EDUCATIONAL RESOURCES FOR K-12 EDUCATORS

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Welding & Fabrication

Lesson Planning Guide: Science of Welding and Welding Careers / Science



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More information is available at www.pct.edu/degreesthatwork or www.wvia.org

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More information is available at www.weld-ed.org.

Pennsylvania College of Technology

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WELD-ED

'degrees that work, Welding and Fabrication'

Lesson Planning Guide – Science Version

Unit: The Science of Welding and Welding Careers

Competency: Describe the process/science of fusing metals together through the process

of welding and list and describe some career choices available in welding.

PA Academic Standards Included: 3.4.7B; 3.6.7C; 3.7.7A

Approximate Time: Four to five 45-minute periods.

Prerequisite Skills

Reading, Writing, Speaking and Listening*

None

Mathematics*

None

Science and Technology*

- 3.4.7 Physical Science, Chemistry and Physics
- B. Relate energy sources and transfers to heat and temperature.
- 3.6.7 Technology Education
- C. Explain physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design.
- 3.7.7 Technological Devices
- A. Describe the safe and appropriate use of tools, materials and techniques to answer questions and solve problems.

Career Education and Work*

None



^{*} Academic Standards, Pennsylvania Department of Education http://www.pde.state.pa.us

Competency: Describe the process/science of fusing metals together through the process of welding and list and describe some career choices available in welding.

Performance Standards

	Performance Standard	Suggested Evaluation Method
1.	Describe the process/science of welding with a 90% accuracy level on the worksheet.	Written evaluation: worksheet
2.	Describe the safety guidelines to follow when welding, based on the science of welding, with a 90% accuracy level on the worksheet and a discussion.	Written evaluation: worksheet Oral evaluation: discussion
3.	List and describe some of the jobs available in welding with 90% accuracy in a class discussion.	Oral evaluation

Suggested Projects

None

Multiple Intelligence Types

Verbal/Linguistic

Visual/Spatial

Resources

1. PowerPoint - Welding

The actual PowerPoint presentation can be obtained by contacting the Outreach for K-12 Office at Pennsylvania College of Technology at 570-320-8003 or CareerEd@pct.edu.

2. Handout - Science of Welding Worksheet

See attached

Teacher resource - Science of Welding Worksheet Key See attached

4. Handout - Safety of Welding Worksheet

See attached

5. Teacher resource - Safety of Welding Worksheet Key See attached

- 6. Video Pennsylvania College of Technology "Degrees That Work": Welding and Fabrication http://www.pct.edu/degreesthatwork/welding.htm
- 7. Teacher resource Lincoln Electric Welding Curriculum http://www.lincolnelectric.com/knowledge/training/weldcurriculum.asp

Equipment/Materials/Software

- 1. Computer with internet access Any supplier
- 2. Video projector Any supplier



Competency: Describe the process/science of fusing metals together through the process of welding and list and describe some career choices available in welding.

Suggested Learning Sequence

Strategy	Outline	Resources/Equipment
Performance Standard 1		
Introduction/ Discussion	Have a discussion of how science relates to different careers. Lead the students to welding and the science of welding.	
Presentation/ Activity	Use the science portion of the Welding PowerPoint to teach the students about welding and four concepts of science related to welding. As you are covering the science material on welding have the students fill out a worksheet. Related Academic Skills: 3.4.7B; 3.6.7C Related SCANS/Soft Skills: Information A	Resource #1 (science section) Resource #2 Resource #3 Equipment #1 Equipment #2
Performance Standard 2		
Introduction/ Discussion	Review the science of welding and lead the students into a discussion on safety. Use what they learned in the science section to come up with some safety issues.	Resource #1 Equipment #1 Equipment #2
Presentation/ Activity	Use the safety portion of the Welding PowerPoint to teach the students about the safety issues associated with welding. Tie in what they learned about the science of welding to understand safety issues. As you cover the safety portion of the PowerPoint have the students fill in the Safety of Welding	Resource #1 (safety section) Resource #4 Resource #5 Equipment #1 Equipment #2
	worksheet. Related Academic Skills: 3.7.7A Related SCANS/Soft Skills: Information A	
Performance Standard 3		
Presentation/ Discussion	Show the students the video about welding careers. Before its showing, explain that they are to identify welding related jobs that are demonstrated or mentioned in the video.	Resource #6
	At the conclusion of the showing, have students identify the related careers in the video and list them on the board. Make sure they know generally what these jobs entail. Ask if they know anyone who has a welding related job and have them describe exactly what they do on the job. Related SCANS/Soft Skills: Information A	
Assessment/	Check for students understanding of the science and	Resource #1
Discussion	safety of welding and related careers with a post unit	Resource #2



Competency: Describe the process/science of fusing metals together through the process of welding and list and describe some career choices available in welding.

	discussion and review of the worksheets and video.	Resource #4
	This could be accomplished using some type of quiz	Equipment #1
	competition between groups of students.	Equipment #2
	Related Academic Skills: 1.6.8D	
Optional	(Optional for schools with available welding	
Exercise	equipment in one of their shops - Technology	
	Education, Agriculture, Automotive, etc.)	
Introduction/	Discuss with the students the proper procedures for	Resource #7
Discussion	welding including safety.	Equipment #1
		Equipment #2
Presentation	Have the shop/vocational teacher demonstrate the	Resource #7
	welding procedure to the students. After checking	Equipment #1
	for understanding and reviewing safety, have the	Equipment #2
	students demonstrate the welding process and explain	
	what is happening scientifically as they weld.	

Related SCANS/Soft Skills

Resources

None

Interpersonal

None

Information

A. Acquires and Evaluates Information

Systems

None

Technology

None

Thinking Skills

None

Personal Qualities

None

Related Worksite/Work Based Activities

None

Additional Resources

N	one
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This planning guide was written by Eric Broughton, Physics/General Science Teacher, Liberty Jr./Sr. High School, Liberty, PA.



The Science of Welding Science Worksheet

me:	Date:
truc	tions: Fill out the worksheet as we cover the science of welding with a PowerPoint.
1.	welding is a process used to join two pieces of similar metals
	together.
2.	A welder uses energy to heat metal until it is molten.
	List 3 things that you use in your life that require welding.
	a.
	b.
	C.
4.	The electrical potential or pressure that causes current to flow is called and it is measured in
5.	The movement of charged particles in a specific direction is a called
	and it is measured in
6.	deals with the direction of electron flow.
	a current has electrons flowing toward the work surface
	b current has electrons flowing away from the work
	surface.
	c current has electrons changing directions toward and
	away from the work surface.
7.	The electricity flows from the, through the
	and across the, through the
	to the work lead and back to the
8.	The process or system above that deals with the path that electricity follows is called
9.	The electron flow in the circuit is what causes an to be formed
10.	The arc created by the is converted into
	heat because of the of electron flow.
11.	The heat that is created the metal and fuses the pieces together.
12.	The changing of energy from one form into another is called

13.	During welding	energy is converted into
		energy.
14.	Name 4 types of energy	•
	a.	
	b.	
	C.	
	d.	
15.	During the welding prod	cess the metal changes
16.	The 4 types or states of	matter are,
		_,, and
17.		e the metal goes through during the welding process.
18.	Name the three elements a. b. c.	nts that can react with the weld pool and weaken the weld.

The Science of Welding Science Worksheet Key

Name:	Date:
Instruc	ctions: Fill out the worksheet as we cover the science of welding with a PowerPoint.
1.	Arc welding is a process used to join two pieces of similar metals
	together.
2.	A welder uses <u>electrical</u> energy to heat metal until it is molten.
	List 3 things that you use in your life that require welding.
	a. Answers will vary. Anything that is welded will be correct
	b.
	C.
4.	The electrical potential or pressure that causes current to flow is called
	<u>voltage</u> and it is measured in <u>volts</u> .
5.	The movement of charged particles in a specific direction is a called
	<u>current</u> and it is measured in <u>amps</u> .
6.	Polarity deals with the direction of electron flow.
	a. <u>DC -</u> current has electrons flowing toward the work surface.
	b. <u>DC +</u> current has electrons flowing away from the work
	surface.
	c. <u>AC</u> current has electrons changing directions toward and away from
	the work surface.
7.	The electricity flows from the <u>Power Source</u> , through the
	<u>electrode</u> and across the <u>arc</u> , through the <u>base</u>
	material to the work lead and back to the <u>power</u>
0	source
8.	The process or system above that deals with the path electricity follows is called a
0	<u>circuit</u> .
9.	The electron flow in the circuit is what causes an <u>arc</u> to be formed.
10.	. The arc created by the <u>electric</u> <u>current</u> is converted into heat
11	because of the <u>resistance</u> of electron flow.
11.	. The heat that is created <u>melts</u> the metal and fuses the pieces
10	together. The changing of energy from one form into enother is called a length of energy.
12.	. The changing of energy from one form into another is called <u>energy</u>

13. Durinզ	g welding	<u>electrical</u>	energ	y is converted into
the	rmal		energy.	
14. Name	4 types of e	energy.		
a.	<u>electrical</u>			
b.	<u>thermal</u>			
C.	<u>chemical</u>			
d.	<u>radiation</u>			
15. During	the weldin	ig process the	e metal changes <u> </u>	<u>states</u> .
16. The 4	types or sta	tes of matter	are <u>solid</u>	, <u>liquid</u>
<u>gas</u>		, andp	<u>lasma</u>	·
17. List th	e changes o	of state the m	etal goes through o	during the welding process.
Solid t	o liquid and	l gas to solid		
18. Name	the three e	elements that	t can react with the	weld pool and weaken the weld.
a.	<u>Hydrogen</u>			
b.	<u>Nitrogen</u>			
C.				

Science of Welding

Safety Worksheet

Name:	Date:
Instruc	ction: Fill out the worksheet on welding safety as you watch the PowerPoint
1.	What three science concepts related to welding makes safety an important topic?
	a.
	b.
	C.
2.	For welding to be safe you must understand and follow all
3.	List three places to find warning labels for welding safety.
	a.
	b.
	C.
4.	What is a MSDS?
5. 6.	List five potential hazards you need to protect yourself from when welding. a. b. c. d. e. List five safety devices worn by a welder to protect themselves. a.
	b. c.
	d.
	e.
	- ·

Science of Welding

Safety Worksheet Key

Name:	Date:
Instruc	etion: Fill out the worksheet on welding safety as you watch the PowerPoint
1.	What three science concepts related to welding makes safety an important topic? a. Electricity b. Chemical Reactions c. Changes of State
2.	For welding to be safe you must understand and follow allDIRECTIONS
	List three places to find warning labels for welding safety. a. On Equipment b. On consumable materials package c. In the instructions What is a MSDS?
	A material safety data sheet – provided by manufacturer to inform of safe handling, potential hazards, identity and composition, and safe use of the material.
5.	List five potential hazards you need to protect yourself from when welding. a. Fumes and gases b. Electric Shock c. Arc Rays d. Fire and Explosion and hot objects e. Noise
6.	List five safety devices worn by a welder to protect themselves.

- a. Fire proof clothing
- b. Work boots
- c. Welding gloves, jackets and pants
- d. Welding cap, helmet and safety glasses
- e. Ear protection