

- **Written Teacher Guide**

This is a BLOSSOMS lesson with a focus on industrial engineering, where students will get a sense for the ways in which different production processes are carried out. The goal is to awaken in them the curiosity to ask themselves how the products they interact with daily are made and the importance of standardization of processes in the industrial environment. The objective of our lesson is for the students to understand the concept of standard and its application to the design of a standardized production process.

It is advisable for you, the teacher, to do some preparatory reading on the subject, which will allow you to guide the students clearly during the activities and contribute to the achievement of our objective. The additional online resources included with this lesson should provide this preparatory material.

The lesson is divided into 5 segments and four activities, designed to carry out the lesson using the following content:

In each segment the key concepts are explained so that the students can carry out the suggested activities, and in the segment immediately following the activity, a brief explanation of what happened is given to conclude it.

For the suggested activities, it will be necessary to consider the following:

- The activities are designed to challenge students to think critically about the solution of the activity, considering the concepts reviewed in the corresponding segment of the video.
- For this, it is important that they clearly understand each concept and that they can approach the topic naturally, for a better understanding
- Students should be invited to discuss the topic, based on what was studied in the lesson. In the case of the standardized process, students should be motivated to make a proposal for improvement that allows for the reduction of process operation times or defects identified in the product.
- In order to fulfill of each activity it is important to consider the following:

Activity 1: Starting questions.

Point the activity towards the detection of the main problem, which is about the lack of a standard schedule. Encourage the students to think about how this problem could be solved with the resources they have at that time until they found an answer that refers them to standardization. For example, they could make a comparison between how traveling is currently coordinated and how it was done before to demonstrate the benefits of standardization of time zones

Activity 2: How much does the room measure in feet?

To perform this activity, the teacher must know the real dimensions of the classroom previously. Each student will measure the length of the classroom in feet, but according to the length of their own feet, that is, each student will walk slowly and walk the length of the classroom, placing one foot right in front of the other, the teacher will record the data on the board. Teacher and students will prepare a histogram in order to analyze the collected data.

It is important to generate in the students the interest for knowing which measure is closest to the standardized measure in order they can understand why standards are necessary.

Activity 3: Aircraft factory part 1

In this activity each student must assemble an airplane either way, is important that paper sheet sizes is different each other. The result will be a number of different aircrafts, thus the production is not considered standard, then, ask to the students: What is the best plane? as they don't have a standard model, they can not resolve objectively which aircraft is the best. Students must discuss how to determine which is the "best" plane.

It must be considered that this activity is designed this way in order to students don't reach the goal, to analyze the importance of standards in production processes. It may be that conflicts arise among students as many of them are competitive and perfectionist. However, is important to recall that the objective of this activity is precisely to spot the problems that may arise in product manufacture if we don't have enough information or previous training.

Activity 4: Aircraft factory part 2

In this activity, the teacher will provide all students with A4 or letter paper (same size for each student), the procedure and precise instructions to assemble the airplane and a list of requirements to evaluate its quality (Appendix A-1: Procedure for standard process paper plane assembly and Appendix A-2: Checklist for evaluation of the standardized assembly.) in this way all students will assemble the same airplane, with the same characteristics.

This variation on the activity will show students that a standardized process is easier to control, evidence failures and quality flaws, besides the process is cheaper, and helps to achieve customer satisfaction in a more efficiently way.

- The lesson and activities are designed to unfold in an environment of collaboration and teamwork, to achieve optimal results.

Once the students understand the basic concepts and the way in which processes are standardized, ask them to reflect on the possibility of standardizing all processes and, by doing so, obtaining more homogeneous products vs. the possibility of personalizing products, so that they can differentiate between products that can be customized without affecting their production process.

When the lesson is finished, invite them to reflect upon the following questions, using the knowledge they just acquired. Can all the products that we know be standardized? What are the main advantages and disadvantages of standardizing for manufacturers, consumers, and the end customer?

Additionally, students can be asked to research what the new tendencies focused on massive production processes are. These can be reviewed in a subsequent lesson.