**AP CSP CodeBot**

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| **LESSON: Binary Numbers** | | **Time: 45 minutes** |
| **Project Goal:** Students will learn and use binary numbers.  **Learning Targets**   * I can name the place values of a binary number. * I can convert a decimal number to binary. * I can convert a binary number to decimal. * I can use binary values in program code. | **Key Concepts**   * Data that a computer uses can be represented using binary numbers. * A binary number can be used to control LEDs. | |
| **Assessment Opportunities**   * Binary Numbers Activity Guide | **Success Criteria**   * Convert decimal numbers to binary * Convert binary numbers to decimal | |
| **AP CSP Framework**  **DAT-1.A** Explain how data can be represented using bits.  **DAT-1.C** Calculate the binary equivalent of a positive integer and vice versa. Compare and order binary numbers. | **Materials**   * Binary Numbers slides * Binary Numbers Activity Guide / Answers * [Video that introduces binary numbers](https://www.youtube.com/watch?v=bva4N7hNrNs) * Activity 2 Manipulative (print in advance) * Pennies or small objects for markers * Flippy-do (print in advance) & scissors for cutting on the dotted lines * [Binary Game (on AppLab)](https://studio.code.org/projects/applab/iukLbcDnzqgoxuu810unLw) | |
| **Teacher Notes**   * This lesson gives students more information about binary numbers and lots of time to practice. There are many ways to teach binary numbers. This lesson gives one way, but you can modify the slides if you have a different way of teaching binary. * This lesson uses a video to introduce binary numbers. Prepare the video and make sure you can show it in your classroom. Or use a different video to introduce binary numbers. * The PDF for Activity 2 goes with the video. If you use a different method for teaching binary, you don’t have to use this manipulative. Students will need small coins or game chips, or even small pieces of paper, to use with the manipulative. * I highly recommend using the flippy-do for Activity 3. It is a helpful unplugged device. * If students want more practice converting to binary, or want to test their skills, have them go to the website posted at the end of the activity guide. It is a binary conversion game. * Activity 4 involves the CodeBot. Students should first write down their answer for each decimal number from Activity 3. Then plug in the CodeBot. Use the decimal number to turn on the LEDs. Did the same LEDs light up as the binary code? Students can create a program for this, or they can type directly into the Console Panel.   Example:  The first problem is **9**. The student looks at their answer from Activity 3 and writes: 1001 or **00001001**. Then they plug in the CodeBot and go to the Console Panel. The student types:  **>>> leds.user(9)**. They check the LEDs and write down which ones are lit in binary:  **00001001** | | |