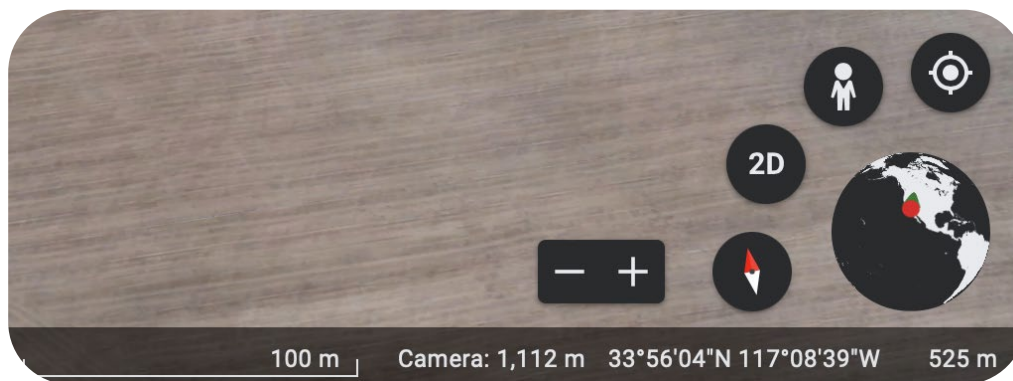
Icons explained:	
	Zoom in and out.
	Fly to a location you specify, key in your home or school address.
	Select and drag to enter street view and look around. Select < or > arrows to pivot around.
	Tilts your view between 2D and 3D. Click to reset the view.
	Compass tracking as you fly around your location.
	Zoom to space or drag it to fly to a place.

The legend at the bottom of your map offers:

300 m	Scale bar, the ground length of the line shown is 300 meters.
Camera: 2,508 m	Height from earth for the current camera (m is meters).
33°56'16"N 117°08'14"W	Coordinates of the point on the ground directly below your cursor.
545 m	Elevation above sea level of the point on the ground directly below your cursor.

Although Google Earth offers a lot of detail, it's considered a GPS system. There are GIS applications available that go into much more detailed data. Google Earth Pro (free software downloaded rather than web-based) offers more detail than Google Earth as a GPS and is a user-friendly resource for learners interested in learning about GIS. If you're interested in learning more about GIS, please see the following National Geographic article:

https://education.nationalgeographic.org/resource/geographic-information-system-gis/

Task 2 | **GIS Decimal Representation**

In addition to identifying latitude and longitude as degrees (°), minutes ('), and seconds ("), known as DMS, latitude and longitude are often represented with a digital equivalent called decimal degrees (DD). DD are used in GIS and other mapping applications.

Positive latitudes are north of the equator;
negative latitudes are south of the equator.

Positive longitudes are east of the Prime Meridian;
negative longitudes are west of the Prime Meridian.

You will convert locations from DMS to DD because the DD format is most useful for this business use case project.
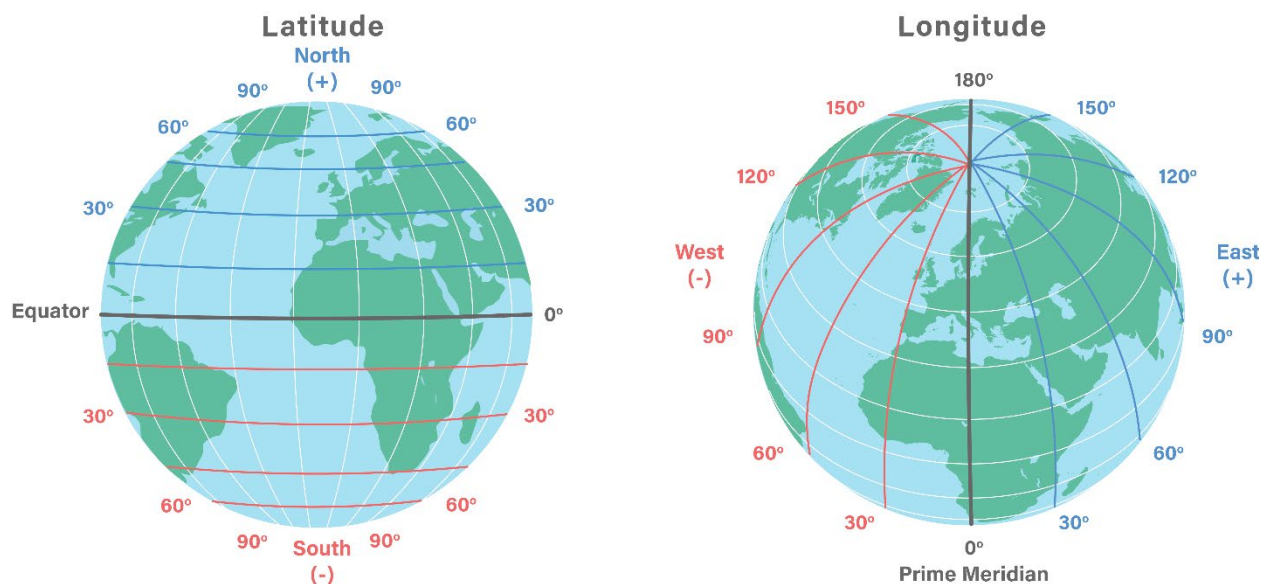
You will use the Federal Communications Commission (FCC) website to convert latitude and longitude from degrees, minutes, seconds (DMS) to decimal degrees (DD).

Please go to the website:

https://www.fcc.gov/media/radio/dms-decimal

where you will see a web form to perform the conversion for you.

Degrees Minutes Seconds to Decimal Degrees

Enter Degrees Minutes Seconds latitude: [ ] [ ] [ ]

Enter Degrees Minutes Seconds longitude: [ ] [ ] [ ]

[Convert to Decimal] [Clear Values]

Results: Latitude: [ ]   Longitude: [ ]

With an address in numbers, people can communicate no matter what language they speak or what directions are given.

Note: The form has a max character count - your seconds may be 3 decimal places rather than 4.

❖ Key the DMS from the Skecher's Warehouse into the FCC site Degree Minutes Seconds (DMS) to Decimal Degrees (DD).

❖ Enter Degrees Minutes Seconds latitude (tab between text fields)

❖ Enter Degrees Minutes Seconds longitude

What is the DD for the Skecher's Warehouse?

_____

| Task 3 | Warehouse Locations |

Here are the locations of the three warehouses you will assess. The first two are available, the third is for a comparison step in the project:

> 33°55'30" N -117°07'30" W - World Logistics Center (option for Builders USA)
>
> 33°59'12.5" N -117°37'48" W - South Ontario Logistics Center (option for Builders USA)
>
> 33°59'12.87" N -117°36'56" W - Amazon Warehouse (comparison example)

1. Identify the DD (decimal degrees) for the DMS of each location

World Logistics Center (option for Builders USA)

_____

South Ontario Logistics Center (option for Builders USA)

_____

Amazon Warehouse (comparison example)

_____

2. Also, identify the DD (decimal degrees) and name a few more locations

33°45'4.6980" N -118°11'19.7232" W   _____

33°48'45.0396" N -117°55'8.3136" W   _____

33°56'36.6972" N -118°24'31.1868" W   _____

33°56'13" N -117°08'54" W   _____

Step By Step Instruction

STEP 1

Open Google Earth

STEP 2

In Google Earth, select the Project icon in the left navigation menu.

STEP 3

In the Projects window, select the New Project button or the Create button, whichever your version of Earth offers.

STEP 4

Select Create project in Google Drive.

Trivia: KML is the acronym for Keyhole Markup Language, a file format used to display geographic data (Google Earth was originally named Keyhole Earth Viewer).

STEP 5

Name your Project and add a Description. Click out below the box to save.
For example:

Builders USA Project

Warehouse recommendations for Builders USA.
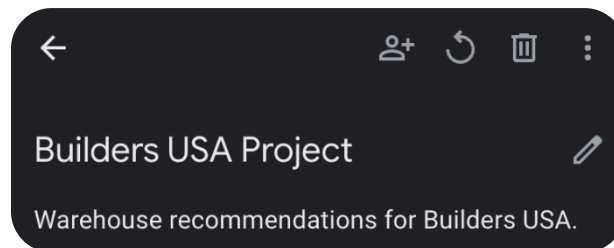
STEP 6

Top right, there are four icons that represent Share project; Reload project; Delete project; and More actions (currently Copy project; Export as KML file; and Report inappropriate content).

STEP 7 | Select the Share button to share with your teacher as assigned.

The pencil icon, to the right of your Project title is for editing your title or description.

STEP 8 | Select the New feature dropdown button and select Search to add a place.

New feature ▾

🔍 Search to add place

STEP 9 | Enter the DD of the first warehouse location, the World Logistics Center.

Separate the two decimals with a comma when keying into Google Earth and remember the - sign on your longitude.

Note that 33°55'30" N, -117°07'30" W - World Logistics Center is the DMS that matches the DD you keyed into search.

Google Earth and Google Map images are often taken years before your viewing, especially in rural and developing locations. In the popup window on the right, select the Add to project button.
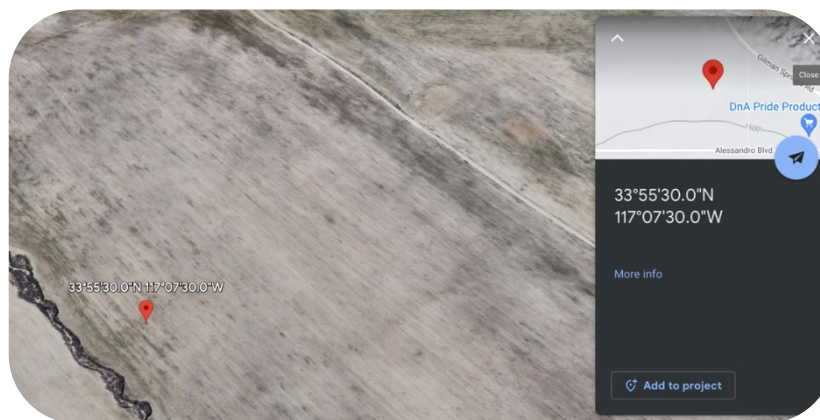
STEP 10

Select the drop menu icon (three dots) to select an icon to represent the warehouse location and change the color with the color fill to your preference.
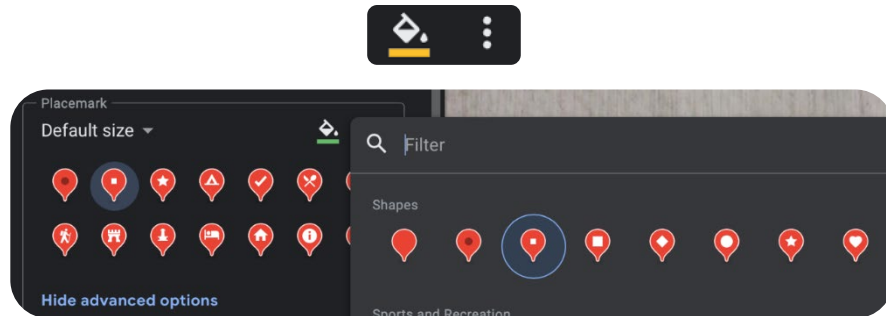
Here's an example with green and square selected.
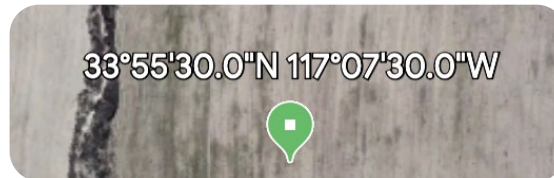
STEP 11

Select the back arrow, in the top left window.

STEP 12

Repeat this process for all locations (seven total). Remember to add a comma between decimals in Earth and if you get stuck or off track, select the project icon, left navigation, and you'll go back to your project.

If you want to change the color or icon on any location, select the location and the pencil icon directs you to the color and icon selection charts.
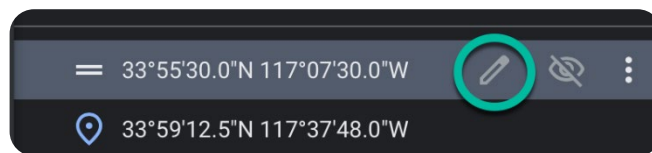
STEP 13	Close Google Earth. Your work is autosaved in Google Drive.

Quick Steps to add the locations:

    a. Enter your project

    b. Select New feature

    c. Select Search to add place

    d. Key DD (with a comma between decimals and a - before your first longitude decimal)

    e. Select Add to project from the popup

    f. Select a Placemark and color (different color and icon for each location)

    g. Return to your project with the back arrow button (top left in Earth, not browser back arrow)

    h. Back to project, start again with Select New feature (repeat this list for all seven locations)

Next up, you will begin assessing warehouse location options using Google Maps and Google Earth.

Task 4	Data Gathering

Data gathering, also called data collection, is when you seek, collect, and synthesize information from various stakeholders and sources in an objective, unbiased manner to reach a conclusion, goal, or judgment and to enable strategic and leadership decision making.

Decisions on where to purchase or lease a warehouse are often made years before building begins. Architects and engineers design the building's exterior and interior shell per the client's priorities. However, the efficiency needed to transport products is as essential as the job site. Your next step is to seek and collect information to inform transportation times from The Port of Long Beach to your potential warehouse locations.

STEP 1	Open Google Maps, https://maps.google.com/

STEP 2	Set your starting location (top left textbox) as:

33.751305, -118.188812

STEP 3	Select Directions and add your destination

33.925, -117.125

| STEP 4	You may need to use the direction arrows, immediate right from the textboxes, to indicate changes in direction.

You will see a map starting from The Port of Long Beach and ending at the World Logistics Center. The route distance is around 80 miles. The travel time depends on the day of the week and time of day you enter this data. Los Angeles Metropolitan Area traffic, like many urban centers, is daunting.

Here is a Saturday afternoon expected travel time. A day/time with minimal commute traffic:
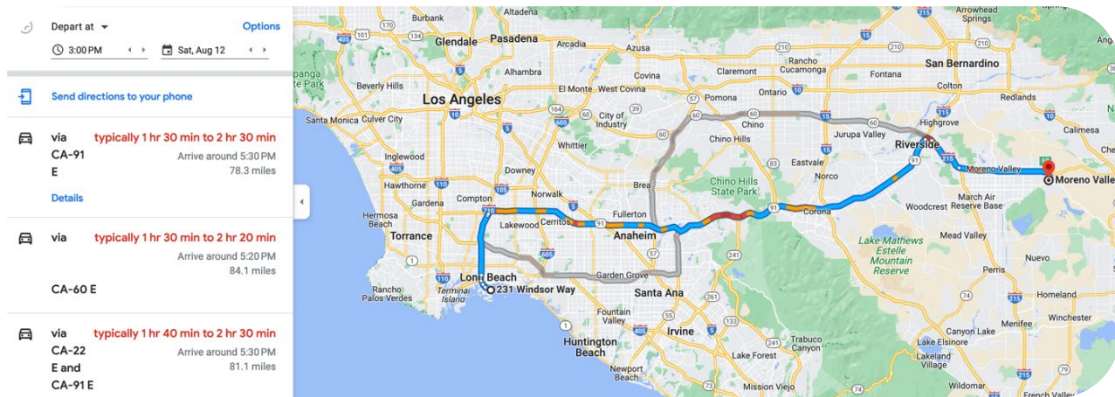
The range of expected travel is an expensive consideration. A range from 1 hour 30 minutes (90 minutes) to 2 hours 30 minutes (150 minutes) is 90/150 = a potential 60% increase in travel time. Reversing directions, from the warehouse to the port changes recommended freeways and maintains a wide time range. These data suggest both directions need further analysis.
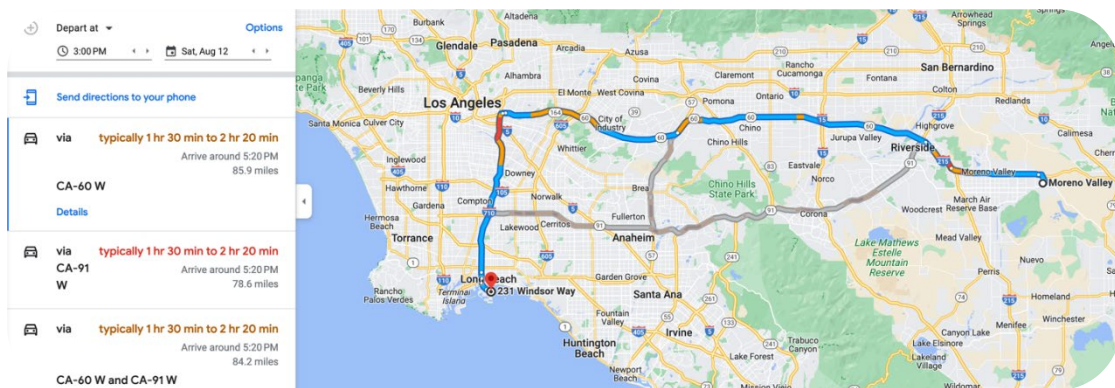
| STEP 5 | To change the day and time of travel in Google Maps, select the Depart at dropdown menu below the locations you entered, and enter a day and time you want to assess. |

Your Turn

Using Google Maps, create a table that details the travel times from:

a. The Port of Long Beach to the World Logistics Center (option for Builders USA)

Day/Time	Eastbound Port to World Logistics Center	Westbound World Logistics Center to Port
Tuesday at 10:00 AM		
Tuesday at 7:00 AM		
Friday at 5:00 PM		
Friday at 7:00 PM		

How many different routes were mapped for the times above?

_____

Using Google Maps, experiment to identify two days/times where traffic appears light and then two days/times where it appears heavy. Note times for each.

Day/Time (2 light, 2 heavy)	Eastbound Port to World Logistics Center	Westbound World Logistics Center to Port

b. The Port of Long Beach to the South Ontario Logistics Center (option for Builders USA)

Day/Time	Eastbound	Westbound
	Port to South Ontario Logistics Center	South Ontario Logistics Center to Port

How many different routes were mapped for the times above?

_____

c. The Port of Long Beach to the Amazon Warehouse (for comparison)

Day/Time	Eastbound	Westbound
	Port to Amazon Warehouse	Amazon Warehouse to Port

How many different routes were mapped for the times above?

_____

Milestone 1 Check-in Meeting

Per your teacher's instructions, meet in small teams and discuss your data findings. Critically assess and discuss the following Milestone 1 questions:

1. What are two primary logistics concerns you have currently for Builders USA transporting from The Port of Long Beach to the World Logistics Center location?

    _____

    _____

    _____

2. How are your logistics concerns similar or different in assessing transporting from The Port of Long Beach to the South Ontario Logistics Center?

    _____

    _____

    _____

3. The massive Amazon Warehouse is not far from the South Ontario Logistics Center. According to your data, do they face similar logistics challenges? To invest in a 4.1-million ft² warehouse in Ontario, with 97-foot-tall ceilings, must have been driven by data. In reviewing the area with Google Earth and Google Maps, what types of business considerations do you think Amazon may have developed or measured to determine this size of investment?

    _____

    _____

    _____

4. Based on the Milestone 1 Check-in Meeting, what additional logistics data might you explore and incorporate into your recommendation?

    _____

    _____

    _____

Quick Check on the Unit's Common Core Standards

Analyze images of

- ✓ two-dimensional objects
- ✓ three-dimensional objects

Identify relationships between

- ❖ two-dimensional and three-dimensional objects
- ❖ two-dimensional cross-sections of three-dimensional objects
- ❖ three-dimensional objects generated by rotations of two-dimensional objects

Transportation Operations

Your Google Earth mapping of location and Google Maps mapping of traveling routes and times will combine with a few more considerations to support a Builders USA location recommendation.

Terms

Freight Shipping

Calculating freight rates is a complex balance of efficiency and profitability. Key to efficiency and cost are five basic freight shipping methods:

Full truckload (FTL)	Freight typically exceeds 15,000 pounds.
Partial truckload (PTL)	When a load doesn't fill up a container, carriers take on multiple shipments to earn more per mile and maximize their earnings per trip. PTL are typically point-to-point, so freight loaded onto a truck stays on board until its definitions. But with some shippers, there might be different locations. PTLs are charged per mile, pro-rated by weight and dimension.
Less than truckload (LTL)	It is like PTL; however, the shipment might move between vehicles during the shipping process.
Intermodal	It involves multiple shipping methods. For example, rail and road.
Expedited	It involves direct routes, overnight or express shipping and is the

Operational Costs

Additional **operational costs** include traffic congestion, fuel prices, and inflation. Highway congestion adds tens of billions of dollars to the cost of freight transportation each year. Truck drivers, who move more than 70% of US freight, sit in traffic for over 1 billion hours per year, at average rush hour speeds of 36.3 miles per hour, burning fuel, and emitting carbon dioxide (Business Insider).

Images as Data

So far, you gathered data regarding traveling time and explored two-dimensional and three-dimensional images to help Builders USA envision their warehouse options.

Imagine the amount of information required to plan an efficient logistics warehouse, from receipt of goods at The Port of Long Beach to distributing different combinations of products through the distribution warehouse to home centers. This image shows one row of 106 containers on a cargo ship, not counting what's below deck or on the rest of the ship. Consider the size of each container you've seen driving and how much each holds in its 2,390 cubic feet of space.

The average number of containers on a cargo ship is approximately 15,000. Small ships may hold 600 containers and massive ships over 20,000.

The planning information needed to analyze and fund a large distribution warehouse includes a combination of maps, blueprints, manufacturer specifications, building code requirements, and more, all of which are a mix of two-dimensional and three-dimensional images. Consider this data:

- An average Walmart is 106,000 ft², with a Walmart Supercenter at an average 182,000 ft².
- An average Target is 130,000 ft².
- A 1 million ft² distribution warehouse is 7.69 Targets under one roof.

The Skechers distribution warehouse described in the use case is 1.8 million ft² and the Amazon distribution warehouse is 4.1 million ft². That's Sketchers at 9.89 and Amazon at 22.5 Walmart Supercenters **under one roof**. Add in 80-97' ceilings and you can see the magnitude involved in changing an infrastructure layout after construction is complete.

Milestone 2: Maximize the Cube!

Warehouses are air-conditioned/heated spaces (called conditioned spaces). Industrial vacancy rates remain historically low, with leasable warehouse space filled in major markets from New York to Georgia. Warehouse rent grew nationally by 3 percent every quarter between mid-2020 and 2023, with per ft² cost exceeding $15 in Los Angeles, Long Island, N.Y., and Silicon Valley.

Across the U.S., annual lease rates averaged $9.09/ft²., with a 3.9% vacancy rate. Figures in major metros topped out in Los Angeles County at $19.55/ft² and were lowest in Atlanta at $5.79/ft². Boston posted the highest vacancy rate, at 7.6%. Bridgeport, Conn., had the lowest vacancy rate, 1.2%, followed closely by the Inland Empire, 1.7%. The Dallas-Fort Worth metro area is seeing the biggest warehouse boom in construction, at 58.97 million ft², compared to the smaller warehouse construction in Orange County, Calif., with about 500,000 ft². The Inland Empire sold the highest dollar amount in warehouse spaces in one period, at $855 million, compared to Kansas City, with $13 million in industrial sales transactions over the same period (Jozsa).

Considering Los Angeles at a minimum of $15 per ft², a poorly planned warehouse aisle, planned too wide, with only 2' wide and 100' long unused space costs Builders USA $3,000 a month with no return. And that cost is before conditioning.

For all warehouses, of all types, in all industry sectors, a top priority is

Maximize the Cube!

Why is this important? Maximize the Cube! refers to what is packed into every cargo ship (it's a cube) loaded with containers (cubes again) arriving at The Port of Long Beach, the warehouse dimensions (another cube), and every storage rack in the warehouse with loaded pallets (all are cubes).

Planning for warehouse efficiency means planning in two- and three-dimensional shapes to include cross-sections.

Let's identify relationships between:

1	2	3
two-dimensional and three-dimensional objects	two-dimensional cross-sections of three-dimensional objects	three-dimensional objects generated by rotations of two-dimensional objects
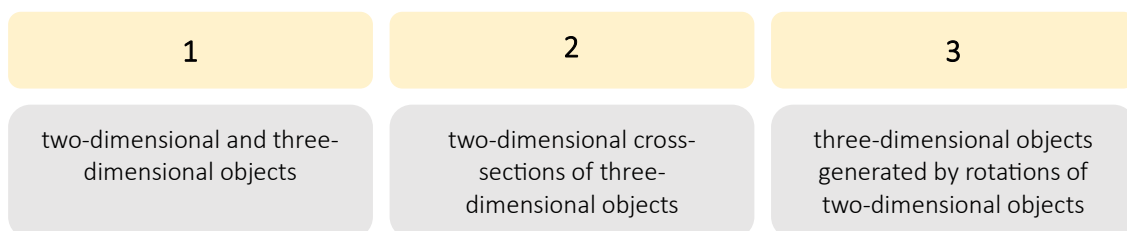
Tasks

Task 1   Two-dimensional and three-dimensional objects

The top-view of a cargo ship below, moored at the Port of Long Beach is a two-dimensional object. The x-axis (width) and y-axis (length) are visible; the z-axis (depth) is not.

> Please draw the x-axis and y-axis on the photo.

Below, is a series of three-dimensional images.

> Please draw the x-axis (width), y-axis (length), and z-axis (depth) on each.
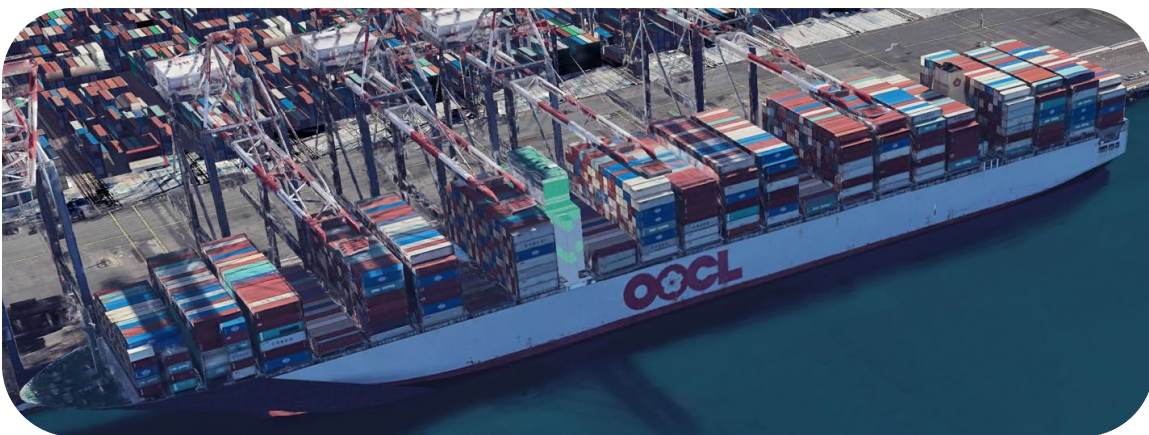
Three-dimensional objects can be used to generate two-dimensional objects. This **face** of the three-dimensional object below is a two-dimensional object with an x-axis (width) and y-axis (length).

Please outline the two-dimensional face of the following three-dimensional images and label the x-axis and y-axis.
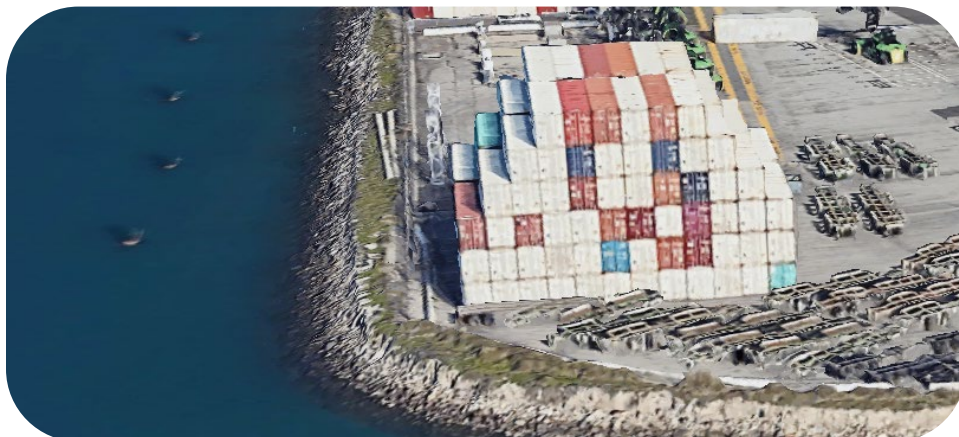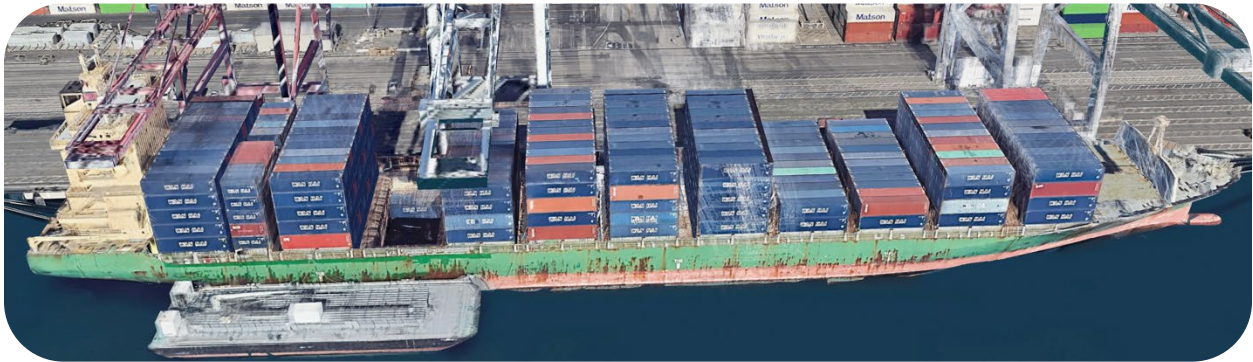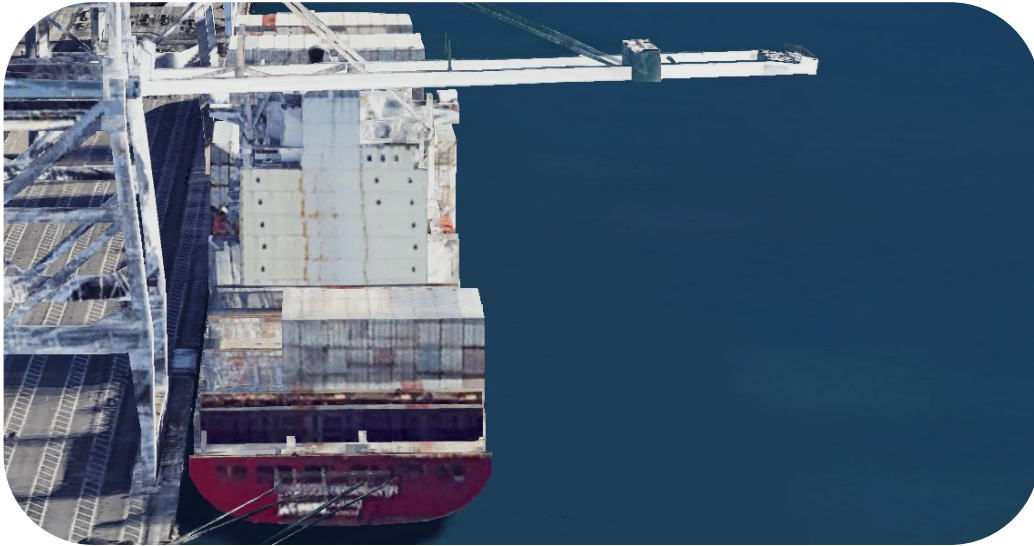
In addition to providing the Builders USA with images that inform company priorities, in Milestone 2, you will create two-dimensional cross-sections of three-dimensional objects and three-dimensional objects generated by rotating two-dimensional objects.

Terms

Cross-section

A **cross-section** of an object is the intersection of that object with a plane (think of a slice of the object). Generally, a cross-section cuts off at a right angle to an axis (cuts straight through the object). The cross-section can be an angled slice. The following image portrays a cross-section of a container, looking out.
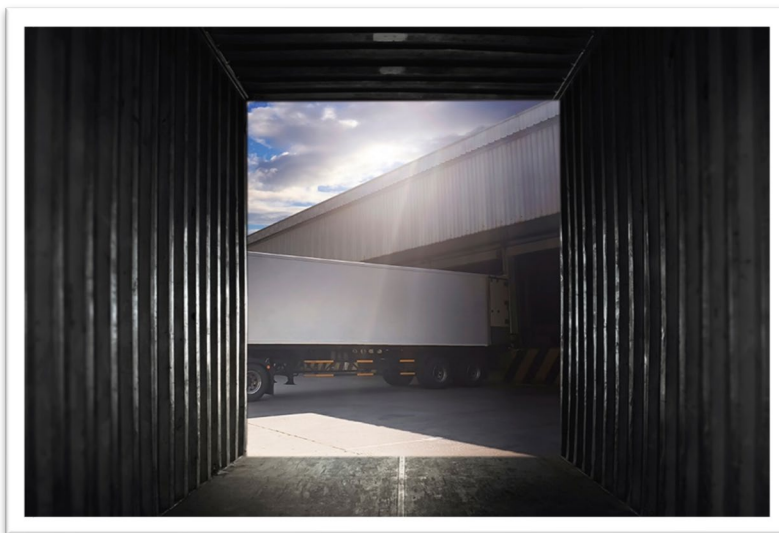
The lines in the next image represent the 'slice' that creates the cross-section.
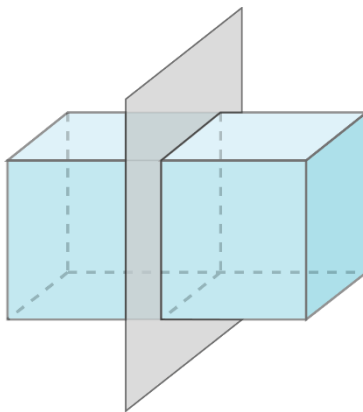
The following cross-section image displays most of the inside of a cargo container with the cross-section defined above added in.

A cross-section of the same container can take multiple forms:

| Horizontal cross-section | Vertical cross-section | Cross-section at another angle |

Which appear as:
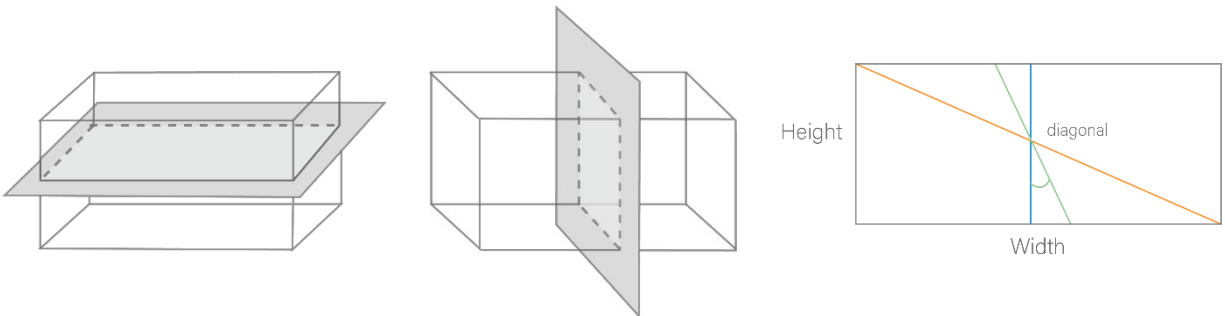
Your intent in utilizing two-dimensional objects, three-dimensional objects, and cross-sections is to inform Builders USA as to what the space and equipment shape and size are so they can determine how they integrate with their business model and logistics priorities. In other words, your data will inform Builders USA how to **Maximize the Cube**.

When creating plans for companies, clients request maps and schematics (drawings or plans) to inform what it will be like to navigate and work in the ecosystem (port, logistics, exterior warehouse, interior warehouse). Clients will visit, survey, measure, and develop workflows to make a final decision; however, working with images as data informs whether to pursue a deeper review of the potential space for their business or pass on a location before spending too much time and money in due diligence (process of investigating and verifying information about a company or investment opportunity).

Task 2	Two-dimensional cross-sections of three-dimensional objects

This image represents a three-dimensional object

In the space below, sketch a cross-section of the loaded pallet, for the purpose of balancing weight on the forklift.

Also sketch a cross-section of the container, for the purpose of viewing how much of the container (front to back) the pallet will occupy.

In the space next to the image, sketch a cross-section through this dock of pallets, for the purpose of navigating an evacuation route for fire trucks.
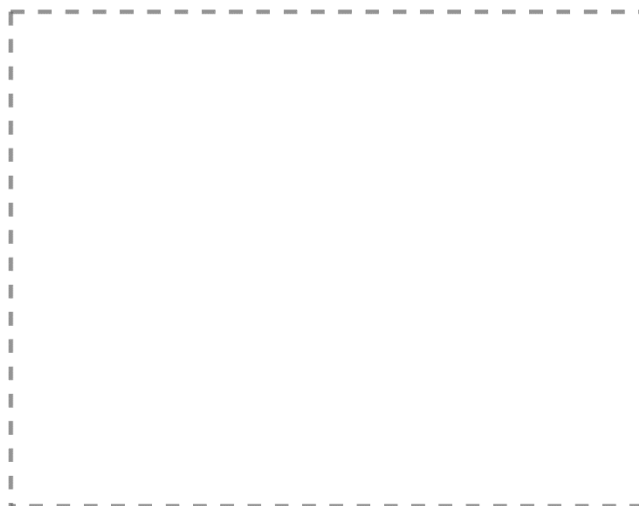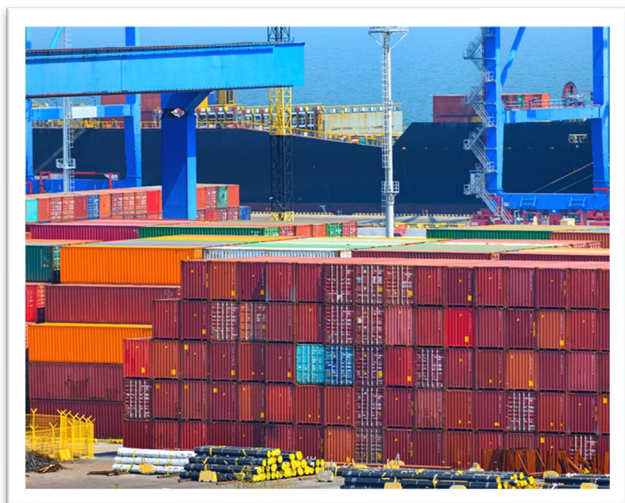
In the space below the image, sketch a cross-section of the four dock bays without the container trucks.

So far, looking at two-dimensional and three-dimensional objects, and their cross-sections and relationships may seem new yet logical. With Maximize the Cube as priority, packing containers, warehouse racks, and pallets create multiple cross-section views that inform and support decision making.

Task 3 Generating three-dimensional objects by rotating two-dimensional objects

Next, generating three-dimensional objects by rotating two-dimensional objects is a little unexpected. With a simple example we will showcase how rotating two-dimensional objects, can easily generate three-dimensional objects.

Step By Step Instruction

STEP 1 Fold a piece of paper into a rectangle, any size paper works.

STEP 2 Tape a pen to one edge or hold the edge with your fingers (the tape is easier) and position the paper vertically.
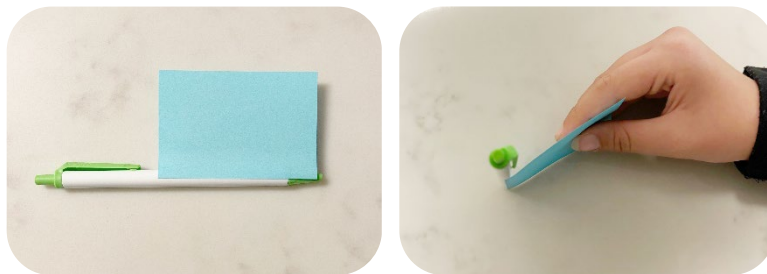
STEP 3 Place the tip of your pen (or finger) on the table surface and watch the outside edge of the paper as turn a full circle (360°).

Although you started with a rectangle similar in shape to the containers you've worked with, rotating a two-dimensional rectangle produces a shape much different than the container. Considering the x-axis (width), y-axis (length), and z-axis (depth) of the paper, the resulting three-dimensional shape is a cylinder.
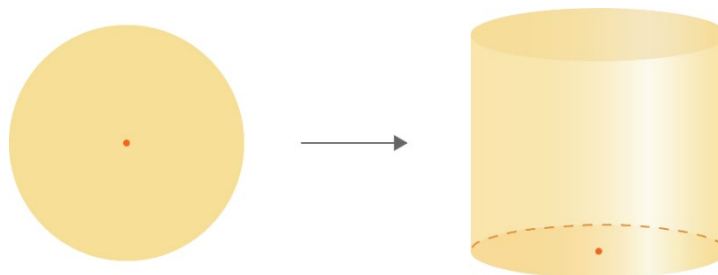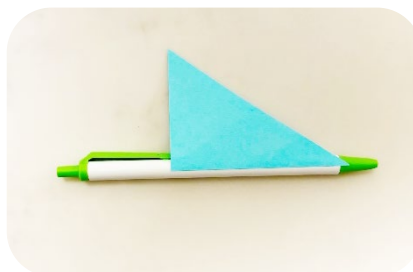
| STEP 4 | Using the same pen and rectangular paper, lay the pen on its side, and the paper flat to one side of the pen. Then roll the pen so the paper lands on the opposite side of the pen. |
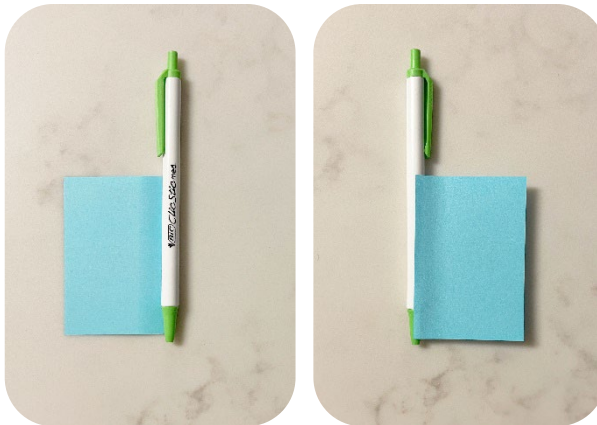
What three-dimensional shape resulted?

| STEP 5 | Cut or fold your rectangle to create a right triangle. |

| STEP 6 | Place the tip of your pen (or finger) on the table surface and watch the outside edge of the paper as turn a full circle (360°). Does this cone shape a surprise? |
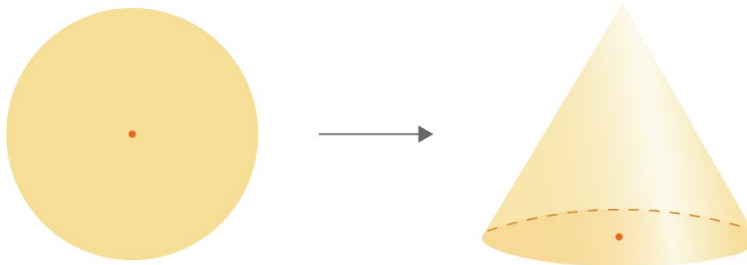
You rotated a two-dimensional rectangle to a three-dimensional cylinder and a two-dimensional triangle to three-dimensional cone. You can also slice three-dimensional shapes into two-dimensional shapes.

Generating three-dimensional objects by rotating two-dimensional objects is an essential skill in distribution warehouses. This two-dimensional image gives your team a fair idea of what to expect at the Builders USA warehouse.


However, a three-dimensional understanding of how each item in this two-dimensional image moves is critical for operations. The forklift needs to be able to drive up to the truck, lift and pick up a pallet, back out, turn around, drive to a warehouse rack, lift to the correct height, insert the pallet, back away from the rack, swing around, and head back to the truck to Maximize the Cube. The truck requires significant space to address security, traffic control, safety, worker comfort, and space availability.

Most containers on trucks are 40' long. A cab with container is 48'-53' long and 8.5' wide. Trucks don't pivot. In dock planning, an entrance driveway needs to be large enough to handle the turning radius of the longest truck serving the site.

Here are two-dimensional example graphics that represent the three-dimensional movement needed for planning (Kelley Dock Solutions).

<div style="background-color:#cfe0c3;">
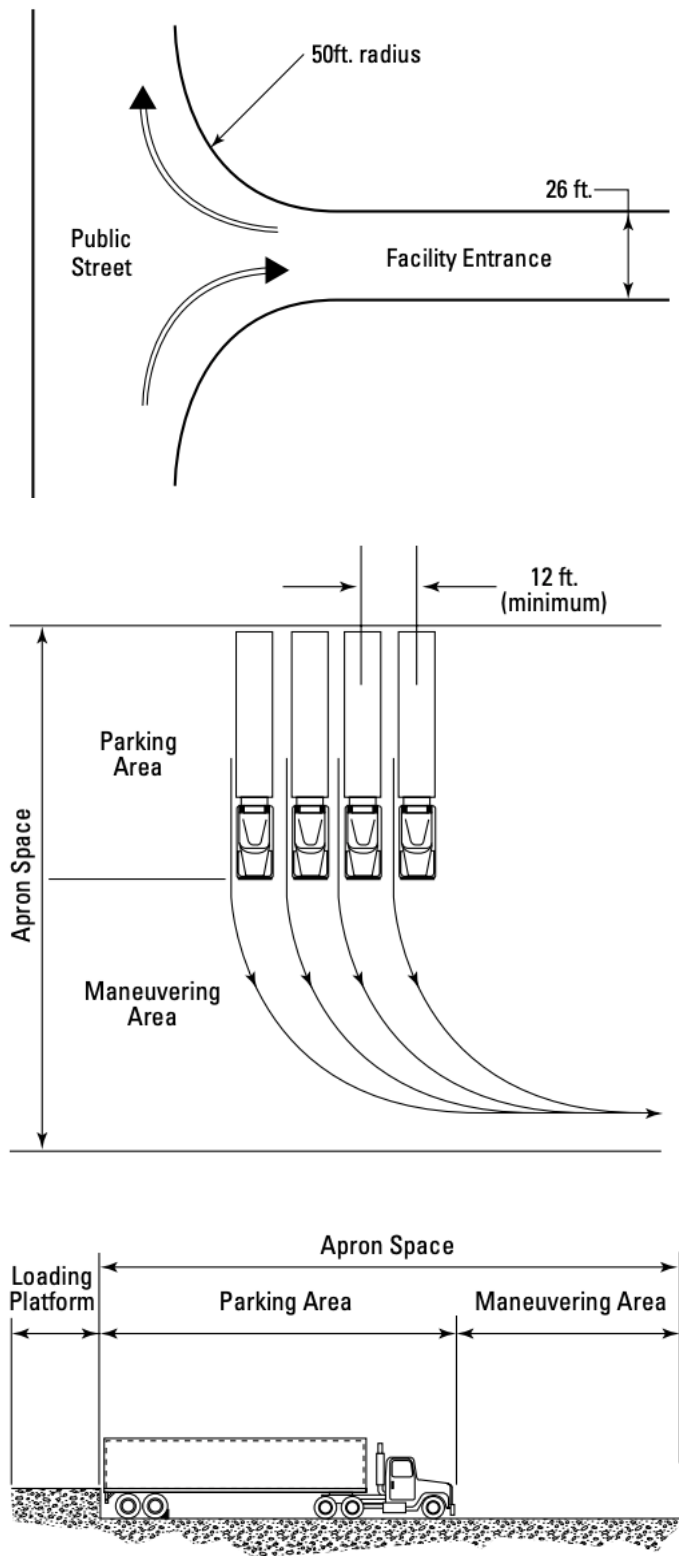
Generate a two-dimensional object with a cross-section of a three-dimensional object

</div>

Often, manufacturer or vendor specifications, construction development photographs, and additional information provided for planning arrive as three-dimensional images. In the same way you need the option to assess a two-dimensional object in three dimensions, your recommendations will include two-dimensional objects generated as cross-sections of three-dimensional objects. Thinking back on the container cross-section example, determining the route for a container to enter and exit an assigned dock at the warehouse, then drawing those logistics on planning documentation, benefits with options to plan and present with two-dimensional, three-dimensional, and cross-sections of three-dimensional objects.

Builders USA may visit another distribution warehouse and, as an example, take photographs and videos of trucks entering, unloading, and exiting the dock area. The data created from the resulting photographs and videos likely becomes two-dimensional drawings and cross-section modeling to ensure adequate space and efficient workflow.

This cross-section of a warehouse rack with pallets can be readily sketched as two-dimensional for aisle planning and placement.
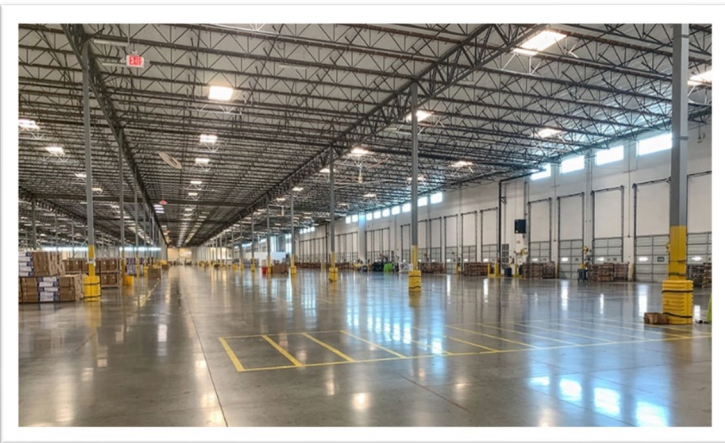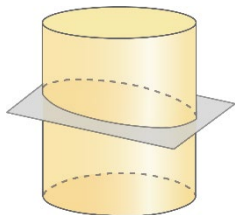

The interior dock doors on the right side of this warehouse can become a two-dimensional map for planning efficient forklift routes for unloading.
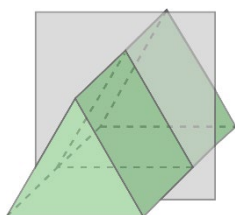
In planning the logistics inside the warehouse (coming in Unit 2), you will work with two-dimensional shapes created from three-dimensional objects.
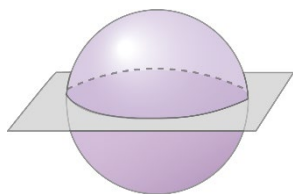
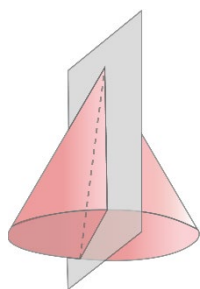For below three-dimensional shapes, which best describes the two-dimensional shape created by the cross-section shown?
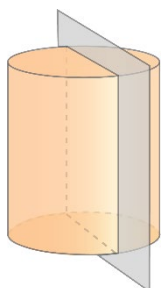

- O Circle
- O Rectangle
- O Ellipse
- O Square

- O Square
- O Rectangle
- O Triangle
- O Trapezoid

- O Circle
- O Sphere
- O Ellipse
- O Square

- O Trapezoid
- O Circle
- O Rectangle
- O Triangle

- O Triangle
- O Circle
- O Square
- O Rectangle

Analyzing two-dimensional, three-dimensional, and cross-section shapes creates different interpretations needed to Maximize the Cube and present a strong recommendation to Builders USA. Converting two-dimensional objects to three-dimensional objects in the workplace often involves conversion methods, algorithms, and working with complex software utilizing machine learning, artificial intelligence, and photogrammetry. As software becomes more sophisticated, customers expect more realistic three-dimensional shapes. However, in all workplace sectors, understanding dimension, shape, and movement are critical to communicating priorities and managing the business. Software is a tool that extends your capacity; you remain the idea person and significant contributor to the organization.

You may know this warehouse employee? Mario works at https://mario.nintendo.com/
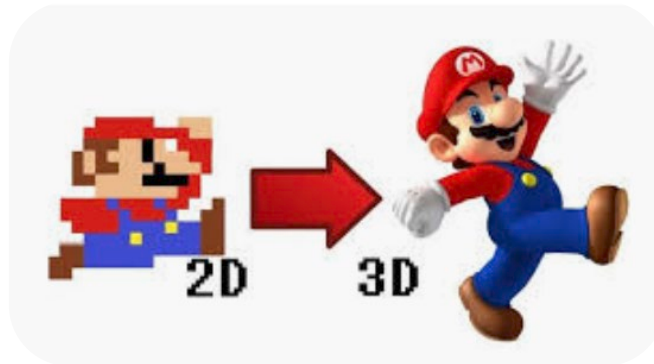
Milestone 2 Check-in Meeting

Per your teacher's instructions, meet in small teams and discuss your data findings. Critically assess and discuss the following Milestone 2 questions:

1. What are two primary ways you can use two-dimensional and three-dimensional objects to analyze your recommendation for Builders USA?

    _____

    _____

    _____

    _____

    _____

2. What are two primary ways you can use two-dimensional cross-sections of three-dimensional objects to inform Builders USA?

    _____

    _____

    _____

    _____

    _____

3. What are two primary ways you can use three-dimensional objects generated by rotations of two-dimensional objects to inform Builders USA?

    _____

    _____

    _____

    _____

    _____

Quick Check on the Unit's Common Core Standards

Analyze images of

- ✓ two-dimensional objects
- ✓ three-dimensional objects

Identify relationships between

- ✓ two-dimensional and three-dimensional objects
- ✓ two-dimensional cross-sections of three-dimensional objects
- ✓ three-dimensional objects generated by rotations of two-dimensional objects

Unit 1 Deliverable

Prepare a location recommendation to Builders USA comparing the two potential warehouse locations:

| World Logistics Center | South Ontario Logistics Center |

Include one of each of the following in your submission:

❖ two-dimensional object

❖ three-dimensional objects

❖ two-dimensional and three-dimensional objects (together to detail your perspective)

❖ two-dimensional cross-section of a three-dimensional object

❖ three-dimensional object generated by rotations of a two-dimensional object

1. Write a short analysis detailing how you rate each location, based on your data findings.

2. Write a short analysis that compares the World Logistics Center and South Ontario Logistics Center to the Amazon Warehouse location.

3. Critically assess and include additional factors that will impact the Builders USA distribution warehouse logistics and operations.

4. Write your assessment of which warehouse location you recommend and why.

5. Review your Google Earth project and make edits you would like to include in your rubric assessment.

Your submission format and scoring rubric will be communicated by your teacher.

In Unit 2 your use case focus enters the building to assess and analyze efficient product storage logistics in distribution warehouse conditions. You will work with the web-based application Tinkercad to apply geometric concepts in modeling the Builders USA distribution warehouse interior.