## Multitasking Mania!

**Lesson 1: A Multitasking Experiment**

**Problem Statement:**

Your task is to create both a computer-based task and non-computer-based task that helps employees evaluate the effectiveness of multitasking and helps them plan their work efficiently.

**Lesson Overview:**

In order to fully understand the concept of multitasking, it is useful to observe real-life multitasking and evaluate its effectiveness in completing projects. In this lesson, students will perform a group experiment, collect data, and discuss the experiment results. In a subsequent lesson, the students will perform data analysis to gain further insights.

The intent of this lesson is to provide students the opportunity to experience multitasking consistent with how the practice of multitasking manifests in a business or factory. This lesson will serve as a baseline for understanding multitasking, and developing methods to measure the effectiveness of a process that includes multitasking. In future lessons, the students will be introduced to a multitasking related problem and will be asked to provide solutions.

**Learning objectives:**

* Students will be able to perform an experiment in multiple parts as a group
* Students will collect data from an experiment
* Students will be able to draw conclusions based on data and observations from experiments.

**Lesson standards (NGSS, CCSS, CTE):**

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| Science (NGSS) | |
| MS-ETS1-3. | Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. |
| Language Arts (CCSS) | |
| [CCSS.ELA-LITERACY.RST.6-8.9](http://www.corestandards.org/ELA-Literacy/RST/6-8/9/) | Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. |

**Soft skills:**

This lesson will require students to collaborate on completing a series of tasks in a mildly competitive environment that follows an established procedure (the scientific experiment). Students will apply critical thinking to the results of the experiment and communicate their conclusions in the group environment. Students will experience working together in teams, giving and taking direction in a group environment, and completing tasks under mild pressure in a chaotic environment.

**Locally and/or personally relevant for students:**

Students will be asked to reflect on when and how they have used multitasking in their own lives.

**Connections to career and educational pathways:**

This lesson uses an educational “experiment” developed at Washington State University that has been used at The Boeing Company to demonstrate multitasking, resource (worker) constraints, and development of workflows. This lesson will introduce students to the concept of “multitasking” as it relates to work processes. Students will also learn and demonstrate the ability to take notes, record data, review results, and draw conclusions. Data collected will be used in a subsequent lesson on data analysis and visualization.

**Materials:**

Each team of students (see grouping below) will need the following materials:

* 2 BOWLS: One blue bowl and one red bowl - typical 6” diameter bowls
* 12 PLATES: Six blue plates and six red plates - typical 6” diameter dessert plates
* 3 SPOONS: Three spoons - sized to pick up 2-4 beads (see below for bead info); typical adult-sized plastic spoons (picnic) are preferred.
* 120 BEADS: 50 “orange”, 40 “black”, and 30 “white” beads

The “beads” for this game should have the following characteristics:

* Unique sides (front and back), and will rest on either side.
  + - * Instructions assume beads with a “flat” side and a “round” or dome-shaped side
* Bead diameter: ≈¾” (20 mm), between ½” to 1” will work

NOTE: Any colors can be used but student instructions will need to be updated to reflect colors other than orange, white and black. To avoid “loss”, candies or coins are not recommended but can be used.

* A set of worker/role sheets (five versions)

Each student will need the following:

* 1 Exit Ticket

**Lesson preparation:**

1. Review the example experiment videos to understand the experiment process (see “Resources”)
2. Collect materials in “kits” - 1 kit per team, with each kit containing:
   * 1 set of bowls, plates, and spoons per team
   * Separate the 120 beads into 2 individual sets of beads; each set consists of 25 orange, 20 black, and 15 white beads
3. Obtain copies of the rules, roles, and data sheets, enough for each team (or student)
4. Setup experiment areas - 1 area per team (See Figure 1)

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**Figure 1: Experiment Layout and Flow**

**Time required:**

Introduction and Discussion: 15 - 30 min

Experiment - Multitasking Version: 30 min

Post-Experiment Discussion: 15 min

Experiment - Non-Multitasking Version: 20 min

Final Discussion: 15 min

**Grouping of students for instruction:**

Ideal team size is 5 or 6 students; 4 students is the minimum for a team.

*NOTE: Students will remain in the same teams and roles for the first two experimental runs (a “multitasking” run and a “non-multitasking”).*

**Team Roles (6 roles)**

* **2 Project Managers**
  + Both project managers share the 3 workers to complete the two projects. Project managers monitor the three workers and make sure that they are performing their tasks and alternating between the projects correctly.
    - Red Project Manager - encourages completion of the Red project
    - Blue Project Manager - encourages completion of the Blue project
* **3 Workers**
  + Worker 1 - Sorts all beads at the beginning and integrates all beads at the end
  + Worker 2 - Responsible for tasks performed on Orange and White beads
  + Worker 3 - Responsible for tasks performed on Black Beads
* **Timekeeper**
  + Records Start and Completion times for each project

*NOTE: The 3 workers and the timekeeper support both projects. The project managers are the only roles that are tied to a specific color project. For smaller class sizes, the “project manager” role can be combined into a single manager, or shared with adjacent groups.*

**Instruction**

*Students will explore and gain an understanding of “multitasking” - performing multiple projects at the same time under the assumption that working projects simultaneously will result in faster completion of the projects.*

The students are introduced to the idea of “multitasking”, and will perform an experiment that will demonstrate how two projects (Red and Blue) might be completed by a shared group of workers (Workers 1, 2, and 3) in different ways. In the “multitasking” version of the experiment, the workers attempt to make equal progress on both projects at nearly every task by rapidly switching between the Red and Blue projects. In the “non-multitasking” version, the workers will start with the Red project, and only switch to the Blue project when they have fully completed a task on the Red project.

Teacher introduces the subject matter and facilitates student discussion by presenting the “Lesson 1” PowerPoint.

See: "Bead Experiment Rules and Sequence" in the Resources section for a link to details experiment rules and flow.

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| **Teacher** | **Student** |
| PowerPoint presentation for Lesson 1 | Class and group discussion on material |
| ***Experiment - Multitasking Version*** | |
| Introduce Multitasking Phase of the experiment; setup teams; describe/demonstrate roles; show video (embedded in PowerPoint) | Gather with the team, review their assigned role and understand what their job is, and why it’s important. |
| Direct students to start the experiment | Run the experiment |
| Allow 12 to 15 minutes for each group to finish a single run through the experiment.  Circulate room to ensure rules are followed; record data from each team on the class data sheet. | Complete a run through the experiment and record the amount of time required to complete each project |
| Collect data from each group and record on the class data sheet. Continue discussion and reference the collected data. Poll students for feelings about roles. | Participate in the discussion. Looking at data, what conclusions, if any, can be drawn? How did each person feel about their role? |
| ***Experiment - Non-Multitasking Version*** | |
| Introduce and explain the changes to the experiment from the multitasking version | Prepare to run the experiment. Understand changes to their roles and tasks. |
| Direct students to start the experiment | Run the experiment |
| Allow 6 to 10 minutes for students to finish a single run through the experiment. | Complete a run through the experiment and share the data with the class |
| Collect data from each group and record on the class data sheet. Continue discussion and reference the collected data. Poll students for feelings about roles. | Participate in the discussion. |
| ***Discussion/Share Observations*** | |
| Have each team share observations, like:  How did you feel about your role?  What was different between the two versions of the experiment? What was the same?  What was different about the results?  Why do you think the results were different?  What role took the longest? Shortest? Why?  Same or different between the phases? | Students share/record observations.  Students should be able to defend any conclusion shared by referencing the data, or suggest a way to further test their conclusions. |

**EXTENSION - Control Experiments:**

A common theory is that the workers perform better on the non-multitasking part of the experiment because they are more skilled at performing their tasks the second time.

Have a discussion with the students about how to compare their datasets.

* If the multitasking phase is run followed by non-multitasking, and you compare times from the two trials, is this a fair comparison? Or might the students just have gotten better at the common elements of the task the 2nd time around?
* How can we reduce the effect of skill improvement on the results?
  + Perhaps run the entire experiment twice:
  + The first time, run the bead game with multitasking phase first and non-multitasking second.
  + The second time have students switch roles within their teams, or between teams, and run non-multitasking first and multitasking second. Switching roles will help eliminate task familiarity.

**Accommodations:**

The experiment lends itself to students with impairments, however, some ability to differentiate colors, respond to spot direction from peers, and lift a spoon are assumed.

Highly capable students should progress quickly and should consider additional experimental runs, using the control extension above, to obtain more data.

**Extensions:**

If time allows, the additional experimental runs should be accomplished to improve the size of the data set. Changing the order of the experiment, and switching roles and teams, can be used to help control variability.

**Assessment:**

Exit ticket: Students will record 3 to 5 observations about the simulations.

The experimental data recorded should be retained for use in in Lesson 2. Each student will require a copy of the “raw” data.

**References and Resources:**

Original Game Instructions: “The Bead Experiment”, Washington State University [EM 530, Manual Simulation, Multi-Project Management](http://www.wsu.edu/~engrmgmt/holt/em530/Docs/BeadExperiment.ppt)

[Bead Experiment Rules and Sequence](https://drive.google.com/open?id=1K7qkJ-N3ZVccr_mXVs30nIsbaSPRsMzTlcGe3JczQGE) - a walkthrough with diagrams of the bead experiment developed for this Lesson

Additional “Theory of Constraints” and teaching games information: <http://public.wsu.edu/~engrmgmt/holt/em530/>

[Bead Game Flow Presentation](https://drive.google.com/open?id=1PhJRex6MkVnkDMQkXT-r2BdWkE-GtyuQ) - walk-through of the bead game (a little easier to follow than the linked instructions above.)

Videos:

These videos demonstrate the actual experiment flows described above.

[Bead Experiment Video Part 1, Multitasking](https://drive.google.com/open?id=15QugCbNQBlNtvnMdupYaO4BjoLU_r40I)

Bead\_Experiment\_Demo\_Pt1\_MT.mp4 - a run through the multitasking version of the experiment, with illustrative annotations

[Bead Experiment Video Part 2, Non-Multitasking](https://drive.google.com/open?id=1M612cWmsbSCvczy3ABTHB8dehgya8Ohk)

Bead\_Experiment\_Demo\_Pt1\_Non-MT.mp4 - a run through the non-multitasking version of the experiment, with illustrative annotations. At the end of the video, the results of Part 1 and Part 2 are compared.