

**UNIT 16: Complexity of Cyberspace**

**Estimated Time in Hours: 7**

<p><u>Big Idea(s)</u> 6 Adversarial Thinking 7 Risk</p>	<p><u>Enduring Understandings</u> 7.2, 6.1</p>	<p><u>Projects &amp; Major Assignments</u> - Research and map the components of a complex system. - Research major Internet milestones. - Experiment with HTML and learn about HTTPS.</p>
<p><b>Guiding Questions:</b></p> <ul style="list-style-type: none"> <li>• What is a complex system?</li> <li>• What is the output of a complex system?</li> <li>• What causes a system to change?</li> <li>• How is cyberspace complex?</li> <li>• What is the Internet?</li> <li>• Who owns the Internet?</li> <li>• Who hands out IP addresses?</li> <li>• How/Why does the Internet change?</li> <li>• What are attacks against the Internet?</li> <li>• Do people always use things the way they are intended?</li> </ul>		
<p><b>Learning Objectives &amp; Respective Essential Knowledge Statements</b></p>	<p><b>Materials</b></p>	<p><b>Instructional Activities and Classroom Assessments</b></p>
<p>6.1.1b EK: Complex systems typically have input from many sources and are highly changeable.</p> <p>7.2.1a EK: A complex system is a system composed of many parts, which may interact with each other, where the interactions</p>	<ul style="list-style-type: none"> <li>• Computer, lecture slides, projector, graphic organizers, access to Internet</li> </ul>	<ul style="list-style-type: none"> <li>• Explain to students the meaning of a complex system and how that systems do can be complex without being complicated.</li> <li>• Have students list all the technology used as school (including apps). Next, have them map the ways the technology is connected.</li> </ul>

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<p>produce properties that its parts do not have.</p>		<ul style="list-style-type: none"> <li>• Ask them if any of the technology ever changes (updates, new equipment, new rules, is phased in or out, etc.). How do these changes happen?</li> <li>• Ask students what the product is of the system. Possible answers: graduates, learning, educated people. Ask if any one of those components, without the help of the rest, could produce this product.</li> <li>• Ask students to map their own version of a complex system. This could be a hospital, bank, grocery store, etc.</li> </ul>
<p>7.2.1c EK: The behavior or output of cybersystems cannot be predicted simply by analyzing the parts and inputs of the system.</p> <p>7.2.1d EK: The behavior of the system is emergent and changes with time. The same input and environmental conditions do not always guarantee the same output.</p> <p>7.2.1b EK: The behavior of complex systems has unpredictable output, i.e., it is intrinsically difficult to model due to the dependencies, competitions, relationships, or other types of interactions</p>		<ul style="list-style-type: none"> <li>• Note that it is the parts working together that determines the behavior or output. Just the individual elements cannot produce it by itself.</li> <li>• Discuss the essential knowledge statements.</li> <li>• Have students note that the behavior of system changes with time and has different outputs. For example, they may receive a different education than their brothers, sisters, or parents. Also, students who sat in the same classroom will use the knowledge attained different ways. There is no way to predict which students will become doctors or which ones will become teachers.</li> <li>• Have them apply this with their version of a complex system.</li> </ul>

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<p>between the parts or between a given system and its environment.</p>		
<p>7.2.1e EK: The participants or agents of a system (human agents, including or especially adversaries, in this case) are self-learning and change their behavior based on the outcomes of the previous experience.</p>		<ul style="list-style-type: none"> <li>• Ask students why systems change. Note that teachers often adjust the way they teach to meet the needs of the learner. Grocery stores may change their layout to improve sales. Adversaries change their techniques to match the weaknesses of a system.</li> </ul>
<p>7.2.1 LO: Students will be able to explain how cyberspace is a very large, complex system of cybersystems that include hardware, software, social, economic, and political components.</p> <p>6.1.1 LO: Students will explain how cybersystems are complex systems.</p> <p>6.1.1a EK: A complex system is a system composed of many components which may interact with each other.</p>	<ul style="list-style-type: none"> <li>• “TRADOC Pamphlet 525-7-8: The United State Army’s Cyberspace Operations Concept Capability Plan 2016-2028.” Federation of American Scientists, <i>FAS.org</i>, <a href="https://fas.org/irp/dod/dir/army/pam525-7-8.pdf">https://fas.org/irp/dod/dir/army/pam525-7-8.pdf</a></li> </ul>	<ul style="list-style-type: none"> <li>• Note that the Internet is a complex system. List the components for students (hardware, software, social, economic, and political). Have them think of examples.</li> <li>• Building on these components, discuss what makes it a complex system.</li> <li>• Have students explore how the components interact. Using the document linked left, explore the layers on page 8 and the infrastructure relationships on page 12.</li> </ul>
<p>6.1.1c EK: The internet is a prime example of a complex system in that it is a large and complex</p>	<ul style="list-style-type: none"> <li>• “What is the Internet? (video)” Khan Academy, <i>KhanAcademy.org</i>,</li> </ul>	<ul style="list-style-type: none"> <li>• Use the video linked on the left to discuss the complexity of the Internet.</li> </ul>

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<p>system composed of multiple, dispersed, independent systems.</p>	<p><a href="https://www.khanacademy.org/computing/computer-science/computers-and-internet/code-org/internet-works-intro/v/what-is-the-internet">https://www.khanacademy.org/computing/computer-science/computers-and-internet/code-org/internet-works-intro/v/what-is-the-internet</a></p> <ul style="list-style-type: none"><li>• “TRADOC Pamphlet 525-7-8: The United State Army’s Cyberspace Operations Concept Capability Plan 2016-2028.” Federation of American Scientists, <i>FAS.org</i>, <a href="https://fas.org/irp/dod/dir/army/pam525-7-8.pdf">https://fas.org/irp/dod/dir/army/pam525-7-8.pdf</a></li><li>• “Khan Academy and Code.org   Wires, cables, and WiFi.” <i>YouTube</i>, uploaded by Khan Academy Partners, 30 July 2018, <a href="https://www.youtube.com/watch?v=qtmTMvXKKdg&amp;feature=emb_lo">https://www.youtube.com/watch?v=qtmTMvXKKdg&amp;feature=emb_lo</a> <a href="#">go</a></li></ul>	<ul style="list-style-type: none"><li>• Discuss who owns the internet. See page 11 of pdf linked left.</li><li>• Discuss wires, cables, and Wi-Fi. Use the video linked left to guide the discussion.</li><li>• Use the Bits and Bytes activity on the left to discussion how information transmitted across the Internet.</li><li>• Discuss cellular networks.</li><li>• Explain IP Addresses and DNS. Use the video on the left for this discussion. Use the activity linked left to help with student understanding.</li><li>• Discuss packets, routers, and reliability. Use the video linked left to guide this discussion.</li><li>• Discuss with students who hands out IP addresses.</li><li>• Using Speedtest.net (linked left), have students run a speed test on their computer. Explain the results.</li><li>• Discuss HTTP and HTML. Use the video linked left to assist with this.</li><li>• Allow students to experiment with HTML using w3schools.com (linked left).</li><li>• Have them do the HTTP activity linked left.</li></ul>
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	<ul style="list-style-type: none"><li>• McNamara, Sherri. “Computer Technology AMI4: Bits and Bytes Activity.” Greene County Tech School District, <i>gctsd.k12.ar.us</i>, <a href="https://www.gctsd.k12.ar.us/images/AMIPackets/JHS/McNamara/PC_Tech/AMI4.pdf">https://www.gctsd.k12.ar.us/images/AMIPackets/JHS/McNamara/PC_Tech/AMI4.pdf</a></li><li>• “IP addresses and DNS   Internet 101   Computer Science   Khan Academy.” <i>YouTube</i>, uploaded by Khan Academy, 23 Apr 2019, <a href="https://www.youtube.com/watch?v=MwxMsaFFycg&amp;feature=emb_logo">https://www.youtube.com/watch?v=MwxMsaFFycg&amp;feature=emb_logo</a></li><li>• “CS Principles 2019-2020   Unit 1   Ch. 2   Lesson 12: The Need for DNS.” <i>Code.org</i>, <a href="https://curriculum.code.org/csp-19/unit1/12/">https://curriculum.code.org/csp-19/unit1/12/</a></li><li>• “Packet, routers, and reliability   Internet 101   Computer Science   Khan Academy.”</li></ul>	
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	<p><i>YouTube</i>, uploaded by Khan Academy, 23 Apr 2019, <a href="https://www.youtube.com/watch?v=aD_yi5VjF78&amp;feature=emb_logo">https://www.youtube.com/watch?v=aD_yi5VjF78&amp;feature=emb_logo</a></p> <ul style="list-style-type: none"><li>• “Speedtest Global Index.” <i>Speedtest.net</i>, <a href="https://www.speedtest.net/global-index#mobile">https://www.speedtest.net/global-index#mobile</a></li><li>•</li><li>• “HTTP and HTML   Internet 101   Computer Science   Khan Academy.” <i>YouTube</i>, uploaded by Khan Academy, 23 Apr 2019, <a href="https://www.youtube.com/watch?v=1K64fWX5z4U&amp;feature=emb_logo">https://www.youtube.com/watch?v=1K64fWX5z4U&amp;feature=emb_logo</a></li><li>• “Tryit Editor v3.6.” <i>W3Schools.com</i>, <a href="https://www.w3schools.com/html/tryit.asp?filename=tryhtml_intro">https://www.w3schools.com/html/tryit.asp?filename=tryhtml_intro</a></li><li>• “CS Principles 2018   Unit 1   Ch. 2   Lesson 13: HTTP and Abstraction</li></ul>	
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	<p>on the Internet   Worksheet - HTTP in Action.” <i>Code.org</i>, <a href="https://docs.google.com/document/d/1zAaHDXi00V4ewphP8w2A41hF-9Fj3Sjg8c6oPbez254/edit">https://docs.google.com/document/d/1zAaHDXi00V4ewphP8w2A41hF-9Fj3Sjg8c6oPbez254/edit</a></p>	
<p>6.1.1c EK: The internet is a prime example of a complex system in that it is a large and complex system composed of multiple, dispersed, independent systems.</p>	<ul style="list-style-type: none"> <li>• Routley, Nick. “The 20 Internet Giants That Rule the Web.” <i>Visual Capitalist</i>, <i>VisualCapitalist.com</i>, 5 Jan 2019, <a href="https://www.visualcapitalist.com/20-internet-giants-rule-web/">https://www.visualcapitalist.com/20-internet-giants-rule-web/</a></li> </ul>	<ul style="list-style-type: none"> <li>• Have students list ways the Internet has changed. The graphic linked left is a good illustration of this.</li> </ul>
<p>7.2 EU: There are factors that necessitate cybersecurity risk as emergent and complex: the presence of an adversary, the logical malleability of computers, and the decentralized and distributed nature of networked systems.</p> <p>1.2.2a: The designer assumptions and user assumptions could differ. Another way to say this,</p>		<ul style="list-style-type: none"> <li>• Discuss EU 7.2 (at left). Have students think of examples to support this.</li> <li>• Have students brainstorm ways adversaries can use cyberspace (recruitment, propaganda, training, command and control). How does this depart from the original intent of the Internet? Discuss the ethical implications of this.</li> <li>• Using the Dyn attack of 2016, discuss the importance of DNS. Who was impacted as a result of the attack?</li> </ul>

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<p>the user may not know the assumptions of the designer for using the tool, leading the user to use the tool in a way the designer never intended.</p> <p>6.1 EU: Adversity comes from anyone or anything where the end result differs from that intended by the system designer and user.</p>		
<p>8.1.1h EK: Cybersecurity events have led to the development of various cybersecurity career paths and various needs in order to prepare people for these new types of jobs.</p>		<ul style="list-style-type: none"> <li>• Tie this unit to a career, such as a system requirements planner.</li> </ul>