

The Periodic Table of the Elements

Transition Metals

Teacher's Guide

Grade Level: 6–8

Curriculum Focus: Physical Science

Lesson Duration: Two class periods

Program Description

Introduce students to the elements that make up about a third of the periodic table. Take a look at how some transition metals are used to make metal alloys. Investigate an element that may hold the clue for what killed the dinosaurs. Consider humanity's infatuation with gold. And provide an insider's look at the massive collection of workers, materials, and technologies that come together to create the most powerful ship on the seas.

- Exploring Transition Metals (5 min.)
 - Manganese: Strengthening Steel (6 min.)
 - Iridium: Meteor Mass Extinction (6 min.)
 - Gold: Wealth From Water (6 min.)
 - Floating City of Steel (22 min.)
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Onscreen Questions

- What properties do the transition metals share?
 - How do the elements vanadium, chromium, and manganese affect steel?
 - How are metal alloys used in the construction of an aircraft carrier?
 - Could modern aircraft carriers exist without metal alloys?
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Lesson Plan

Student Objectives

- Identify and describe transition metals.
- Discuss alloys and their benefits.
- Research one common alloy and report on its composition, properties, and uses.

Materials

- Transition Metals program
- Periodic table
- Print and online resources about common alloys
- Computer with Internet access
- Color copier and printer

Procedures

1. After watching the program, have students identify the transition metals on a periodic table. (*They are the elements in groups 3 through 12.*) Point out that this is the largest group of elements. Ask students: What are some familiar transition metals? (*iron, copper, silver, gold, zinc*) What properties do most transition metals share? (*hard, dense, shiny, high melting and boiling points, good conductors of heat and electricity, malleable, ductile*)
2. Ask students to identify the material used to make the aircraft carrier in the video. (*steel*) Explain that steel is an alloy, not an element or pure metal. Alloys are solid materials made by mixing a metal with another substance, usually another metal. Ask students: What is the advantage of creating alloys? (*They combine the desirable properties of their elements.*) Explain that steel is an alloy composed mostly of iron with some carbon; it is much stronger than pure iron. By adding additional metals to steel, you can make a steel alloy, which is even stronger or more durable. An example of this was shown in the video – chromium, manganese, and vanadium were added to steel to make special alloys for the aircraft carriers.
3. Create a classroom chart like the one below on a flipchart or chalkboard. Tell students they'll be exploring common alloys made from transition metals. Assign a small group of students to each alloy in the chart, and provide appropriate print and online resources.

Have the groups determine the composition, properties, and common uses of their alloys. In addition, ask them to gather three color images of objects made with the alloy – they may cut images from magazines, print color copies of images from the Web, or make color copies from images in books. However, they should not label these images in any way.

Alloy	Composition (elements)	Properties	Common uses
brass			
bronze			
14-karat gold			
pewter			
solder			
stainless steel			

Alloy	Composition (elements)	Properties	Common uses
sterling silver			
wrought iron			

4. Collect the images, and have one member from each group fill in its alloy information on the classroom chart.
5. Review the chart with the class. Then show students some of the alloy images, asking them to guess what alloy each object is made of. Discuss why that alloy is an ideal material for the object.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Students were active in class discussions; showed a strong understanding of transition metals and alloys; researched all the required information for their assigned alloy and found at least three appropriate images; correctly identified and described several alloys used in the images.
- 2 points: Students participated in class discussions; showed a satisfactory understanding of transition metals and alloys; researched the required information for their assigned alloy and found two or three appropriate images; correctly identified and described a few alloys used in the images.
- 1 point: Students did not participate in class discussions; showed a weak understanding of transition metals and alloys; researched little or none of the required information for their assigned alloy and found only one appropriate image; could not correctly identify or describe any of the alloys used in the images.

Vocabulary

alloy

Definition: A solid substance made by mixing a metal with another substance (usually another metal)

Context: Many transition metals can be combined to create metal alloys that are vital for modern construction, commerce, and industry.

element

Definition: A substance composed of one type of atom; an element cannot be chemically separated.

Context: The elements iron, nickel, and titanium are used in technology production.

metal

Definition: An element that is a good conductor of heat and electricity; metals are usually shiny and hard at normal temperatures.

Context: As with all metals, most of the transition metals are malleable and ductile, meaning they can be flattened into sheets or pulled into long wires without breaking.

steel

Definition: An alloy of iron and carbon that is hard, strong, and malleable

Context: As the iron cools, the carbon is trapped within or binds with the iron molecules, creating a much stronger metal, steel.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/compendium/browse.asp>.

This lesson plan addresses the following national standards:

- Science: Physical Sciences – Understands the structure and properties of matter

The National Council for the Social Studies (NCSS)

The National Council for the Social Studies (NCSS) has developed national standards to provide guidelines for teaching social studies. To view the standards online, go to <http://www.socialstudies.org/standards/strands/>.

This lesson plan addresses the following thematic standards:

- Physical Science
 - Science and Technology
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How to Use the DVD

The DVD starting screen has the following options:

Play Video – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index – Here the video is divided into five segments (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units – These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link – Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources – This screen gives the technical support number and Web site address.

Video Index

I. Exploring Transition Metals (5 min.)

Transition metals are the largest group of elements on the periodic table. Learn about the common traits and the unique properties of this large group of elements.

II. Manganese: Strengthening Steel (6 min.)

About 90 percent of the manganese produced each year is used in steel manufacturing. Learn about the element manganese and see why it is so useful in the making of steel.

III. Iridium: Meteor Mass Extinction (6 min.)

Examine the properties and uses of iridium and see how this element led to a theory about the disappearance of the dinosaurs some 65 million years ago.

IV. Gold: Wealth from Water (6 min.)

Throughout human history gold has been used to make coins, jewelry, and objects of beauty. Learn about the properties of gold and discover how this transition metal is produced.

V. Floating City of Steel (22 min.)

Comprised of steel and steel alloys, aircraft carriers take seven years to build. Learn about the design and manufacturing work involved with building these floating cities of steel.

Curriculum Units

1. Transition Metals: Traits and Properties

Pre-viewing question

Q: What do you think are the most important transition metals?

A: Answers will vary.

Post-viewing question

Q: What is the d-orbital and how does it set transition metals apart from other elements?

A: For most groups on the periodic table, the number of valence electrons an element has corresponds with the element's position on the table. However, transition metals have valence electrons in two shells instead of one. Like other elements, transition metals have valence electrons in their outermost shell. But they also have valence electrons in an interior shell called a d-orbital. A d-orbital holds between one and 10 additional valence electrons. When a transition metal reacts with other elements, the d-orbital determines how the elements will interact.

2. Manganese: Properties and Uses

Pre-viewing question

Q: What are the strongest metals that you know of?

A: Answers will vary.

Post-viewing question

Q: What are some common uses of manganese?

A: Almost 90 percent of the manganese produced every year is used in steel manufacturing. It is also used to make dry-cell batteries, added to paints as a drying agent, or used to give ceramics or glass a green color.

3. Making Steel Alloys

Pre-viewing question

Q: What everyday appliances, gadgets, and items contain steel or steel alloys?

A: Answers will vary.

Post-viewing question

Q: How would the world be different if we could not create steel alloys?

A: Answers will vary.

4. Iridium: Properties and Uses

Pre-viewing question

Q: What do you know about iridium and its uses?

A: Answers will vary.

Post-viewing question

Q: Why is iridium often used in sparkplugs?

A: It is the most corrosion-resistant metal known. Air, water, and acids do not affect it. Sparkplugs made with iridium-coated tips require less voltage, burn fuel more efficiently, and deliver higher horsepower and better gas mileage.

5. Iridium Gives a Clue

Pre-viewing question

Q: What do you think caused the extinction of the dinosaurs?

A: Answers will vary.

Post-viewing question

Q: Do you agree or disagree with the theory that the extinction of the dinosaurs was caused by a large meteor strike?

A: Answers will vary.

6. Gold: Properties and Uses

Pre-viewing question

Q: What do you know about gold and its uses?

A: Answers will vary.

Post-viewing question

Q: What are the common uses of gold?

A: Because it is a beautiful and malleable metal, making it easy to work with, gold has been used throughout history to make coins, jewelry, and other valuables. It is also the standard that many currencies are based on and, because it conducts electricity well and resists corrosion, it has many uses in electronics and industry.

7. Mining for Gold

Pre-viewing question

Q: What do you find attractive about gold?

A: Answers will vary.

Post-viewing question

Q: Do you think the work involved with gold production is worth it?

A: Answers will vary.

8. A Shipbuilding Challenge

Pre-viewing question

Q: Have you ever seen or been aboard an aircraft carrier?

A: Answers will vary.

Post-viewing question

Q: If you were designing an aircraft carrier, what features would you include?

A: Answers will vary.

9. Manufacturing an Aircraft Carrier

Pre-viewing question

Q: What is the value of building a complicated model or puzzle?

A: Answers will vary.

Post-viewing question

Q: What do you think is the most difficult aspect of manufacturing an aircraft carrier?

A: Answers will vary.

10. An Aircraft Carrier Takes Shape

Pre-viewing question

Q: What is your proudest accomplishment?

A: Answers will vary.

Post-viewing question

Q: What are the most significant accomplishments in building an aircraft carrier?

A: Answers will vary.

11. Aircraft Catapults

Pre-viewing question

Q: Describe how a catapult launches an object.

A: Answers will vary.

Post-viewing question

Q: Why is it important to test an aircraft carrier's launch system?

A: Because these aircraft are expensive and not easily replaced, the system must be tested and adjusted for the plane's weight before each launch. If a plane is launched too quickly or too slowly, it may crash into the water. The catapults use steam pressure to launch aircraft, and the system must be properly set for the weight of the plane so that it is launched at the right speed.

12. Weapons Systems and Sea Trials

Pre-viewing question

Q: Describe the experience of working on a tight deadline.

A: Answers will vary.

Post-viewing question

Q: What aspect of aircraft carrier construction would you be best at and why?

A: Answers will vary.