**Grades 3-5 Binary Code**

| **Adopted from:**  [**https://www.csunplugged.org/en/topics/binary-numbers/how-binary-digits-work-junior/#key-question**](https://www.csunplugged.org/en/topics/binary-numbers/how-binary-digits-work-junior/#key-question) | **Grade: 3-5** | **Lesson duration:** |
| --- | --- | --- |
| **Topic/Title of lesson: How do binary digits work?** | | |

| **STANDARD(s) ADDRESSED**  *(Include the performance expectation number and text of each standard.)* | 8.1.5.DA.2: Compare the amount of storage space required for different types of data.  8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data. |
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| **CS PRACTICE(s)** *that students will engage in throughout the lesson.* | Pattern recognition, Algorithmic thinking |
| **CS CORE IDEA(s) or**  **SUB-CONCEPT(s)** *related to the performance expectation(s).* | Data can be organized, displayed, and presented to highlight relationships.  Individuals can select, organize, and transform data into different visual representations and communicate insights gained from the data. |
| **CENTRAL FOCUS** *(The central focus is an overarching goal of the lesson or big idea for student learning.)* | Conceptualize how billions of circuits inside a digital device are like switches that turn on and off. By turning on and off, the device is able to communicate as a “bit” (binary digit) that can be on or off/black or white/ 0 or 1. Six bits together make up a byte. |
| **EU/EQ** (*The enduring understanding(s) and/or essential question(s) that guide the lesson.)* | How do you think a digital device stores information? |
| **PRIOR KNOWLEDGE AND CONCEPTIONS** *(What prior knowledge, skills and/or academic language do these students need to have that will help them be successful with this lesson? Any misconceptions you may anticipate?)* | Number sense and pattern recognition |

**UDL/PLANNED SUPPORT**

*(Discuss the universally designed decisions guided by learner diversity and/or individualized adaptations for the variety of learners in your class/group who may require different strategies/support (e.g., children with IEPs or 504 plans, English language learners, children at different points in the developmental continuum, struggling readers, and/or gifted children).*

| **UDL:**  *How are you universally designing your lesson with your focus learner in mind? What other characteristic of diverse learners are considering through UDL?* | **Multiple means of representation** | **Multiple means of expression** | **Multiple Means of engagement** |
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| Vocabulary will be printed in the classroom, and provided in their worksheet. Terms will be spoken as they are applied in the lesson.  Demonstration cards visually represent binary through color, dot, number of dots. | Students can communicate what they know verbally, worksheet completion (individually or with a peer), and exit slip. | Students can participate by volunteering in the activity, discussion, think-pair-share, individual work. |
| **ADAPTATIONS with focus learner noted:** *If you were not able to meet your focus learners needs through UDL, what individual adaptations will you use to meet your focus learners needs (especially ELLS)* |  | | |

| **ACADEMIC VOCABULARY/**  **LANGUAGE** | *Vocabulary:* bit, byte, binary, ASCII, code, decode, computational thinking | *Describe the supports for each language demand in this lesson. Address whole class and individual needs.*  Vocabulary will be printed in the classroom, and provided in their worksheet. Terms will be spoken as they are applied in the lesson. |
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| **LEARNING OBJECTIVES** | **LEARNING CRITERIA** *(How will you know that students have met and/or are moving toward meeting that LO?)* | **ASSESSMENT** *(What will be the preassessment, formative, or summative assessment(s) in this lesson?)* |
| Explain a bit and byte | Students explain in their own words with a bit and byte are during class discussions, and individually on the exit slip. | Whole class discussion, think-pair-share with notes, exit slip. |
| Demonstrate how 0 and 1, black and white facing cards represent a bit | Students identify patterns in the relationship between 0 and 1, black and dot-facing cards represent a bit | Students communicate how 0 and 1, black and dot-facing cards represent on and off. |
| Analyze patterns in binary cards to code a message | Students can code and decode messages in binary in pairs or individually | Students communicate how 0 and 1, black and dot-facing cards, on and off can represent letters, numbers, symbols. |
| Apply computational thinking | Students communicate how they arrived at answers. | Students recognize patterns in numbers, face of card, and letters. |
| Collaborate and develop interpersonal skills | Student engagement in the form of volunteering to participate or answer a question, ask questions, positive interaction with peers, self-aware. | Observe student participation by raising hands, volunteering, asking questions. |

**MATERIALS, RESOURCES, and INSTRUCTIONAL TECHNOLOGY**

| **What resources and technology do you need to teach the lesson:** | **What materials, technology will students need?** |
| --- | --- |
| Weblink: <https://www.csunplugged.org/en/topics/binary-numbers/how-binary-digits-work-junior/#key-question>  Video of lesson:  <https://vimeo.com/437725275> | Six copies of binary cards for demonstration  Binary cards for each student.  Code/decode worksheet for each student.  Exit slip for each student. |

**INSTRUCTIONAL STRATEGIES AND LEARNING ACTIVITIES**

*(Describe explicitly what the teacher and the students will do to meet learning outcomes. Use bulleted or numbered list)*

|  | **What is the teacher doing?** | **What are students doing? (including adaptions)** |
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| **LAUNCH/**  **Beginning ( mins)**  *How will you engage students and capture their interest? 3-7 minutes* | Ask what is the next card, and go through the subsequent cards to assess pattern recognition. | 6 student volunteers hold large binary cards at the front of the room. the 1st bit “1 dot” card is on. Other cards are off. |
| **LEARNING ACTIVITIES/**  **Middle ( mins)**  *“I do” “We do” “You do” How will you explain/ demonstrate knowledge /skills required of each objective? How will you ensure that students have multiple opportunities to practice? How will you address the academic language demands?* | This activity is teacher led using inquiry to evaluate students’ understanding of the terms bit, byte, and binary code.  Example questions to pose:  How would we show 3 dots? Begin by asking: how many dots are on the left-most card? Count together that there are 8 dots. Let’s look at the number line. Is 8 bigger than 3? Let’s hide it because it’s too big. Now let’s look at the next card, how many dots can we see?  How would you make the number 6? | * Group students into pairs * Give each pair a set of the smaller binary cards * Explain to students that we're working with just two digits, so they are called binary digits. (You could explore the meaning of the "bi" prefix with words like bicycle, biennial, bilingual and bicultural.) Binary digits are so common that we have a short name for them: write "binary digit" on a piece of paper, then rip off the "bi" at the start, and the "t" at the end, put it together and ask what the combined word ("bit") spells. This is the short name for a binary digit, which is why we've been referring to the cards as bits; the 4 cards that they have are actually 4 bits. * Now let’s count from the smallest number that we can make, up to the highest number a. What is the smallest number? (they may suggest 1, then realise that it’s actually 0). * Get the number 0 displayed on the cards (i.e. no dots showing) * Now count up 1, 2, 3, 4 …. (each pair should work out these numbers between them) * Once they start to get into a routine, ask: how often are we seeing the 1-dot card? (every second time, every odd number) a. What other patterns are we seeing? (the 2-dot card flips on every second count, the 4-dot on every 4th and so on; the 8 dot card doesn't do much; this may be challenging for some students to recognise, and the main goal is that they are aware that the 1-dot card flips every time, and that every second number is an odd number). |
| **CLOSURE/**  **End ( mins)**  *How will students summarize and state the significance of what they learned? 3-7 minutes* | Teacher conducts a whole group debrief to recall takeaways and distributes exit slips. | Students complete an exit slip |
| **Extension/Reinforcement/Homework:** | | |
| **Family/Community Engagement—** | | |

**\* Please attach copies of assessments and/or handouts to be used**