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TECH MACHINES

TEACHER GUIDE

45002

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LESSONS

TECH MACHINES

Teacher Guide Introduction

Who is the material for?

The Tech Machines Teacher Guide is for preschool teachers. It is designed to help teachers develop children's early engineering skills, such as designing and building, investigating and solving problems, and exploring machines and their functions.

What is it for?

Designed for preschoolers, the construction theme enables children to explore engineering concepts in a familiar setting as they build vehicles, machines, construction equipment, and imaginative models.

The Tech Machines Teacher Guide provides fun and engaging exploration opportunities while promoting the development of children's science, technology, and math skills.

Using the Teacher Guide, preschool teachers can facilitate exciting lessons in which children will learn about machine parts like wheels, pulleys, and joints while exploring their functions. The specially designed screwdriver allows children to use tools in a fun and safe way. Most importantly, the lessons will enable them to become problem solvers, enhancing their creativity through construction and demonstration.

How are the learning objectives achieved?

Throughout the lessons, strategic questions will guide children through the process of applying engineering skills. Furthermore, the LEGO® DUPLO® building activities will reinforce creativity, inquiry, and exploration.

The Tech Machines set comes with a Getting Started card that includes five quick steps for introducing the set in your classroom. By following the steps, you will introduce the children to the unique elements of the set, such as the screwdrivers and interlocking bricks.

This Teacher Guide includes eight lessons. Refer to the table of contents for a brief description of lesson topics. Each lesson is labeled as *beginner*, *intermediate* or *advanced*, based on the skills and knowledge needed to complete the lesson. The lessons may be selected and adapted according to what is most relevant and appropriate for the children.

The activities and lessons contained in this Teacher Guide require the LEGO® Education Tech Machines set (45002)

Customizing to Your Class Needs

The Tech Machines lessons can be tailored to your needs and the needs of your class. One Tech Machines set can be used with up to four children at a time, working in pairs if the children are able. Children need a lot of practice before becoming proficient at building with a partner, and this is a good way to promote collaboration. Only the advanced activities explicitly ask the children to build with a partner. However, if the children are ready, you may incorporate partner building into all the activities.

Lesson Structure

Each lesson is structured according to a natural learning flow called the *LEGO® Education 4C approach*, which promotes successful learning experiences. The Connect, Construct, and Contemplate phases, which are the first three phases of each lesson, can be done in one session. The Continue phase is more challenging and can be completed in a later session.

Connect

During the Connect phase, discussions will spark children's curiosity and activate their existing knowledge while preparing them for a new learning experience.

Construct

In this phase, the children will participate in a hands-on building activity. As their hands create models of people, places, objects, and ideas, their minds will organize and store new information related to these structures.

Contemplate

During the Contemplate phase, children are given the opportunity to reflect on what they have done and to talk about and share insights they have gained during the Construct phase of the lesson.

Continue

New challenges in this phase build upon the concepts learned previously in the lesson, providing an opportunity for children to apply their newly-acquired knowledge during extension activities. Because the children may not be ready to complete the Continue phase until they have repeatedly practiced the skills learned earlier in the lesson, this phase can be done during a later session.

Did you notice?

The learning guidelines from the National Association for the Education of Young Children (NAEYC), Head Start, and the Next Generation Science Standards (NGSS) have been used to develop the Tech Machines lessons. This Teacher Guide focuses on the learning values for math, science, and engineering. Please refer to the learning grid for an overview of the learning values referenced throughout this Teacher Guide. The learning goals listed at the end of each lesson can be used to determine whether each child is developing the relevant skills. These bullet points target specific skills or pieces of information that are practiced or presented during each lesson.

TECH MACHINES LEARNING GRID

		LESSONS							
		Wheeling away	Heavy Load	Safety First	Special Machine Parts	Machines with a Purpose	Park Project	Helping Machines	Water Vehicles
		Beginner			Intermediate			Advanced	
SCIENCE	Use strategy and planning to solve problems			●	●	●	●		●
	Observe and describe objects and events				●			●	
TECHNOLOGY	Use technology, such as wheels and simple tools in appropriate ways	●		●					●
	Ask questions about science and technology-related concepts	●					●	●	
ENGINEERING	Build physical models and illustrate how they function			●	●	●			
	Investigate, ask questions, make observations, and gather information to inform the design of machines or tools				●		●	●	●
	Participate in the engineering process by designing, building, and testing models	●	●	●			●	●	●
	Understand and demonstrate how tools help people to solve problems and accomplish tasks		●			●			
MATH	Recognize, compare, and name shapes; begin to recognize that objects are composed of different shapes	●						●	
	Use spatial awareness to understand objects and how they move	●			●		●		
	Compare two or more objects or attributes		●						●

Beginner - Wheeling away

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002), small ramp or materials to construct one

Vocabulary

vehicles, wheels, stable, roll, test, ramp, treads

Connect

Show the children a couple of the wheels from the Tech Machines set.
Talk about the attributes and function of wheels.
Ask questions like:
- What shape are wheels?
- How do they move?
- How do they help vehicles get around?

Talk about how the round shape of wheels allows them to roll easily.
Explain that vehicles with multiple wheels can balance and move heavy objects.
If the children are not used to using the screwdrivers, model how to build a four-wheeled vehicle, using the screwdriver to secure the wheels.

Construct

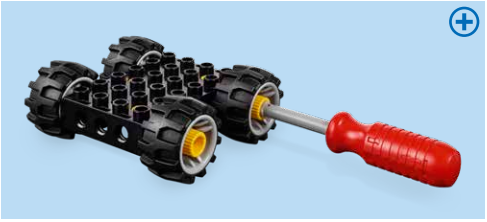
Ask the children to build their very own four-wheeled vehicles.
Explain that they may use the building cards for inspiration or design their own vehicle.
- Some children will use the single tire treads and some will use the long treads that extend over two wheels.
- Help them assemble the tires with treads as needed.

As the children build, help them use the screwdriver to secure their wheels.
Once the children have finished building, ask them to test their vehicles by rolling them across the floor.

LEARNING OUTCOMES

Children will:

- Explore the components of the Tech Machines set
- Learn about the function of wheels
- Recognize shapes and attributes
- Use spatial awareness to understand how wheeled vehicles move



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Contemplate

Facilitate a discussion about the children's vehicles.
Ask questions like:
- What kind of vehicle did you build?
- How do the wheels help your vehicle move?

Give children the opportunity to adapt their designs based on what they have learned when they tested them.
Have the children test their vehicles again and tell them to be sure to include a passenger or two!

Continue

Build a small ramp and ask the children to roll their vehicles down it.
Encourage the children to test different four-wheeled vehicle designs and mark how far each one rolls.
As a group, compare and contrast the different designs and their ability to roll down the ramp.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Technology - Using technology, such as wheels and simple tools in appropriate ways
- Technology - Asking questions about technology-related concepts
- Engineering - Participating in the engineering process by building and testing models
- Math - Recognizing, comparing, and naming shapes
- Math - Using spatial awareness to understand objects and how they move

Beginner - Heavy Load

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002), a heavy object and a light object from around the classroom, additional objects that fit into the truck models

Vocabulary

weight, heavy, light, carry, load, lift, heavy-duty, haul, cargo

Connect

Pick two objects from around the classroom, one heavy and one light, to illustrate a difference in weight.
Ask the children to compare the two objects.
Ask questions like:
- Which of these is heavier?
- Explain that the heavier object weighs more than the lighter object.
- Which is lighter?

Explain that the lighter object weighs less than the heavier object.
Tell the children that lifting heavy objects is a common challenge that people face.
Explain that one way people transport heavy objects is by using special heavy-duty trucks.

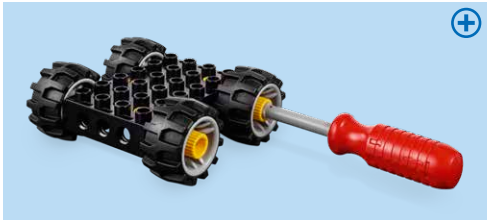
Construct

Ask the children to build their very own heavy-duty truck to haul a heavy load.
Explain that they may use the building cards for inspiration or design their own truck.
Remind the children that their truck should include a place to load heavy objects.
As the children build, help them use the screwdriver to secure their wheels.
Once the children have finished building, ask them to test their heavy-duty trucks using objects from around the classroom.
Encourage the children to load up their trucks and haul the load across the room!

LEARNING OUTCOMES

Children will:

- Explore the components of the Tech Machines set
- Explore weight and compare objects
- Use comparative language
- Design a vehicle to help with a task, and demonstrate how it works



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Contemplate

Facilitate a discussion about the children's trucks.
Ask questions like:
- Why was your truck able (or not) to move the heavy load?
- What other machines might have been able to move the same load?

Talk about how lifting heavy objects can be dangerous. Discuss how workers should always use their trucks in a safe manner.

Continue

Explain that other types of vehicles and machines can transport heavy items.
Give a few examples, like cranes which use pulleys to lift heavy objects.
Ask the children to design and build another machine or vehicle to transport their heavy load.
Encourage them to test their new designs and demonstrate how to safely load and unload their new machine or vehicle.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Technology - Asking questions about science-related concepts, specifically weight
- Engineering - Participating in the engineering process by designing, building, and testing models
- Engineering - Understanding and demonstrating how machines help people to solve problems and accomplish tasks
- Math - Comparing two or more objects or attributes

Beginner – Safety First

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002)

Vocabulary

safety, safe, protect, accident, shield, treads

Connect

Talk to the children about safety.
Explain that:

- Construction equipment can be very dangerous.
- Big, heavy machinery takes skill to operate.
- Just like adults have to get a license to drive a car, machine operators have to get a license to operate their machines.

Tell the children that accidents do happen and that's why it's important for construction equipment to be designed to be as safe as possible.

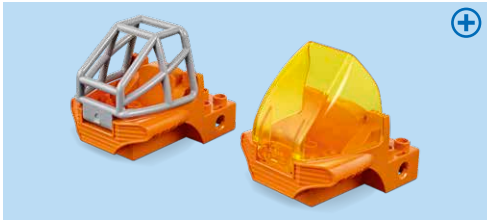
Construct

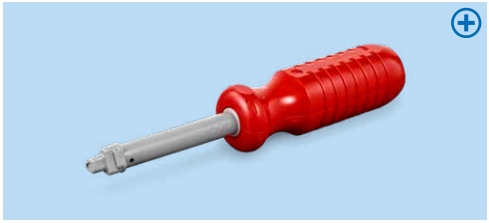
Show the children the two types of shields.
Explain that a shield protects a machine operator from debris, and may even protect the operator if their construction equipment rolls over.
Show the children the tire treads and explain that treads keep the operators safe by helping their construction equipment roll over all types of ground.
Ask the children to build a piece of construction equipment with the special safety elements of a shield and tire treads.
Explain that they may use the building cards for inspiration or design their own piece of equipment.
As the children build, help them use the screwdriver to secure elements as needed.

LEARNING OUTCOMES

Children will:

- Explore the components of the Tech Machines set
- Discuss safety
- Think creatively to solve safety problems
- Describe how safety elements, such as a windshield, function





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Contemplate

Facilitate a discussion about the children's models.
Ask questions like:
- Which special safety element did you use?
- How does it help make the equipment safer?
- What are some other ways machine operators can stay safe?

Tell the children that it is important for machine operators to follow safety rules.
Ask: What are some rules that machine operators should follow in order to stay safe?

Continue

Encourage the children to demonstrate how the operator uses the equipment safely.
If the children are able to, ask them to demonstrate how the special safety element protected the operator during the accident.
Discuss what action people would take during an accident in real life (e.g., calling 9-1-1).

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Science - Using strategy and planning to solve problems
- Technology - Using technology, such as wheels and simple tools in appropriate ways
- Engineering - Building physical models and illustrating how they function
- Engineering - Participating in the engineering process by designing, building, and testing models

Intermediate - Special Machine Parts

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002), pictures or videos of real machines

Vocabulary

machine, part, function, purpose, move, spin, pivot, turn, pulley

Connect

Tell the children that machines need to move in special ways to complete their tasks and solve problems.

Explain that machines often have special parts that enable them to move in these different ways.

Show the children all the of special, movable parts from the set and demonstrate how each one works:

- The pulley moves up and down
- The blade spins
- The yellow turntable pivots
- The tumbler rotates

Explain how certain machines incorporate these special parts to enable them to perform unique functions.

If possible, show pictures or videos of real machines that use some of these elements (e.g., a crane with a pulley or a wind turbine with a blade).

Construct

Ask the children to build a machine with one of the special parts they just saw.

Explain that they can build any machine, it doesn't have to be a construction machine, but it must have one of the four special parts.

Tell the children that they may use the building cards for inspiration or design their own machine.

Help the children as needed to attach some of the special parts.

Once the children have finished building, ask each child to share their model with the group and demonstrate its special part and function.

Continued >

LEARNING OUTCOMES

Children will:

- Use spatial awareness to understand how objects move
- Demonstrate how to solve problems
- Observe and describe special parts and functions
- Build a model with a special part and demonstrate how it works
- Ask questions, make observations, and gather information to inform the design of machines

Contemplate

Facilitate a discussion about the importance of machines being able to move in unique ways.
Ask questions like:

- What special part does your machine have?
- What does the special part allow your machine to do?
- How does that function help to solve a problem?

Continue

Consider setting up little challenges (e.g., a nearby town needs a wind turbine to create energy or LEGO® DUPLO® construction workers need help lifting material up a big cliff).
Ask the children to solve the challenge.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:"

- Science - Using strategy and planning to solve problems
- Science - Observing and describing objects and events
- Engineering - Building physical models and illustrating how they function
- Engineering - Investigating, asking questions, making observations, and gathering information to inform the design of machines or tools
- Math - Using spatial awareness to understand objects and how they move

Intermediate - Machines with a Purpose

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002)

Vocabulary

vehicles, machines, purpose, challenge, project, drilling, bulldozing

Connect

Tell children about a group of construction workers who are trying to build a brand-new tunnel to connect two cities located on opposite sides of a mountain.

Hold up a couple of LEGO® DUPLO® figures.

- Ask the children to identify types of vehicles and machines that might help the workers with their tasks (e.g., a drilling machine to carve into the mountain or a cement truck to mix the asphalt for the new road).

Construct

Ask the children to build a machine or vehicle to help the workers build the tunnel.

Explain that they may use the building cards for inspiration, or design their own machine or vehicle.

Help the children as needed to attach some of the more difficult parts.

Once the children have finished building, ask each child to share their machine or vehicle with the group, describing its features and demonstrating how it would help with the tunnel project.

Contemplate

Facilitate a discussion about the children's models by asking them to describe the part of the project their machine or vehicle helped with.

Tell the children that machines often have to work together or in a sequence (e.g., one machine makes the tunnel, another clears away debris).

Ask the children to demonstrate how each of their models helps on the tunnel project.

LEARNING OUTCOMES

Children will:

- Design machines or vehicles to solve problems
- Build a model and demonstrate how it works
- Demonstrate how tools help people to solve problems and accomplish tasks

Continued >

Continue

Explain that sometimes machines need to be multi-functional, meaning they can perform multiple tasks (e.g., a digger can dig up the soil and pat it down with the back of its scooper).
Tell the children that it is even possible to invent imaginative multi-functional machines like one that flies and scoops!
Ask the children to build a machine that performs two functions, tell them that they can choose whichever functions they would like.
Once the children have finished building, ask each child to share their new invention with the group.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Science - Using strategy and planning to solve problems
- Engineering - Building physical models and illustrating how they function
- Engineering - Understanding and demonstrating how tools or machines help people to solve problems and accomplish tasks

Intermediate – Park Project

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002)

Vocabulary

city, project, park, plan, machines, before, after, complete

Connect

Hold up a couple of the LEGO® DUPLO® figures.
Tell the children that the city where the figures live has no outside places where children can play.
Explain that they are in desperate need of a new park but that building a new park is a big project.
Tell the children that the city needs help planning for this big project and talk to them about the different pieces of equipment they would need for such a project (e.g., a digger to move and flatten the ground or a wheelbarrow to haul smaller materials and debris).

Construct

Ask the children to build a piece of equipment to help with the park project.
Explain that they may use the building cards for inspiration, or design their own machine or vehicle.
Help the children as needed to attach some of the more difficult parts.
If a child finishes quickly ask them to build another piece of equipment, tell them that several pieces of equipment are needed to complete the project.
Once the children have finished building, ask each child to share their model(s) with the group and describe how it will help with the park building project.

LEARNING OUTCOMES

Children will:

- Design machines or vehicles to solve problems
- Investigate how machines work together to complete a project
- Discuss sequence of events
- Explore roles related to projects

Continued >

Contemplate

Facilitate a discussion about the children's models.
Ask questions like:
- Which part of the project would your piece of equipment help with?
- Would it be used during the whole project or only for part of it? Why?

Encourage the children to demonstrate how their piece of equipment would help with building the park.

Continue

Tell the children that the city wants to provide transportation so people can easily visit the new park.
Ask them to build a vehicle that can hold one or two passengers.
Have them demonstrate how the vehicle transports the passenger(s) to the park.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Science - Using strategy and planning to solve problems
- Technology - Asking questions about technology-related concepts
- Engineering - Investigating, asking questions, making observations, and gathering information to inform the design of machines or tools
- Engineering - Participating in the engineering process by designing, building, and testing models
- Math - Using spatial awareness to understand objects and how they move

Advanced – Helping Machines

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002), colored pencils or crayons, and paper

Vocabulary

machines, robots, help, task, design, test

Connect

Tell the children about a special type of machine called a robot.
Explain that robots can help with a lot of different tasks.
Ask the children to name and describe robots they have seen or heard about.
Tell the children that even though a lot of different robots have been invented, there are still many more tasks we'd like their help with. There are small tasks like loading the dishwasher and bigger tasks like providing medical treatment to sick people.

Construct

Ask the children to build a model of their very own robot and that they may draw a picture first if they like.
Once the children have finished building, ask each child to share their robot with the group and talk about its features and what it can do.

Contemplate

Facilitate a discussion about the children's robots.
Ask questions like:
- How would you describe your robot?
- What can your robot do?

Ask the children to think about a problem or task their robot might help with.
Have them demonstrate how the robot can help with this task (e.g., if it's a cleaning robot, ask it to clean up toys in the classroom).

Continued >

LEARNING OUTCOMES

Children will:

- Design machines to solve problems
- Investigate how machines help people
- Test and adapt machine designs
- Work with others to build different machines

Continue

Tell the children that some robots can do many different things at once.
Ask them to add another element to their robot (e.g., another arm or a rotating function) to make it an even more useful machine.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Science - Observing and describing objects and events
- Technology - Asking questions about technology-related concepts
- Engineering - Investigating, asking questions, making observations, and gathering information to inform the design of machines or tools
- Engineering - Participating in the engineering process by designing, building, and testing models
- Math - Recognizing, comparing, and naming shapes; beginning to recognize that objects are composed of different shapes

Advanced – Water Vehicles

For up to 4 children

Materials Needed

LEGO® Education Tech Machines set (45002)

Vocabulary

underwater, ocean, vehicle, propeller, anchor, adapt, design

Connect

Explain how vehicles that go in the water are different from vehicles that travel on land.
Ask the children to compare a land vehicle (e.g., a car) to a water vehicle (e.g., a boat).
Tell the children that water vehicles often have special elements like propellers that give them the power needed to move on or under the water, or anchors on a pulley system that help prevent them from drifting away.

Construct

Ask the children to work with a partner to design and build a water vehicle.
Assign each pair of children the task of designing and building a water vehicle with a propeller or one with a pulley for an anchor.
Once the children have finished building, have each pair present their underwater vehicle to the group, describing its special element, and explaining what it is used for.

Contemplate

Facilitate a discussion about the children's water vehicles.
Ask questions like:

- How is your water vehicle different from a land vehicle?
- What might your water vehicle be used for (e.g., fishing, researching marine life, cleaning the ocean, sightseeing)?

Tell the children that some water vehicles go under the water (i.e., submarines), allowing people to explore parts of the ocean that are not possible to reach in a normal vehicle.
Ask the children to adapt their designs so that their vehicle can go underwater.

LEARNING OUTCOMES

Children will:

- Investigate water vehicles
- Compare types of vehicles
- Talk about the function of propellers and anchors
- Adapt their designs

Continued >

Continue

Tell the children that people build all kinds of vehicles for different purposes. Some go underwater to explore the ocean and some go up in the air to do things like transport people, go on rescue missions, and deliver goods.
Ask the children to work together in their pairs to design and build a flying vehicle like a helicopter, airplane, or even a space shuttle!
Once the children have finished building, have them demonstrate how their models are used.

Did you notice?

Observing the following skills can help you monitor whether the children are developing the necessary competencies:

- Science - Using strategy and planning to solve problems
- Technology - Using technology, such as simple machines in appropriate ways
- Engineering - Investigating, asking questions, making observations, and gathering information to inform the design of machines or tools
- Engineering - Participating in the engineering process by designing, building, and testing models
- Math - Comparing two or more objects or attributes

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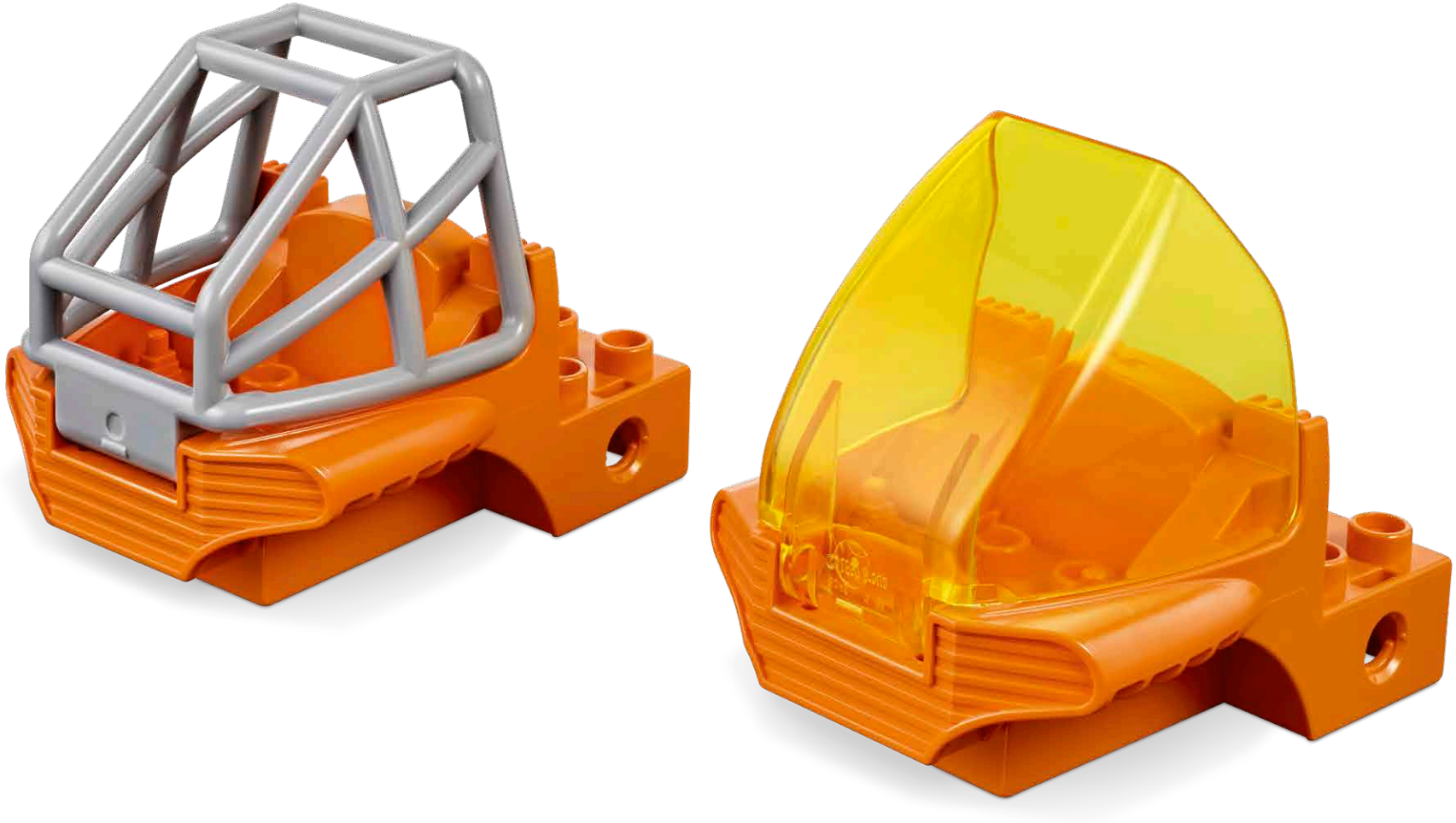

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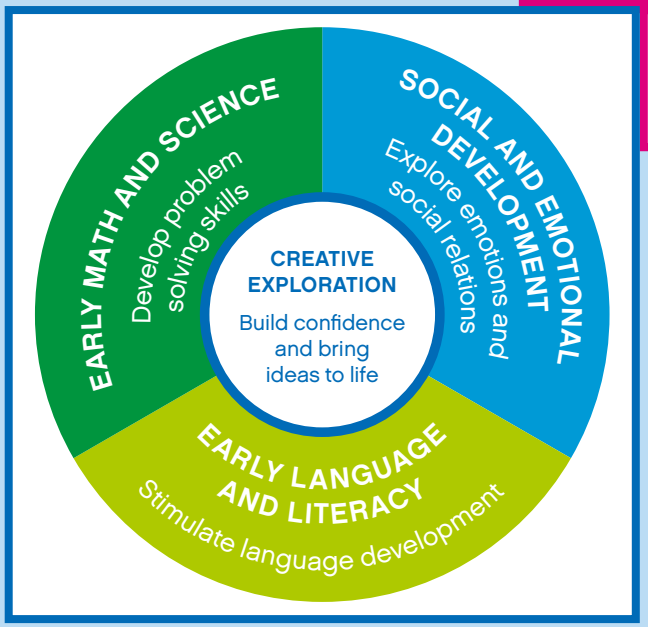
CURIOUS

CREATE

CONFIDENT

CONNECT



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Help your preschoolers develop important skills

LEGO® Education Preschool solutions stimulate children's natural curiosity to explore together and learn through play. Our preschool solutions will support you in developing your preschoolers in the following ways:

- give them social skills to collaborate and communicate with the world around them
- let them discover their own capabilities and acquire fundamental life skills
- develop crucial skills for school readiness focusing on four key learning areas essential for early childhood development: Creative Exploration, Social and Emotional Development, Early Math and Science, and Early Language and Literacy

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