**AP CSP CodeX**

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| **MISSION 12 Night Light** | | **Time: 45 minutes** |
| **Project Goal:** Students will use the light sensor to make a smart night light  **Learning Targets**   * I can explain the differences between analog and digital I/O. * I can use code to read the light sensor * I can convert a light sensor reading to a brightness level. * I can use the light sensor reading to control the pixel brightness. | **Key Concepts**   * The photocell helps convert light level into an electrical voltage level. * Analog means infinite variation from dark to light, cold to hot, and so on. The CodeX’s *analog to digital converter* (ADC) gives a digital approximation of the photocell’s analog reading. * I/O pins can be read with read\_digital() and read\_analog()functions. | |
| **Assessment Opportunities**   * Mission 12 Assignment * NightLight program | **Success Criteria**   * Read data from the light sensor * Use the data to control the pixel light * Convert data to a brightness level * Use the converted data to set the pixels’ brightness level. * Create and call a function with a parameter | |
| **AP CSP Framework**  **DAT-2.A** Describe what information can be extracted from data.  **Computational Thinking Practice 3.A** Generalize data sources through variables.  **Computational Thinking Practice 4.C** Identify and correct errors in algorithms and programs, including error discovery through testing. | **Materials**   * Mission 12 Assignment / Answers * [Mission 12 Kahoot Review](https://create.kahoot.it/share/firia-labs-mission-12/fa531904-7b0a-44e0-b68f-6c6eac181cf5) * Solution code for final objective, with functions, and the challenge. | |
| **Teacher Notes**   * The assignment is best completed digitally. Prepare the assignment for distributing through your LMS. * Encourage the students to do as much code on their own as they can, and use the CodeTrek to check their work, or as a hint when needed. * The assignment adds an extra step to complete after Objective 5, before turning in the program. * If you have time at the end of the lesson, use the [Mission 12 Kahoot Review](https://create.kahoot.it/share/firia-labs-mission-12/fa531904-7b0a-44e0-b68f-6c6eac181cf5). * Another suggestion for assessment is for students to keep a daily journal, or use a reflection form for students to process information they learned and reflect on questions they may still have. * Refer to the Python with CodeX Curriculum Guide or Mission 12 Lesson Prep (found in the l[earning portal](https://learn.firialabs.com/curricula/python-with-codex/teachers-resources/codex-teacher-materials)) for more information. * The teaching guide (below) gives the narration for one way to present the lesson. | | |

**Teaching Guide**

The actual coding part of this Mission is about one normal class period. This is a fairly short lesson.

**Warm-up (5 minutes)**

🧑‍🤝‍🧑 **Discuss** – Use a discussion strategy, like journaling, working at boards, selecting random students, or a form of think-pair-share.

* **Topic:** In Mission 5 you learned about analog and digital sounds. What do you remember about analog and digital? Besides sounds, what else can be analog? – Discussion – In today’s lesson you will use analog light and convert it to digital information. Then use it in a program to control the CodeX’s pixels.

**Activity – Mission #10 (35 minutes)**

💻 Randomly group students into pairs for pair programming (or they can work individually).

For pair programming, students log in to one computer. Two computers can be used if they want to have the assignment open on one computer and CodeSpace on the other computer.

Students go to [make.firialabs.com](http://make.firialabs.com) and should be at the beginning of Mission 12.

💡 **Teaching tip – Objective 1:**

Students start a new file, and then locate the light sensor. They need to close the Objective Panel to see the CodeX in the simulator (3D view).

💡 **Teaching tip – After Objective 1:**

Use the slides from “Analog and Digital”, found in Unit 1 Mission 5, to review analog and digital. Students answer questions on their activity guide.

💡 **Teaching tip – Objective 2:**

Students will use the light sensor in code. They will need to experiment a little and come up with their own value for darkness. The suggested value is 2000, which is pretty dark. The number is changed in the next objective.

💡 **Teaching tip – Objective 3:**

Students will learn a new way to turn on all the pixels. They can compare this single command to using a list.

💡 **Teaching tip – Objective 4:**

The code will require some math here. Students should use the hints and the CodeTrek to guide them. They will be adding the math inside the if statement. This is a logical place to create a function.

💡 **Teaching tip – Objective 5:**

Students will modify the math to include brightness. A code solution for this objective is available.

💡 **Teaching tip – After Objective 5:**

The students define a constant for the max percent and create a function with a parameter for converting the light sensor reading into a brightness level. Instructions are on the assignment document. A code solution for functions is available.

💡 **Teaching tip – Challenge:**

If students have time, have them try the challenge. This gives them an opportunity to apply their knowledge in a new situation. A code solution for the challenge is available, but hopefully students will be creative in how they incorporate images in the program.

✅ Assignment is complete and ready to turn in.

**Wrap-Up (5 minutes – optional)**

Discussion: This project introduced students to an area with lots of potential for improving the world! Light Sensors and LCD lights controlled with code can reduce energy consumed and make lighting more awesome!

This code can enable and enhance many real-world applications. Have students brainstorm their own applications of using a light sensor. Here are some ideas:

* Outdoor Lighting
  + Street Lights, Parking lots, Home lighting
* Stadium Lights
  + Even controlling the light color so it looks better on camera
* Indoor Lighting
  + Sensing daylight from windows and skylights is calLCD Daylight Harvesting - it saves energy!
  + That’s exactly what your last NightLight code was doing!

You can use a formative assessment for the wrap-up.

✅ **IMPORTANT!!**

* Remind students to clear their CodeX.

Formative Assessment:

* Daily reflection journal
* [Mission 12 Kahoot Review](https://create.kahoot.it/share/firia-labs-mission-12/fa531904-7b0a-44e0-b68f-6c6eac181cf5) (in class or individual)
* Exit ticket on analog and digital devices or measurements