# Teaching Plan

| Name of the Experiment | Production of Moebius Strips | |
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| Instructional Objectives | ➢ To calculate & distinguish Total Product, Average Product and Marginal Product. <br> ➢ To draw $TP_L$, $AP_L$ and $MP_L$ curves. <br> ➢ To illustrate how labor, capital and technology affect production in short run. | |
| Keywords and Concepts Illustrated | ➢ Production function <br> ➢ Fixed factor <br> ➢ Variable factor <br> ➢ Total product <br> ➢ Marginal product <br> ➢ Average product <br> ➢ Law of diminishing returns <br> ➢ Technology change effect <br> ➢ Capital change effect <br> ➢ Division of labor | |
| Needed Time | ➢ A double-lesson period, 80 minutes in total | |

| Sessions | Details | Time Spent |
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| Activity/ Announcement | 1. T: "Nothing comes from nothing.  Nothing ever could." (from the movie "Sound of Music") <br><br> 2. T: Production is a way to transform some resources into another form.  For example, we combine/use land, seed, tools and labor to produce wheat.  Land, seed, tools and labor are called factors of production.  Wheat is called the output. <br><br> 3. Teacher draws the following diagram on board <br><br> Factors of production          Output <br><br>  <br><br> 4. T: Often, in economics, we abstract from the many type of factor inputs and classify them as land, labor, capital and entrepreneurship.  And more often, we abstract that land are natural resources and unlimited in supply.  In this experiment, we focus our attention on capital and labor as capital inputs. <br><br> 5. T: To see that how a typical production is done and the factors that may affect the production, we will conduct many experiments/games of production as explained | 15 mins |

| | below. | |
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| | 6.   T: Today, we will produce the Moebius Strip.   Here is how we may produce a moebius strip. (Show Figure 1) | |
| | 7.   Demonstration by teacher using the toothpick to pick up glue. Also, pick two students to do demonstration. | |
| | 8.   T: Here, the toothpicks and glue are the capital. You are obvious the labor. | |
| | 9.   T: Let's divide the class into two groups and compete in the production of moebius strip. The production mimics a firm that has two production teams. We have only 30 seconds to produce as many moebius strips as we can. | 13 mins |
| | 10.  After evenly dividing the class into two groups, teacher should assign a number to each student. The numbers assigned in each group start from 1. If there are 40 students in the class, students' number of each group should be from 1 to 20. They will participate in the competition according to their assigned number. Moreover, a student is chosen from each group to be a Quality Control (QC) and recorder of the other group. Teacher should post two Table 1 (one for group one's record and one for group two's) and a Table 2 on blackboard in advance. The classroom setting can be seen in Figure 2. | |
| | 11.  With one toothpick, vary the number of labor (students). | |
| |     i.   Invite zero student and produce for 30 seconds $\rightarrow$ zero output | |
| |     ii.  Invite student No.1 student to enter the game. Time allowed to produce is 30 seconds. After the production, ask the two QCs to check the product quality and record the number of passed strips produced by the other group in Table 1. | |
| |     iii. Invite student No.2 student to enter the game. Time allowed to produce is 30 seconds. After the production, ask the two QCs to check the product quality and record the number of passed strips produced by the other group in Table 1. So on and on till all students have participated in the game. | |
| | 12.  Repeat with two toothpicks. Tell students that capital  $\uparrow$ . | 13 mins |
| | 13.  Repeat with a glue pen. Tell students that technology  $\uparrow$ . | 13 mins |
| | 14.  T: Since we have 2 sets of data now, let's take the simple average and record it in Table 2 of column $TP_L$ as our class result. Student No.1 please tell us the average $TP_L$ of two groups in three rounds of game when only one labor was used; student No.2 please tell us the average $TP_L$ of two groups in three rounds of game when two labors were used. (So on until all three $TP_L$ columns of table 2 are filled in. For the row of zero labor used, teacher can simply write down the answers.) | 15 mins |
| | 15.  Teacher introduces the concept and calculation of $TP_L$, $AP_L$ and $MP_L$. | |

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| | 16. T: Now, student No.1 please tell us the $MP_L$ and $AP_L$ in the three rounds of game when only one labor was used. Student No.2 please tell us the $MP_L$ and $AP_L$ in the three rounds of game when two labors were used. (So on until the all the columns of $MP_L$ and $AP_L$ are filled in. For the row of zero labor used, teacher can tell students the answers.)<br>17. After they are done with the calculation, teacher can plot the $TPC_L$, $APC_L$ and $MPC_L$ for each round of games on three separate transparencies with graph paper printed on (Teacher should print the Diagram 1 on three blank transparencies in advance.) Use this opportunity as a demonstration of how to plot graphs.<br>18. Teacher facilitates students to discuss the following questions:<br>   1  For any given technology and capital, how does the total product change with labor used?<br>   2  How does an increase in technology affect the output for any given labor input?<br>   3  How does an increase in capital affect the output for any given labor input?<br>   4  The change in technology and the change in capital seem to have different effects on the total product. Can you suggest the reason(s) behind?<br>   5  Pick one student and ask, "If you are the manager and you can employ only two labors, who should be chosen to produce the strips and why?"<br>   6  How much are you willing to pay to increase the number of capital (i.e. the number of toothpicks in the game)?<br>   7  How much are you willing to pay for raising the level of production technology (i.e. buying glue pen to replace toothpicks and glue)?<br>   8  How much are you willing to pay for employing an extra labor?<br>   9  In the game, did you practise division of labor? If yes, how and why?<br>19. After class, demonstrate the magic of moebius strip by cutting the strip's width into half again and again. | 10 mins |
| Tools | ➢ A lot of paper strips<br>    ✧ suggested size: length: the width of an A4 size paper width: 1 inch<br>➢ Some toothpicks<br>➢ Two containers<br>    ✧ for carrying glue in the competition<br>➢ Two glue pens<br>➢ Flip charts if teacher wants to post the tables on board.<br>➢ 3 sheets of transparencies with graph paper printed on<br>    ✧ for drawing $TPC_L$, $MPC_L$ and $APC_L$<br>➢ Transparency pen – for teacher's use | |

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| | ➢ Overhead projector | |
| Definitions | ➢ Production function – is the relationship between the maximum output attainable and the quantities of all inputs used. (Parkin,1996)<br>➢ Fixed factor – input whose employment remains constant when output changes. (Li, 1997)<br>➢ Variable factor – input whose employment increases (drops) as output increases (drops). (Li, 1997)<br>➢ Total product – the whole amount of output produced by all the factors employed. (Wong, 1999)<br>➢ Marginal product – the change in output resulting from employing an additional unit of variable factor. (Wong, 1999)<br>➢ Average product of labor – the total output produced by labor in a given period of time, holding capital and technology constant. (Wong, 1999)<br>➢ Law of diminishing marginal returns – as more variable factors are added to given quantity of fixed factors, holding technology constant, marginal product eventually drops. (Li, 1997)<br>➢ Technology change effect – refers to new technologies that enable producers to use less of each factor of production lower the cost of production and increase supply. (Parkin,1996)<br>➢ Capital change effect – increase in capital can increase the total output without changing variable factors.<br>➢ Division of labor – labors specify in doing one task or one portion of a task. | |
| Variations of this experiments | ➢ The product produced can be replaced by:<br>   ✧ Angel fish<br>   ✧ Aeroplane<br>➢ This game can be used as an introduction of<br>   ✧ Supply curve and its shifters (suitable for F.5 and F.6 syllabus)<br>   ✧ Production cost (suitable for F.6 syllabus) | |
| Past experience | After doing this experiment with a class of 36 F. 4 students, below are the suggestions for improvement:<br><br>1) As students are not ready to discover the economic concept(s) from the game they play, it would be better for teacher to introduce the concepts first.<br>2) Before adding an additional labor to the production, it is important to ask students to clear their desk so that students will not be able to use the unfinished strips produced last time.<br>3) After adding an additional labor, at least 20 seconds of production time should be given.<br>4) After the first round of production with one toothpick, teacher should ask students to identify the variable and fixed | |

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| | factors involved in their production process. Teacher should also introduce the law of diminishing marginal returns by using the data before proceeding to round 2.<br>5) It is not feasible to have 3 rounds in a double-lesson period (80 mins in total). Thus, teacher has to choose which concept (i.e., the effect of an increase in capital or the effect of a technological improvement) he/she wants to illustrate at any one time. | 5 |
| References | Li, W., S., 1997. *New Introductory Economics* 1 2<sup>nd</sup> ed. HK: Longman Asia Ltd.<br>Parkin, M., 1996. *Economics 3<sup>rd</sup> rd.* USA: Addison-Wesley Publishing Company, Inc.<br>Wong, Y. C., 1999. *Understanding Microeconomics 1 2<sup>nd</sup> ed.* HK: Pilot Publishers Services Ltd. | |

**Appendix    Materials for Teacher**

Table 1        The Number of Moebius Strips Produced
Table 2        The Class Average of Moebius Strips Produced
Figure 1      How to Produce a Moebius Strip
Figure 2      Classroom Setting
Figure 3      Graph paper