MATTER splatter

EDUCATOR RESOURCE PACKET

DISCOVERY
Center of Idaho

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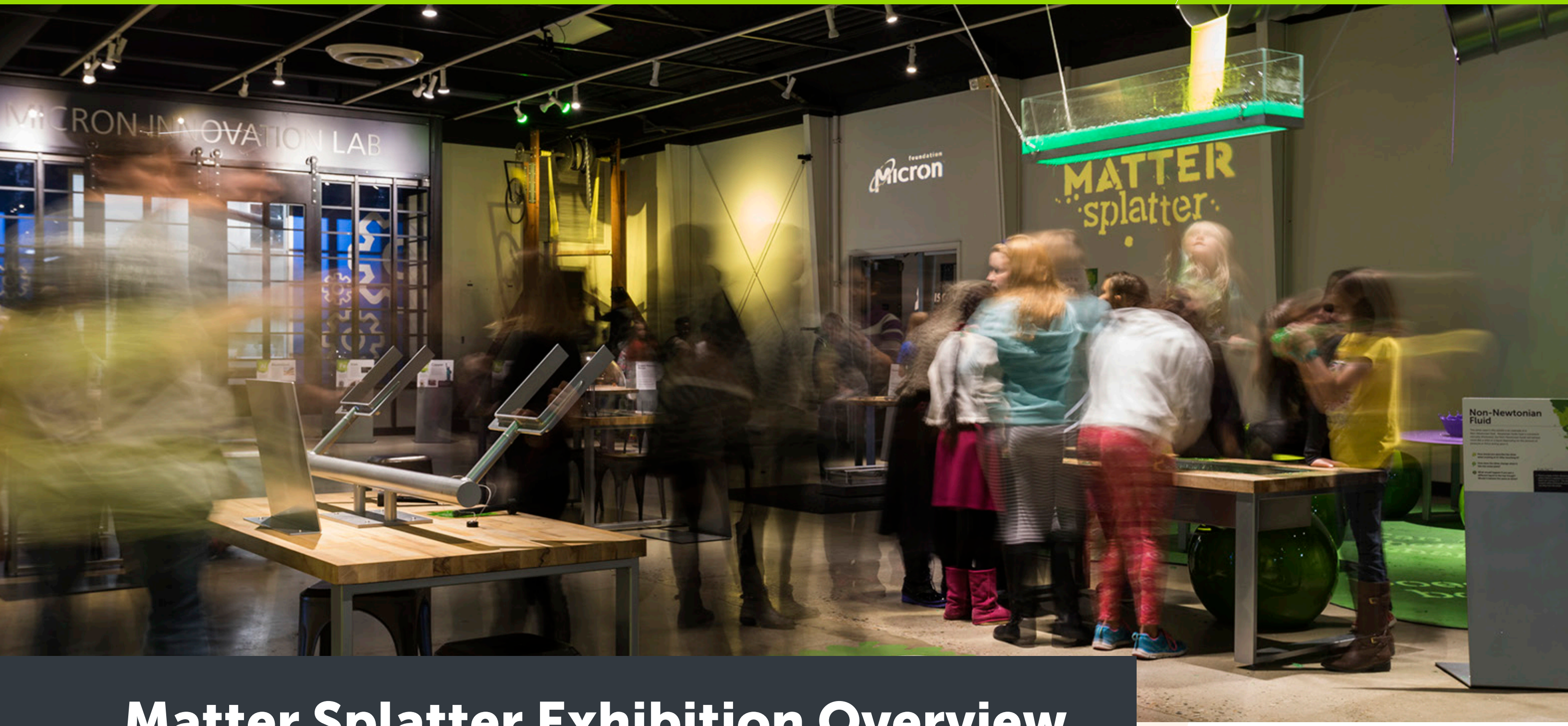

Matter Splatter Exhibition Overview

Matter Splatter is a one-of-a-kind, 3,000 square foot exhibition packed full of innovative hands-on exhibits and experiences related to material science. During your visit, students will have the chance to explore materials used to produce some of the most advanced technology in existence today while learning about the structure and function of matter. As part of the exhibition, our engaging educators will be leading science demonstrations to excite students' curiosity and showcase spectacular materials and their properties. Whether it is exploring the properties of metals, or experimenting with gooey slime, Matter Splatter has something for everyone!

How to Use the Educator Resource Packet

Matter Splatter offers a unique opportunity for students to dive into the world of material science and engineering. Our intent is for you to use this resource packet as a starting place for ideas on how to design a meaningful, informative and fun visit to the Discovery Center that supports and furthers learning and discovery in the classroom.

This resource packet first identifies key themes represented throughout the exhibition's interactive exhibits. These themes may help you to shape and define your goals for students' field work while at the Discovery Center. Within each of the key themes there is a list of related exhibits and suggested inquiry questions to help facilitate students' learning and discovery while at the Center. Copies of exhibits' signage are included to help provide background information about the main concepts covered at each of the interactive exhibits. There is a list of potential connections between Matter Splatter and the Idaho Science Content Standard to help draw connections between the exhibition and your classroom. Lastly, we have included a field work planning guide to help you set goals and prepare your students for their visit to the Discovery Center.

Key Concepts

1. **Today's technology & innovation is possible due to scientists' ability to understand, control and combine materials**

From our iPhones to NASA spacecraft, today's advanced world is built using the same chemical elements that have existed since the beginning of time. It is because of our growing understanding of these elements and their properties that we are able to engineer and create today's innovative technology. Matter Splatter gives students the opportunity to interact with advanced technologies and learn how scientists and engineers use their understanding of materials to create today's technological world.

Related Exhibits:
Elastic Collisions, Biomimicry, Element Kiosks, Ferrofluids, Non-Newtonian Fluids, Shape Memory Alloys, Splatter Zone

Inquiry Questions for Students:

1. Which types of sporting equipment would benefit from amorphous materials? Which would not? (related exhibit: elastic collisions)
2. What natural object or phenomenon might inspire the next great technology? (related exhibit: biomimicry)
3. If you were a scientist, what types of questions could the periodic table help answer? (related exhibit: element kiosks)
4. How could you use ferrofluids to improve everyday tasks? (related exhibit: ferrofluids)
5. Water is an example of a Newtonian fluid. Can you think of a time when it might be beneficial for water to act like a Non-Newtonian fluid? (related exhibit: non-newtonian fluids)
6. Where could you imagine using nitinol? (related exhibit: shape memory alloy)
7. What types of experiments can you conduct in the splatter zone to learn about the physical properties of slime? (related exhibit: splatter zone)

2. **Atoms are the basic building blocks for all matter in the universe. A material's atomic structure affects its physical properties**

Matter is anything that has mass and takes up space. Everything is made up of matter. Which is why matter, matters! Matter Splatter gives students the opportunity to experiment with different materials and to observe how a material's physical properties affect how it interacts with its environment. Many of the exhibits examine how a material's atomic structure plays an important role in shaping its physical properties. These concepts further illustrate how our understanding of different materials is important for engineers and scientists who are responsible for designing and building today's technological world.

Related Exhibits:
Elastic Collisions, Conductivity, Density, Element Kiosks, Energy Through Solids, Newton's Cradle, Non-Newtonian Fluids, Shape Memory Alloys, Slippery Slope, Splatter Zone

Inquiry Questions for Students:

1. Using your observations, what can you infer about the atomic structure of glass? (related exhibit: elastic collisions)
2. What are some examples of applications needing high conductivity? Low conductivity? (related exhibit: conductivity)
3. What material would you use to make a racing bike? How could you measure and compare object's densities? (related exhibit: density)
4. What trends do you notice as you move left to right across a row of the periodic table? Top to bottom? (related exhibit: element kiosks)
5. What do you see and feel when the mallet taps the tuning fork? (related exhibit: energy through solids)
6. What happens when you put the rod at the end of the cradle? The middle? What other material properties could affect how objects interact in Newton's Cradle? (related exhibit: newton's cradle)

7. How would you describe the slime when looking at it? After touching it? How does slime change when it hits the metal plate? (related exhibit: non-newtonian fluids)
8. Can you see the fine nitinol wire? How does the wire change when you push the button? When you release it? (related exhibit: shape memory alloy)
9. Feel the bottom of each sled. Which do you think will go the farthest? What material would you want the bottom of your shoes to be made of? (related exhibit: slippery slope)
10. What types of experiments can you conduct in the splatter zone to learn about the physical properties of slime? (related exhibit: splatter zone)

3. Atoms are the basic building blocks for all matter in the universe. A material's atomic structure affects its physical properties

A material's ability to transfer energy has large implications for the work of engineers and material scientists. Consider the team of engineers who designed the Empire State Building in New York. They had to create a design that anticipated how external forces such as wind and weather would affect the structural integrity and life span of an iconic structure. Many of the Matter Splatter exhibits help illustrate how a material's properties affect the transfer and movement of energy through both solid and liquid states of matter.

Related Exhibits:
Elastic Collisions, Conductivity, Element Kiosks, Energy Through Solids, Newton's Cradle

Inquiry Questions for Students:

1. Which material makes the ball bounce the highest and longest? (related exhibit: elastic collisions)
2. Which materials are the most conductive? The least? (related exhibit: conductivity)
3. What similarities do you notice about elements grouped in the same family? (related exhibit: element kiosks)

4. Can you stop the movement of energy? Why is it important for engineers to consider how different materials transmit energy? (related exhibit: energy through solids)
5. What rods have the same weight as the steel balls? What do you predict would happen if you added a heavier, or lighter, ball? (related exhibit: newton's cradle)

Matter Splatter Science Content Standard Connections

The Idaho Science Content Standards identified below are an overview of some of the physical science standards addressed through the Matter Splatter exhibition. Please remember, this is just a place to start! There are many additional connections, including those across disciplines and among many fields of science that can be addressed during a visit to the Center.

First Grade
1.S.2.1.1, 1.S.2.2.1

Second Grade
2.S.2.1.1, 2.S.2.2.1

Third Grade
3.S.2.1.2, 3.S.2.1.3, 3.S.2.3.1

Fourth Grade
4.S.2.1.1, 4.S.2.1.2, 4.S.2.1.3

Fifth Grade
5.S.2.1.1, 5.S.2.1.2

Sixth Grade
6.S.2.1.1, 6.S.2.1.2, 6.S.2.1.3

Eight & Ninth Grade
8-9.PS.2.2.1, 8-9.PS.2.3.1, 8-9.PS.2.3.2, 8-9.PS.2.4.1, 8-9.PS.2.4.5

Copies of Matter Splatter Exhibit Signage

Elastic Collisions

The falling steel ball has energy. When the ball hits the material at the bottom of the tube, the material can either take the energy from the ball or give it back. The messy arrangement of atoms in the amorphous metal gives most of the energy back to the ball. Therefore, the ball bounces more times on the amorphous metal than it does on a material that has an atomically organized, crystalline structure.

Biomimicry

Nature-inspired design and production of human-made materials is called biomimicry (mimicking biology). Many technologies commonly used today were initially inspired by people's observations of the natural world.

Conductivity

The easier it is for electrons to move through a material, the more conductive it is. Electrons easily move through most metals. They are called conductors. Other materials, like air, are good insulators because electrons do not easily move through them.

The temperature of a wire gives clues about its conductivity. Electrons that have an easy path through a conductor zip through unnoticed. If the electrons struggle to move through the material, the resistance will cause the material to heat up.

Liquids, like solids, can either permit or resist the flow of electricity. Pure freshwater is a poor conductor. Impurities added to water, such as salts, increase water's conductivity.

Density

Why does a gallon of milk weigh more than a gallon of air? Because the milk is more dense! Density measures how much stuff is in a material compared to how much space the material takes up. Material density can be the difference between a light racing bike and a heavy clunker. Density also determines which materials will float and sink.

Element Kiosks

Atoms are extremely small particles made up of even smaller particles called electrons, protons, and neutrons. They are the basic building blocks for all matter in the universe.

Chemical elements are pure substances made up of a single type of atom. Today's technology and innovation is possible due to scientists' ability to understand, control and combine elements.

Aluminum

Aluminum (Al) is a silvery-white metal. The atomic number is 13 and atomic mass is 26.98. It is light, highly malleable, and strong when alloyed (mixed) with other elements.

Aluminum alloys are commonly used in aircraft and aerospace technology due to their low density and ability to withstand stresses associated with launch, flight and operation in air and space. The primary structure of NASA's new spacecraft for astronauts, Orion, is largely composed of an aluminum-lithium alloy. NASA's goal is for Orion to carry astronauts into deep space, including Mars, by 2030.

Carbon

Carbon (C) is a nonmetal element. The atomic number is 6 and atomic mass is 12.01. Carbon forms a vast number and variety of compounds, many critical to life.

Carbon may be the key to next-generation materials. Carbon nanotube-based microprocessors would be smaller, faster and more efficient than current silicon-based technology. They would significantly increase both the speed and battery life of electronic devices. Carbon fiber has a very high strength-to-weight ratio and has the potential to replace steel as a strong, stiff, lightweight materials.

Copper

Copper (Cu) is a reddish transition metal. The atomic number is 29 and atomic mass is 63.55. It is ductile, malleable and has very high electrical and thermal conductivity.

Copper is commonly used for electrical wiring due to its high electrical conductivity. It is also used in particle accelerators to crate electromagnets. The Tevatron Collider at Fermilab in Batavia, Illinois, used superconducting electromagnets made with copper. These magnets were part of a 3.9-mile-long particle accelerator used to study subatomic particles such as protons.

Gold

Gold (Au) is a shiny transition metal. The atomic number is 79 and atomic mass is 196.97. It is ductile, malleable, reflective, highly conductive and corrosion resistant.

Gold nanoparticles (AuNPS) are tiny particles the size of a virus. They are currently being studied for many environmental and biomedical applications. Notably, AuNPS can increase the light absorption and efficiency of organic, plastic-based solar cells. AuNPS could also be engineered to more efficiently target and deliver drugs to cancer cells.

Iron

Iron (Fe) is a silver-gray transition metal. The atomic number is 26 and atomic mass is 55.85. It is ductile, malleable and abundant in the universe. Iron rusts when exposed to oxygen and moisture for longer periods of time.

Steel is made by combining iron with carbon. Adding carbon to iron increases its hardness. From skyscrapers to dinner forks, modern civilization is built on steel. Future space colonies will likely depend on iron and other natural resources mind from celestial bodies such as asteroids. Researchers are currently studying the feasibility of mining these raw materials to make space colonization less expensive and more efficient.

Lithium

Lithium (Li) is a slivery alkali metal. The atomic number is 3 and atomic mass is 6.94. It is the lightest and least dense of any metal.

Lithium-ion batteries are used to power electronic devices including cell phones, laptops and even cars. They have a high energy-per-volume ration and can recharge often without capacity loss. Tesla's all electric-vehicle, the Model S, uses 7,104 lithium-ion battery cells in its 85 kWh battery pack. It can accelerate from 0 to 60 mph in as little as 2.5 seconds and has a range of 200 plus miles per charge.

Silicon

Silicon (Si) is a metalloid. In crystalline form, Silicon is gray with a metallic luster. The atomic number is 14 and atomic mass is 28.09. It is a natural semiconductor.

Silicon is abundant and can act as an "on-off" switch for circuitry, making it an ideal material for computer chips. Microprocessors, made primarily of silicon transistors (electrical on-off switches), are the brains of all computers and many electronic devices. The first microprocessor created in 1971 had 2,300 transistors. Today, microprocessors have as many as 7.2 billion transistors, and are smaller than those created in 1971.

Titanium

Titanium (Ti) is a hard, shiny transition metal. The atomic number is 22 and atomic mass is 47.87. It has a high strength-to-weight ratio and is corrosion resistant.

Titanium is more expensive than steel but offers a lighter, stronger alternative in certain industrial applications. The US Navy is currently researching the feasibility of building all-titanium ships. Titanium would increase the ship's service life due to its corrosion resistance in saltwater. Since titanium is less dense than steel, this change would also make ships more fuel efficient and increase the ship's cargo carrying capacity.

Energy Through Solids

Energy moves through all states of matter including solids, liquids, and gases. Here, sound energy in the form of vibrations moves from one solid tuning fork to another.

Ferrofluids

Ferrofluids contain magnetic nanoparticles so small they can only be seen with a very powerful microscope. When ferrofluids come close to a magnet, the magnetic particles are attracted to the magnet's invisible magnetic field. However, the liquid keeps the particles from moving too far. This pull between liquid and magnet creates the spikey formations seen in the exhibit.

Newton's Cradle

When objects collide, energy is transferred. An object with a larger mass can transfer more energy when it collides with another object. Each of the balls in this exhibit are made from the same materials and are equal in size and weight. This means they have the same mass. The rods are made from different materials and have different masses. These differences affect how the cradle swings.

Non-Newtonian Fluid

The slime used in this exhibit is an example of a Non-Newtonian fluid. Newtonian fluids have a consistent viscosity (thickness), but Non-Newtonian fluids will behave more like a solid or a liquid depending on the amount of pressure of force acting upon it.

Shape Memory Alloys

The clear track is raised and lowered by a fine nitinol wire, a material made by mixing nickel and titanium. Nitinol is a shape memory alloy with unique properties that cause it to return to its original shape when heat is applied. Heat, from an electrical current, is applied to the nitinol wire when the button is pushed. They heat causes the wire to shorten back to its original form, lifting the track. When the button is released, the wire cools, stretching the wire and lowering the track.

Slippery Slope

Friction is a force that causes the resistance of motion when two objects rub against each other. This is what causes the slippery slope sleds to slow down on the track. Materials with smoother surfaces create less friction, allowing the sleds to go farther than those with rougher surfaces.

Splatter Zone

Polymers are long chains of molecules. How polymers look, feel and act depends on the molecules that make up the polymer and how they are connected to one another. Some are gooey, like this slime. Others are rubbery, like the sold of a shoe or hard, like the plastic made to use a water bottle. Examples of polymers include plastics, silly putty, rubber, polyester, nylon, proteins, and DNA.

Discovery Center of Idaho Field Work Planning Guide

From "Field Trip" to "Field Work"; Reimagining the Student Experience

Just like scientists, students benefit from spending time in the field making observations, inspiring curiosity, and researching a concept. This planning guide can help identify your goals for your students' field work at the Center and help your students meet those goals.

STEP ONE: IMAGINE THE POSSIBILITIES

In the boxes below, please describe the learning experience you have imagined for your students. What field work will your students do while they are at the Center? What will your students do before and after your field work to connect learning to your classroom?

Before	During	After

STEP TWO: DEFINE YOUR GOALS

What do you hope students will be curious about when they visit the Center? What do you hope students will take away from this experience?

STEP THREE: COLLABORATION

Please contact Discovery Center education staff at education@dcidaho.org with any remaining questions or concerns you have about your upcoming field work. We're here to help!