CodeX Lesson Plan

UNIT: Science / Math	**MISSION: Mental Chronometry**	**# DAYS:** 2-3 class periods
LAB GOAL: Students will conduct an experiment using CodeX: measure and analyze reaction times with different stimuli.	**ADDITIONAL MATERIALS:** ● Batteries (optional) ● Lab worksheet for students (printed or digital)	**VOCABULARY:** ● Mental chronometry ● Scientific process ● Visual representation ● Parameter ● Argument ● Computer clock

SCIENCE STANDARDS: 1	**MATH STANDARDS:** 1

LEARNING TARGETS:

- I can write a function with a parameter to make code more efficient and readable.
- I can utilize multiple variables in a new program and describe their purposes.
- I can modify the code to use different output (light, sound, text)
- I can import Python library modules and use their built-in functions
- I can conduct an experiment and record test data
- I can analyze experimental test data and draw conclusions

SUCCESS CRITERIA:

- ❑ Give the player a 3-2-1 countdown.
- ❑ Program a random delay so the player can't "guess" the timing.
- ❑ Use a variety of outputs, such as pixels, sound and text.
- ❑ Measure the time until a button press occurs.
- ❑ Scroll the reaction time across the display.
- ❑ Wait for a button press, then restart the game.
- ❑ Record test data for at least four experiments .
- ❑ Analyze test data with visual representations and draw conclusions.

KEY CONCEPTS:

- Computers are driven by internal clocks. Use the `time.ticks_ms()` function to determine how long the CodeX's clock has been running.
- Functions can have named parameters to make them reusable.
- The reaction time between a stimulus and a response can be timed and recorded.
- Data analysis can be aided with visual representations that help draw conclusions.

DISCUSS REAL WORLD APPLICATIONS:

Computer programs and physical devices can be used in science and math applications.

- Gather data using sensors on a physical device
- Use a computer program to process the data, create visual representations, or draw conclusions
- PHYSICS: Use the reaction time application to measure reaction time across different distances. Calculate the rate.
- MATH: Change the reaction time range incrementally and record averages for each. Then plot the points and write an algebraic expression to extrapolate or predict the result of future experiments.

ASSESSMENT STRATEGIES:

- Students can submit their four program files.
- Lab assignment document is complete, with four sets of test data, three charts or graphs, and conclusions.
- Students write a lab report about the experiment.
- Students present their findings (poster, in-person, gallery walk, etc.).
- Students write a reflection about their program and their experience with the lab.

TEACHER NOTES:

Answer keys are available for all four programs. Code files.

Suggested time for the lab activity is 2-3 class periods. If Mission 10 is already completed, it will take less time.

🗝️ **PRE-LAB Notes**

- Students should be familiar with the scientific process before beginning the lab.
- You may want to have a lesson or watch a video about the brain or mental chronometry before beginning the lab.
- Students should know how to calculate an average.
- Students should be familiar with different types of charts and graphs. This can be a separate lesson (if needed) or embedded in the lesson during the data analysis section.

🗝️ **LAB Experiment Notes**

- The lesson starts with Mission 10 in the CodeX curriculum. If your students have already completed the mission, they can open their file and start with the code. They do not need to recreate it. If students haven't done mission 10, they will start there and follow the instructions in CodeSpace.
- Mission 10 is the first experiment. After finishing the code for the mission, students will use CodeX and their program do conduct experiment #1 and write their test data in the lab assignment.
- Experiment #2 will modify the code to use sound. Students should resave their code with a different name (File-Save As); that way they can return to the original experiment if they need to. After modifying the code students will use CodeX and their program to conduct experiment #2 and write their test data in the lab assignment.
- Experiment #3 modifies the code again, so students should resave their code with a different name. This experiment requires the most modifications, so assist students in typing code correctly and in the right places. After modifying the code students will use CodeX and their program to conduct experiment #3 and write their test data in the lab assignment.
- Experiment #4 requires very little modification. It is still a good idea to have students resave their code with a different name. At the end of the lab, students should have four program files. The code modification is minor. After modifying the code students will use CodeX and their program to conduct experiment #4 and write their test data in the lab assignment.

🗝️ **LAB Data Analysis Notes**

- Students should have a table with four sets of test data recorded. If they haven't calculated the averages for each set, they should do so next.
- Chart #1
    - Each student will select one of the four experiments. They should look at the test data and averages for this experiment from other students. They can write it down on the lab document in the margins, or on scrap paper. They can use the chart template provided, or you can have them do a chart in a different way, such as on large graph paper, in groups, etc.
    - As an alternative, students can input the data in Excel and create a chart there, or use other software.
    - Suggestion: Use a scatter plot or line chart
- Graph #2
    - Students use their own data from the four experiments to create a graph. They can use the template provided, or any way you choose for them to create the graph.
    - As an alternative, students can input the data in software and use it to create a graph.
    - Suggestion: Use a bar graph
- Visual representation #3
    - Students come up with their own ideas for a visual representation. There are many ways this can be done, and students should use their creativity for this part of the assignment. They can use their own data, data from other students, or even conduct another experiment and collect data.
    - Students can create a digital representation using software as an alternative.
- Conclusions
    - Students can use their visual representations to draw conclusions about mental chronometry.
    - You can lead a class discussion on their findings and the class can collectively draw conclusions.
    - Students can prepare a presentation about the experiments, their visual representations, and their conclusions.

🗝 **POST-LAB Notes**

- This lab assignment can take two or three class periods (Mission 10, then Experiments 2-4, and Data Analysis), or it can be completed in one morning or afternoon.
- There are many extensions or branches to this lab, where you can continue with the science and math. Or you can stop with the assignment and you don't have to go any further.
- Many extensions to the experiments are listed on Slide 20. Students are also curious and creative and can probably think of many more experiments for the reaction tester and the brain.
- **Computer Science Continuation:**
    - Students can make the reaction tester into a game and award points for either a fast time or pressing the correct button with a time frame. Points could also be deducted. Program a way to win or lose.
- **Physics or Physical Science Continuation:**
    - The study of physics includes motion. Instead of holding the CodeX, move the CodeX a measured distance away. Then have one student start the countdown, and another student wait for the stimulus and then go to the CodeX to press the button. Record the times. Move the CodeX a little farther and repeat. After they have enough data, chart the data and see if the reaction time is linear. Calculate the rate of speed for the student (d = r*t). Make predictions and test them.
- **Algebra Continuation:**
    - A linear equation can be written using y=mx + b. Let x be the delay and y be the reaction time. Display both the delay time and the reaction time on the screen so it can be recorded. After getting some test data, plot the points and come up with an algebraic expression that describes the data.