Shattering the Mold

Chihuly & the Science of Glass Blowing

UNPACKING DALE CHIHULY

Group Talk

- Dale Chihuly is inspired by the nature that surrounds him. How do you think nature inspired him? Can you see the inspiration in his artwork? Are you inspired by nature? Why or why not?
- Is there art in the process of glass blowing or is the art only found in the final product? Is this the same for using different types of mediums, such as pencils, paint or clay?
- What role does color play in Dale Chihuly's glass?
  You might discuss how the colors represent the audience or the theme of his artwork.
- How has Dale Chihuly's experience as an interior designer influenced his work with glass blowing? Are these experiences completely opposite? Is that good?

UNPACKING DALE CHIHULY

Group Talk

- Have Dale Chihuly's injuries positively or negatively impacted his ability to create art?
  Positively! You might discuss how his roles have shifted since his accidents and how teamwork comes into play.

- Due to his injuries and the intricacies of his work, how does Dale Chihuly work with his team? Is Dale Chihuly the sole artist in creating his glass pieces? Would you consider the members of his team artists? Why or why not?

LET'S TALK GLASS

- If we are going to understand how artists such as Dale Chihuly use glass, it would be best to know some basic background information about glass. Here are some engaging questions:

Group Talk

- What experience do you have with glass?
- What everyday objects are made from glass?
- Would you consider these everyday objects art?
- How was glass used in historical periods?

A BIT OF PROPERTY OF MATTER

- So what property of matter is glass? It may not be what you think. Here is a fantastic, basic overview.

Today, glass is created by melting ordinary sand at 3090F (1700C). At this point, the glass is considered to be molten, which means it is now a hot, thick, liquid state. While in the furnace, the molten sand becomes gooey and flexible. Then, the artist takes the molten sand out of the furnace and is able to begin manipulating the molten sand into the desired shape. The molten sand never turns into a solid, no matter how much you cool it. Instead, it becomes a cross between a liquid and a solid called an amorphous solid.

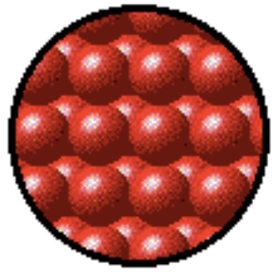
Properties of matter can be divided into two groups: chemical and physical. Chemical properties are any characteristics that can only be determined by the changes in a substance's molecular structure. These properties cannot be determined through touching or viewing the substance, it is only evident during a chemical reaction. Examples of chemical properties include flammability, hydrolysis, and oxidation. Physical properties are any characteristics that do not change the substance's chemical identity and includes color, density, volume, mass, boiling point, and melting point. These properties can be viewed through touching or viewing the substance.

All substances can be divided into three properties: gasses, liquids, or solids. Gasses are substances where the particles are separated and move freely at high speeds, while moving past one another. Liquids have particles that are close together but still have the freedom to move and slide past one another with no regular pattern. They take the shape of the space it occupies and is not easily compressible. Solids are substances with particles that are tightly packed, move in a regular pattern, and do not generally move from place to place. Particles can be described as rigid, meaning they are locked into place.

An amorphous solid is a substance, such as glass, whose particles are not organized in a specific pattern but they are close in proximity to each other. Plastics and gels are also considered to be amorphous solids.

gas

liquid



solid

Group Talk

- Are solid, liquid, and gas a physical or chemical property of matter? Why?
- Think of everyday objects. Would you classify them as solids, liquids, or gasses? Explain your reasoning.
- Does being an amorphous solid help artists in shaping their glass? Why or why not?

HANDS-ON WITH PROPERTIES OF MATTER

Ready to explore properties of matter? Let's give it a shot!

Reach Out Michigan has a great experiment for students to explore the properties of butter in different temperatures. Remember that this is your classroom so be mindful to tailor this activity to your specific groups of students. Depending on the resources available to you, time, and your students, there are many ways you can make adaptations to this project while still including the content.

- What other substances could be tested?
  - Shaving Cream
  - Peanut Butter

Provided on the following page is an example of a way to assess students throughout the process of testing the properties of matter.

Group Talk

- Predict if the shape of glass would change due to temperature. Would temperature have an effect on glass?
- Which test tube do you think most closely resembles the property of glass during the glass blowing process? Explain.
- Which test tube do you think most closely resembles the property of glass in Chihuly's final artwork? Explain.
- Which test tube would you rather use if you had to build a sculpture out of butter? Explain your reasoning.

*Group Members:*_____

Test Tube Number: _____ *Date:* _____

What are the physical properties of this test tube?

_____
_____
_____
_____

Explain the relationship between the physical properties of the butter and the temperature at which it was maintained.

_____
_____
_____
_____

Was there a chemical reaction? Explain your reasoning.

_____
_____
_____
_____

Engineering

LET'S TALK ENGINEERING

- There is a lot of engineering that plays into building Dale Chihuly's Firework of Glass sculpture at the Children's Museum in Indianapolis.

Let's check out some fascinating engineering history!

Engineering can be defined as a combination of science and technology that studies the design, building, and use of engines, machines, and structures. Engineering began in what is known as the Pre-Scientific Revolution, where the founding fathers of engineering succeeded through trial and error. Their curiosity to tinker with objects led to inventions, proving that imagination and art play a role in the sciences. Leonardo da Vinci, known as a founding father of engineering, inspired others to ask what works and why.

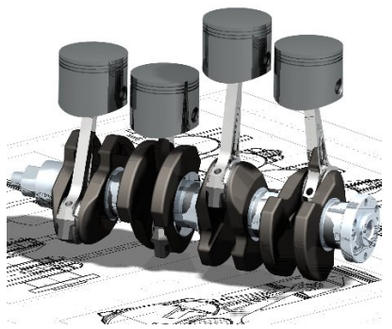
The next phase of engineering, the Industrial Revolution, used a scientific approach to solve problems and adopted structural analysis, the mathematical process and thinking of building structures. It was during this time period that machines began to replace human labor and technical training shifted from apprenticeship to a university education. Branches of engineering such as civil and mechanical were introduced.

During the Second Industrial Revolution, university engineering programs were solid and graduate schools were created. As well, chemical and electrical engineering developed and aeronautic engineers made it possible for ordinary people to travel by flight.

The Information Revolution lead to a greater effort of engineering research. As well, new technology was created because of the engineering programs, which included inventions like microelectronics, computers, cell phones, and rocket engines.

Today, there are over 40 branches of engineering, all falling into one of the following four categories: mechanical, chemical, civil, and electrical.

Civil Engineering



Mechanical Engineering

Chemical Engineering

Electrical Engineering

HANDS ON WITH REVERSE ENGINEERING

Reverse Engineering is the process of thoroughly and methodically understanding how a device is put together in order to understand how it functions and serves its purpose. Click here to read about reverse engineering more in-depth.

TeachingEngineering.org has a great engaging activity for students to explore the elements of pens!

There are several ways to extend this exploration:

- Compare and contract retractable pens with capped pens
- Design a new pen with improvements

Group Talk

- How do the parts of the pen work together in order for the pen to function correctly?
- Did reverse engineering help you better understand the parts of the pen and how they work together? How so?
- What other objects could you reverse engineer to learn more about?

Reverse Engineering

Before taking the device apart…

What device is being taken apart? _____

Draw the device. Label the parts.

What does the devise do when in operation?

_____
_____
_____.

How are you going to take it apart? What tools do you need?

_____
_____
_____.

What kind of parts do you think you will find inside?

_____
_____
_____.

What do you think the inside parts look like and what do you think they do?

_____
_____
_____.

Take the device apart…

Draw the inside of the device. Label any of the parts you know.

What inside parts connect with the outside parts?

_____
_____
_____.

What do you think the parts do?

_____
_____
_____.

Can you take the device apart further? Explain.

_____
_____
_____.
_____
_____
_____.

EDUCATIONAL STANDARDS

Within every episode we strive to meet every content standard within the National Core Arts Standards. Please be sure to include and reference these standards when preparing and documenting your lessons.
For additional, and more in-depth information, you can reference this site.

NATIONAL CORE ARTS STANDARDS

Associated Anchor Standards

Creating

#VA:Cr1.1
Anchor Standard: Generate and conceptualize artistic ideas and work.
Enduring Understanding: Creativity and innovative thinking are essential life skills that can be developed.
Essential Question: What conditions, attitudes, and behaviors support creativity and innovative thinking? What factors prevent or encourage people to take creative risks? How does collaboration expand the creative process?

#VA:Cr1.2
Anchor Standard: Generate and conceptualize artistic ideas and work.
Enduring Understanding: Artists and designers shape artistic investigations, following or breaking with traditions in pursuit of creative art-making goals.
Essential Question: How does knowing the contexts histories, & traditions of art forms help us create works of art & design? Why do artists follow or break from established traditions? How do artists determine what resources are needed to formulate artistic investigations.

#VA:Cr2.1
Anchor Standard: Organize and develop artistic ideas and work.
Enduring Understanding: Artists and designers experiment with forms, structures, materials, concepts, media, and art-making approaches.
Essential Question: How do artists work? How do artists and designers determine whether a particular direction in their work is effective? How do artists and designers learn from trial and error?

EDUCATIONAL STANDARDS

Creating

#VA:Cr2.3

Anchor Standard: Organize and develop artistic ideas and work.
Enduring Understanding: People create and interact with objects, places, and design that define, shape, enhance, and empower their lives.
Essential Question: How do objects, places, and design shape lives and communities? How do artists and designers determine goals for designing or redesigning objects, places, or systems? How do artists and designers create works of art or design that effectively communicate

#VA:Cr3.1

Anchor Standard: Refine and complete artistic work.
Enduring Understanding: Artist and designers develop excellence through practice and constructive critique, reflecting on, revising, and refining work over time.
Essential Question: What role does persistence play in revising, refining, and developing work? How do artists grow and become accomplished in art forms? How does collaboratively reflecting on a work help us experience it more completely?

EDUCATIONAL STANDARDS

Responding

#VA:Re7.1

Anchor Standard: Perceive and analyze artistic work.
Enduring Understanding: Individual aesthetic and empathetic awareness developed through engagement with art can lead to understanding and appreciation of self, others, the natural world, and constructed environments.
Essential Question: How do life experiences influence the way you relate to art? How does learning about art impact how we perceive the world? What can we learn from our responses to art?

#VA:Re7.2

Anchor Standard: Perceive and analyze artistic work.
Enduring Understanding: Visual imagery influences understanding of and responses to the world.
Essential Question: What is an image? Where and how do we encounter images in our world? How do images influence our views of the world?

#VA:Re8.1

Anchor Standard: Interpret intent and meaning in artistic work.
Enduring Understanding: People gain insights into meanings of artworks by engaging in the process of art criticism.
Essential Question: What is the value of engaging in the process of art criticism? How can the viewer "read" a work of art as text? How does knowing and using visual art vocabularies help us understand and interpret works of art?

#VA:Re7.2

Anchor Standard: Perceive and analyze artistic work.
Enduring Understanding: Visual imagery influences understanding of and responses to the world.
Essential Question: What is an image? Where and how do we encounter images in our world? How do images influence our views of the world?

EDUCATIONAL STANDARDS

Connecting

#VA:Cn11.1

Anchor Standard: Relate artistic ideas and works with societal, cultural, and historical context to deepen understanding.
Enduring Understanding: People develop ideas and understandings of society, culture, and history through their interactions with and analysis of art.
Essential Question: How does art help us understand the lives of people of different times, places, and cultures? How is art used to impact the views of a society? How does art preserve aspects of life?

#VA:Re8.1

Anchor Standard: Interpret intent and meaning in artistic work.
Enduring Understanding: People gain insights into meanings of artworks by engaging in the process of art criticism.
Essential Question: What is the value of engaging in the process of art criticism? How can the viewer "read" a work of art as text? How does knowing and using visual art vocabularies help us understand and interpret works of art?