OMSI

Property of Science Playground

SIMPLE MACHINES DISCOVERY BOX

ACTIVITY BOOKLET

Table Contents

Say: Now we need to create the next part of the machine.

Do: Place a second child next to the first. Give him a sound and movement, but remind him that he cannot make his sound and movement until the first child has.

Do: Repeat for each child until everyone has a sound and movement. Assign one child to stand at the very front of the line, and tell everyone that his arm will be the switch. The last child should do what the machine was designed to do (mime bed making, pet feeding, etc.)

Say: Now let's see if our machine works. I'm going to turn the power switch on, but remember, you can't move until the part before you has started.

Do: Turn the machine "on," and let all of the children make their sound and movement. After a few minutes, turn the machine off.

Say: Uh-oh. I think a part of our machine is broken. Let's see if it will work without it.

Do: Take a child out of the line and turn the machine on. The child after the broken part cannot move or make a sound.

Ask: Our machine isn't working! Can anyone think of a tool we can use to fix this part?

Do: The children may suggest tools to fix the broken part. Mime using a giant wrench, hammer, screwdriver, or any other suggested tool. Turn the machine on to see if it is working.

Say: Even if just one part of the machine is broken, the whole machine will not work.

Kid Machine

Visitors will have the opportunity to work collaboratively and create a machine using their own bodies and creativity.

Age Range: 4 & up

Supplies

- None

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Set out one or several wood simple machine sets and let the children play and explore.

Ask: Can anybody think of a machine they use everyday?

Say: We use a lot of machines to make our lives easier. For example, a washing machine helps us by washing our clothes automatically. It would take a long time to scrub our clothes by hand. Complex machines are machines with a lot of moving parts. Today we are going to make up our own complex machine, and we are going to pretend to be the moving parts!

Ask: First we are going to decide what our machine will do. Does anyone have an idea of what our machine could help us with? (If the children are stumped, you can offer suggestions. Ex: a machine to make beds, sweep dirt, feed pets, etc.)

Say: Now I need somebody to be the first part of our machine.

Do: Choose a child to be the first part of the machine, and place her in front of the others. Give her both an action and a sound to make. Some movements could be lift one arm up, then down; a ballerina plie, head nod, head shake once, turn around, touch toes then shoulders, etc. Sounds could be boing, ping, whoosh, beep, honk, shhh, clap hands, etc. Encourage the children to think of sounds and movements of their own.

Simple Machines Discovery Box Contents

Books

- ***Inclined Planes* by Michael Dahl**
- ***Levers* by Michael Dahl**
- ***Pulleys* by Michael Dahl**
- ***Wheels and Axles* by Michael Dahl**
- ***Simple Machines* by Allan Fowler**
- ***What is Gravity?* by Lisa Trumbauer**
- ***How do you lift a Lion?* by Robert E. Wells**

"Gears" box with plastic gears

Hoberman "Twist-o"

Masking Tape

"Wooden Parts" box

- **Inclined plane car**
- **Inclined plane wedge**
- **Lever weight**
- **Pendulum weight**
- **Pulley weights**
- **Two (2) plastic cars**

Wood simple machines

- **Gear train**
- **Inclined plane**
- **Lever**
- **Pulley**
- **Pendulum**

Introduction to the Discovery Boxes

The main goal of the Discovery Boxes is to give young children hands on and authentic experiences around a big idea. We can introduce the ideas through storybooks, open-ended explorations of real objects, open-ended questions and conversations, investigations and role-playing.

In this activity booklet you will find many things to help you introduce or further explore a thematic topic with young children. It was also designed for an Educator or Volunteer to choose which works best for them and their space. The materials provided can guide you or you can make up completely new activities for the materials in the box. The choice is yours. **We only ask that you supervise the use of items in the box and return it the way you found it!**

The Discovery Box themes were selected for their relation to the real world. Young children are very egocentric and therefore experience most ideas from a personal perspective. For example, activities associated with how things work, animals, habitat, family dynamics, food, shelter, and survival hold the most meaning for young children. Keep these in mind when discussing how something works. Try to relate it to these ideas, as they are concepts that young children relate to.

Young children are natural scientists, eager to find out about the world around them. Children use the process of play to investigate in much the same way scientists use the scientific method. A comparison of the two processes reveals many similarities:

Process of Play	Scientific Method
See	Observe
Wonder	Hypothesize
Try	Test
Make Sense	Conclude

Adult roles during play vary from commenting on play, extending the activity and actively participating, to providing verbal interpretations, emotional support and suggestions or alternatives. By fostering children's natural curiosity, adults can help them develop positive attitudes toward learning, as well as important critical-thinking and problem-solving skills. The Discovery Box activities were designed to help children develop confidence in their own abilities.

Do: Let a child hold the bottle on the string and then let go.

Ask: What kind of designs do you see? If we change the pattern the bottle is swinging in, do you think the designs will change too?

Do: Allow another child to release the bottle from a different angle to change its course.

Ask: What happened to the pattern?

Do: Allow children to have turns releasing the pendulum at different angles. Ask them to predict what will happen to the pattern of the sand. Replace the sand bottles as needed. Do this until the sand runs out and the swinging stops.

Ask: Why do you think the bottle stopped swinging?

Say: Eventually, gravity forced the bottle to stop swinging. Gravity never stops pulling down on every object on earth. Even this bottle stopped swinging because of the force of gravity pulling it down.

Pendulum Patterns

Visitors will have the opportunity to observe the patterns created by a pendulum.

Age Range: 3 & up

Supplies *(These materials are not in the Discovery Box.)*

- Two chairs
- String
- Colored sand
- Masking tape
- Pole (broom handle)
- Black poster board
- Two or three squeeze bottles (mustard or ketchup bottle)

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Prepare for the demonstration:

- Poke a hole in the bottom of the squeeze bottles to allow for good flow of sand.
- Cover the hole with tape, fill with sand and close the lid.
- Hang bottle upside down in vertical string hammock.
- Spread newspaper out on the floor and place black poster board on top.
- Place chairs several feet apart and lay pole across the backs of the chairs. Tape the pole down to secure its position.
- Tie the string to the center of the pole.
- The closer the bottle is to the ground, the more defined the pattern will be.
- The pattern will change depending on the length of the string. Have some extra paper on hand in case the sand exceeds the original boundaries.

Say: I would like to show you an example of a pendulum. This string is weighed down by this bottle full of sand. I'm going to take the tape off of this bottle, and then one of you may let the bottle go. Let's see what kind of patterns the sand will make.

Directions for Using the Discovery Box Activity Booklet

The activities that follow are directions for hands-on experiences that can take place anywhere in the museum. The activities are arranged in the booklet so that the most basic concepts about the topic are covered in the beginning and then move on to more in depth concepts at the end.

Each activity includes the following:

Icons: These icons will indicate the subject of an activity. All the activities are scientific in their nature, but they may fall more into a craft activity or a game.

Title & Purpose: A brief explanation of the activity.

Supplies: These are the items that you need to take out of the box in order to complete the activity. **Please do not take everything out of the box at once or leave the box lid open for children to rummage through. You are responsible for returning the items neatly back into the box. Do not let visitors wander away with the items. Kindly ask them to leave the items with you when they are done. Let the visitor know that the items belong to OMSI and they are for everyone to play with.**

Procedure: It is best to review the activity cards before you interact with the visitors. This allows you to understand the main idea so you can start the activity with confidence. You can read from the script directly or refer to it as needed as a way to converse with visitors. Remember to go with the flow and don't worry if the child is not interested. Just follow their lead.

Notes: These are helpful hints, cautions and extensions to the activity. It is best to review the entire card before getting started.

Teaching Methods for the Discovery Box Activities

- Don't be a "teacher." Be a partner in learning.
- Let the child lead with their ideas and suggestions for play. Introduce new concepts through your conversations and actions. Talk ideas through as you're doing it. Not only does this introduce a new idea and model how to do it, but also models the concept to the child as a way to share their ideas.
- Test the theories and construct new knowledge through hands-on exploration, investigation and play.
- Model the scientific process, stating it as you do it.
- Model this process to caregivers around you.
- Body language says a lot. Don't just sit in front of them and talk about something or ask questions in an intimidating "authoritarian figure" manner. Get on their level. Invite them to find the answer with you. Ask them to tell you what they think.
- If you don't know the answer to a question ask the child what they think the answer is. Try looking for the answer in a book.
- Play and be silly.
- Go with the flow and expect the unexpected. If a child is not interested in doing what you are suggesting, ask them what they would like to learn, or observe what they are doing with the object and ask them to tell you about it. You could also give them words for their actions. "Oh, I see you like the way the skeleton moves. Can you feel the bones in your body move? Put you hand on your knee and bend it." Show the child how.
- Don't be offended when a child is disinterested. Be interested in what they are interested in. Learning is a two way street. You may have put out an item that you want to teach a child about, but an opportunity has arisen for you to observe and learn what a child will creatively do with that item. You have a chance to observe how they will place meaning onto it and listen to how they relate it to their own lives.

Say: A wrecking ball on construction equipment is a pendulum, and grandfather clocks have pendulums too. Next time you see a grandfather clock, see if you can find the swinging pendulum. Another example of a pendulum is a swing on a playground.

Ask: What do you think weighs down the bottom of a swing?

Say: When you play on a swing, you are the weight that keeps the swing moving back and forth.

Ask: How do you think pendulums help us?

Say: Pendulums can help regulate time in a grandfather clock, and help workers stay safe when using wrecking balls. The workers can measure the length of the cable the ball is attached to tell how far the ball will swing.

Pendulum

Visitors will have the opportunity to explore the actions of a pendulum as a simple machine.

Age Range: 3 & up

Supplies

- Wood pendulum set
- Small red wood square
- Masking tape

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Set up wooden pendulum, placing the wood square in one of the notches; taping it securely. Encourage the children to release the rod from various places and observe the swinging movement.

Ask: What happens when you release the rod?

Say: The red wooden square adds weight to the rod which makes it swing back and forth at a specific speed. That means the rod is swinging at an exact rate. This is called a pendulum.

Ask: What do you think would happen if we put the wood square in a different notch?

Do: Let the child choose a different notch to place the square in, tape securely and release the rod.

Ask: What do you notice about the swinging now? Is it faster, slower, or about the same?

Say: Usually, the shorter the rod is, the faster it swings. You have to observe very closely to notice the difference.

Ask: How fast do you think you can make the rod swing?

Ask: Can you think of anywhere you have seen a pendulum before?

What is a Simple Machine?

Visitors will explore and discuss examples of tools and machines, both complex and simple.

Age Range: 3 & up

Supplies

- Wood simple machine set of your choice
- *Simple Machines* book
- *How Do you Lift a Lion?* book

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Set out one or several wood simple machine sets and let the children play and explore.

Ask: Can anybody name a tool?

Say: A tool is anything that makes our lives easier by helping us accomplish tasks. A knife helps us cut bread; a hammer helps us pound and pry.

Say: Humans also use machines to make their lives easier. These wood toys we are playing with are all examples of simple machines.

Ask: Can anyone think of machines that they use everyday?

Say: We use a lot of different machines. Some, like a washing machine or a car, are complex. That means that they have many moving parts. Today, we are just looking at simple machines.

Ask: What do you think makes these simple machines?

Say: Simple machines have no or few moving parts. I have a book that can help us explore how simple machines work and how we use them.

Do: Read *Simple Machines* or *How Do you Lift a Lion?* or both . With young children, it may not be necessary to read every word on every page. Be sure to take time to make observations, let the children ask questions, and ask open-ended questions of your own.

Levers

Visitors will have the opportunity to experiment with levers, discover how they work, and learn about some of their basic functions.

Age Range: 2.5 & up

Supplies

- Wood lever set
- *How do you lift a Lion?* book
- *Levers* book

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Position the lever on any notch of the wooden stand, where the fulcrum (the nail) is. Place books on one side of the lever, then allow the children to apply force on the other end of the lever to lift the object.

Ask: This is called a lever. What do you think a lever is used for?

Say: A lever makes it easy for us to lift heavy loads.

Ask: What do you think will happen if we put the lever on a different notch?

Do: Place the lever on a different notch and let the children apply force to one end of the lever.

Ask: What does that feel like? Does it seem easier to lift, harder to lift, or about the same?

Say: When we moved the lever, we also changed the fulcrum. For this lever, the fulcrum is right where the nail is. It is the point on which the lever pivots. That means that on one side of the fulcrum, the lever is moving down, and on the other, the lever moves up.

Do: Experiment with various weights on different fulcrum settings. As you do this, ask the child to describe what the different settings feel like.

Wheels and Axles

Visitors will have the opportunity to explore how wheels and axles work and some of their basic functions.

Age Range: 3 & up

Supplies

- Plastic cars from "Wood Parts" box
- *Wheels and Axles* book

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Set out plastic car and let children drive it around.

Say: A car is a complex machine made of many moving parts. Right now, we are going to look at just one part, which is a simple machine. If you look on the bottom of the car, you will see wheels that help it roll along the ground. Those wheels use axles to turn on. The axle is a bar that goes through the wheel.

Do: Point out the wheels and axles on the other side of the car.

Ask: Can you think of anything else that has wheels?

Say: We use wheels for a lot of different things. Strollers, wagons, wheelbarrows, roller skates, bikes, trains, and buses all have wheels and axles.

Ask: How do you think wheels and axles help us?

Say: Wheels and axles are very useful for moving people and things easily. Thanks to wheels and axles, we can move heavy loads, travel quickly and easily, and have fun on bikes and roller skates.

Gears

Visitors will have the opportunity to build, explore, and experiment with the plastic gear set.

Age Range: 3 & up

Supplies

- Plastic gear set

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Set up a simple gear and turn it, illustrating how the gears interlock to help each other turn.

Ask: What happens when I turn one gear?

Say: When I turn one gear, the others move as well. If you look at the edges of these gears, you can see little notches. These notches push against each other and that makes the gears move. The force I use to turn this one gear is transferred to all the other gears touching it.

Do: Place plastic gear set on a flat surface and let the children build with it. As the children build, offer encouragement and advice.

Ask: What are you building?

Ask: What do you think would happen if I took out one gear?

Ask: Do all the gears move when you turn the handle?

Ask: How would you build a tower with these gears?

Notes

- This activity provides an opportunity for you and the children to get creative. Don't feel pressured to ask every single question listed on this card. They are meant to be ideas for conversation, so feel free to make up your own questions.

Ask: Can you think of anywhere you may have seen a lever before?

Say: We use levers for a lot of different things, some of them just for fun. A see-saw is a type of lever. It's probably a lot easier to play on a see-saw than to lift your friend into the air.

Ask: Have you ever tried to get ice cream out of the container into your bowl using just your hands?

Say: That would be pretty hard to do, and I bet your hands would get messy and cold. If you use a spoon, which is a lever / wedge combination, you can move the ice cream from the container into the bowl quickly and easily.

Explore: Feel free to explore the *Levers* book or *How do you lift a Lion?* book or both.

Notes

- Other examples of levers include a rowboat oar, the human arm, and a garden hoe.

Pompom Catapults

Visitors will have the opportunity to explore catapults and understand how they function as levers.

Age Range: 3 & up

Supplies

- Spoons
- Pompoms
- Open space

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Ask: I have some materials that we can make a catapult with. Does anyone know what a catapult is?

Say: A catapult is a type of lever that can fling objects long distances. Today, our catapult is going to be made out of a plastic spoon and our fingers, and we are going to try to fling these pompoms.

Do: Demonstrate using a catapult. First, place a pompom on the handle. Then, press down on the bowl of the spoon with your finger. The pompom will go flying.

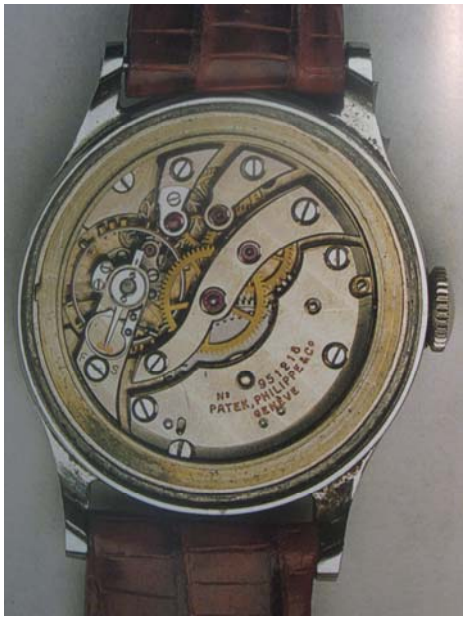
Say: It's important not to hit the spoon too hard or it will break. Now you can have a turn.

Do: Let the children have their own spoons and pompoms, and assist them if they are not quite sure how to make the catapult work. Remind them to be gentle.

Ask: How far did your pompom fly? You can measure it with your feet by walking from your spoon to where your pompom landed. How hard did you push it? Do you think you can make it go farther?

Say: By pushing the bowl of the spoon harder, the pompom goes farther.

Turbine Hall Clock



Gear Train

Visitors will have the opportunity to explore how gears work and what they can be used for.

Age Range: 3 & up

Supplies

- Wood gear train set
- Picture of gears in clock

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Explore: Let the children play with the wood gear train set. Encourage them to turn the red knob and see what happens.

Ask: What happens when you turn the red knob?

Say: When you turn the red knob, many other parts of this machine move. These are called gears. Gears are wheels that have notches all around the edge. These notches interlock, push each other, and make it easy to turn both gears at the same time. The force you use to turn the red knob is transferred to all of the other gears touching it. If these gears didn't have notches, they wouldn't be gears, and you would have to use both hands to move them at the same time.

Ask: Let's watch the gears while you turn the knob slowly. What do you notice about the direction of the gears?

Say: They are moving in opposite directions, one clockwise and one counter-clockwise.

Do: Continue playing with the gear train set. You may encourage the children to turn the gears quickly or slowly; forwards or backwards.

Ask: Have you ever seen gears anywhere else?

Say: Next time you see a bike, take a good look at how the wheels turn. There are gears on bikes to help the wheels move. Also, many clocks have gears inside of them.

Construction

Visitors will have the opportunity to explore how a hammer and nail may be used as a lever and a wedge in construction.

Age Range: 3 & up

Supplies

These materials are not in the Discovery Box. They are in the blue Construction activity bin.

- Plastic foam packing material
- Plastic golf tees
- Bowls for golf tees
- Plastic hammers
- Construction tools & hard hats *optional*

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Say: I have some materials that we can use for construction. Here are some hammers, and we can use these golf tees as nails. We can put the nails in this foam material.

Ask: How do you think we can use the hammer to put the nail in the foam?

Say: We can pound the top of the nail with our hammers. The other end of the nail is a wedge. See how it comes to a point at the end? This point pushes the foam apart so that the nail can go through.

Ask: How could you take a nail out of the foam using the hammer?

Say: We can use this other end of the hammer as a lever to pry out the nail. When you push the handle of the hammer down, the nail will come up.

Say: You can attach these pieces of foam together using the nails to build anything you like.

Do: Talk to the children about what they are building. You may ask them what they are making and give suggestions as needed. Some children may prefer to just experiment with the materials rather than build a specific object.

Inclined Plane

Visitors will have the opportunity to explore how inclined planes are simple machines, and learn about some of their basic functions.

Age Range: 3 & up

Supplies

- Wood inclined plane set
- Flat surface
- *Inclined Plane* book

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Run the string attached to the car over the red pulley and align the wheels in the grooves. Place the triangular wedge under the plane to give it an incline. Let the children have turns pulling the car up the ramp, and letting the car roll down the incline.

Ask: Does anyone have an idea of what this is?

Say: This is an inclined plane. If it were flat on the table, it would just be a plane, but since it is raised on one side, it is an inclined plane. This is a different kind of plane than the ones you see flying in the sky.

Do: Move the triangular wedge to make the incline steeper. Let the children have turns pushing the car up.

Do: Let the car roll down the ramp.

Ask: How fast did the car go? How do you think we could make it go faster?

Do: Let the children move the wedge and see what it feels like to pull the car up on various levels, and compare the speeds of the car as it rolls down.

Say: When the incline is steep, the car moves pretty quickly. The car doesn't move so fast when the incline is not very steep.

Say: A lot of machines use pulleys to help lift objects. A construction crane and an elevator are just a few examples. Usually, the more pulleys you have, the easier it will be to move an object. The elevator in the turbine hall has glass on all sides so you can see how the cables run over the pulleys.

Pulleys

Visitors will have the opportunity to explore the actions and reactions of pulleys.

Age Range: 3 & up

Supplies

- Wood pulley stand and block set
- *Pulleys* book

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Run the string of the block set over pulley (red moving circle) #1, located in the top left corner. Then wrap the string down, across and around the pulley #2, located in the middle at the bottom. Finally wrap the string up and over pulley #3. The red blocks should now be hanging from pulley #1 and pulley #3.

Do: Let the children explore the pulley. Encourage them to pull the blocks down on either side.

Ask: What happens when one block is pulled down?

Say: When you pull down on one side, the block on the other side goes up. This is called a pulley, and it is a simple machine. Watch the red wheels while you pull down on a block.

Ask: What do you notice about the red wheels? Are they turning in the same direction?

Say: They make each other turn in different directions. This makes it easier to lift an object.

Ask: What do you think would happen if you moved the string? Will the pulley still work?

Ask: Can you think of anywhere you have seen a pulley before?

Ask: Can anyone think of a place they've seen an inclined plane before?

Say: It's easy to find inclined planes. A hill is a type of inclined plane, and so is a slide, a wheelchair ramp, or a set of stairs.

Ask: How do you think inclined planes help us?

Say: Inclined planes make it easier to raise objects. A lot of times, moving trucks will have ramps to make it easier to move the furniture into the back of the truck. A ramp is an inclined plane. It would be hard to just lift the furniture into the truck. Also, one way we can get to the second floor in OMSI is to use stairs, which are also a type of inclined plane. Stairs make it easy for us to move between levels. If we didn't have inclined planes, we might have to use ladders to get to the second floor!

Say: Should we read this book and find out more about inclined planes?

Do: Read the *Inclined Planes* book for a more in depth look at inclined planes.

Do: Continue experimenting with the inclined plane and brainstorming other places inclined planes are used.

Ramp Races

Children will explore the concept of an inclined plane by observing toy cars on wooden ramps with different inclines.

Age Range: 3 & up

Supplies (*These materials are not in the Discovery Box.)*

- Wooden planks or plastic tubes
- Wooden blocks
- Toy cars

Procedure

Explore the visitors' knowledge on the subject through open–ended questions before explaining how the subject works.

Do: Place one plank on a flat surface. Stack blocks underneath one end of a second block to create a small incline.

Ask: Which do you think would go faster, a car I place on this flat ramp or a car I put on this steeper ramp?

Say: Let's see what happens.

Do: Release two toy cars at the same time on both ramps. The one on the flat ramp will hardly move at all.

Ask: What happened?

Say: The car on the flat ramp hardly moved, while the one on the steeper ramp moved pretty quickly.

Ask: Why do you think the car went faster on the steep ramp?

Say: While both of these wooden planks are planes, this steep one makes an inclined plane. The plane I'm talking about isn't the kind you see flying in the sky. An inclined plane is like a hill. In fact, a hill is a type of inclined plane. That means it's taller on one side than on the other.

Ask: If I wanted to make my toy car go really fast, what should I do to these planks?

Say: I can make a car go faster by making the incline bigger. This means I'll have to stack more blocks underneath the plank.

Do: Let the children create their own inclined planes. Encourage them to see how fast or slow the cars move, or race cars on different inclines. Ask questions as they do this, such as "Which one went faster?" "What do you think would happen if we added / removed a block?" etc.