

Instructional Plan for Science Research Lesson Featured on the Videotape "Can You Lift 100 kilograms? (Grade 5) *

1. Unit: The Way Levers Work

2. Unit Objectives

Enable students to investigate the design and operation of levers by changing the position from which effort is exerted and the amount of effort. To learn that:

- A. If you change the position of the weight, the angle of the lever changes, even though the heaviness of the weight remains the same.
- B. The lever has three major points: the fulcrum, the point of effort and the point of resistance.
- C. In the operation of a lever, there is a relationship between the amount of effort exerted and position from which effort it is exerted. When the lever balances, the amount and position of effort are related to each other according to a constant principle.

3. Connection with Research Focus

In their daily lives, the children use tools that involve the lever principle without realizing it. Their use of these tools is thus based upon their experience. We believe that in this unit of study, by discovering the rules and laws of the lever, the children will be able to experience anew the usefulness of tools that employ the lever principle.

If the children can discover that the rules and laws of nature are at work even in the commonplace tools of everyday life, it should be a joyful experience for them.

Also, the children will be divided into groups of several children each, and there will be a number of objectives that can only be achieved through cooperating and working together. In the midst of that activity, using the ideas of their classmates for reference, we think that the students will come to be able to give expression to ideas deeper than their own (initial) thoughts, and that is why we decided upon this unit.

4. Actual Situation of the Students

There are a lot of children who look forward to science classes because there are so many experiments and so much hands-on work involved. The boys and girls generally get along well and work together cooperatively, but there are one or two children in the class who have difficulty entering smoothly into such groups.

Generally, the students are serious and willing to work hard at whatever they are directed to do, but they also tend to lack the desire to come up with and try out their own ideas independently. It is noticeable that some students cannot make presentations confidently, because they don't have their own firm ideas and predictions.

5. Steps to Accomplish our (Research) Focus

(1) Strategies for the Learning Process

Based on the actual situation of the students, our plan of instruction aims to have students grapple naturally with the subject.

Our overall plan is to enter the unit from learning that interests and fascinates the children, then pursue the scientific facts, and then end with learning that is useful in their everyday lives. We hope to maintain the students' interest through this unit design.

Part One of the Unit (Lessons 1-4)

In part one of the unit, we planned the following learning flow:

Grasp the problem → Make a prediction → Discuss → Verify → Consolidate → Grasp new issue

Through this “learning flow” children should be able to grasp the problem at hand as their own problem, and take initiative in solving it.

Part Two of the Unit (Lessons 5-7)

In part two, by using (calibrated) laboratory levers, allow the children to discover the rules by which the lever slants and balances.

Part Three of the Unit (Lessons 8-9)

In part three, we plan to help the children realize that there are a great many tools that employ the lever principle even in their ordinary environments, so that in their everyday lives they could put into practice what they learn. In the new National Course of Study, the “weight and balance” unit presently studied at the fourth grade will be combined into this unit. With that in mind, we included the balance scale in this unit.

(2) Strategies for Curriculum Materials

Because we are trying to use materials from their everyday environment to get them interested, we have chosen to use sandbags for the weights. The students already have the experience of trying to move sandbags during their physical education classes. In addition, moving the heavy sandbags is a task that will give the students a very clear sense of the problem at hand. Furthermore, using a pole in order to move these sandbags will make the students more aware that the objects around them can, with a little engineering, become useful tools.

Among the tools that employ the lever principle, we choose one [the can-crusher] that relates to the new “environmentally aware” recycling lifestyle of modern children.

(3) Strategies for Support and Evaluation

We will prepare a worksheet for each problem in the lesson and observe the depth and flow of the students' thoughts. Since the students who do not have the confidence to come up with and share their own ideas will be writing them down on the worksheet, they will be able to organize their own ideas and they will leave written evidence regarding the process via which their own thinking deepened through group discussion.

Also, we want to value the *tsubuyaki* (under the breath exclamations) of the children during the experiments. Since this unit is supported by team teaching, we hope that we can hear more of the students' *tsubuyaki* and, by transmitting them to the other students, help each of the individual students to deepen their own thoughts.

(4) Strategies for the Learning Activities

Depending on the content of a lesson, there are many different ways to group children. We decided that for this unit we want to group together children who came up with similar first ideas for solving the problem. This will make the discussions which take place within each group particularly important; by relating to other students who have similar ideas, the students should thus be able both to deepen and modify their own thoughts.

Also, feelings of competition among groups may lead students to aim at higher goals and work all the harder at devising their own group's experimental methods.

6 Plan of Instruction [UNIT PLAN]

Lesson	Learning Activity	Methods; Points to Notice	
<p>(The Research Lesson)</p> <p>1.</p> <p>2.</p> <p>3.</p> <p>4.</p>	<p>Part 1: Let's Try Moving Heavy Objects</p> <hr/> <ul style="list-style-type: none"> ○ What should be done in order to lift a heavy object off the ground? <ul style="list-style-type: none"> • How heavy is it? • Which tools should be used? • Which way should it be done? ○ Let's really try moving it <ul style="list-style-type: none"> • Will it lift? • How does it feel? • Isn't there an easier way to lift it? • Let's try the pole • Let's try changing the position we lift from • Let's change the place it's supported • Let's see how the weight feels ○ Let's find the rules for moving heaving objects <ul style="list-style-type: none"> • Let's think about the relation between the fulcrum and the point of effort • Let's think about the power put into the point of effort 	<p>(3) Worksheet (2) Sandbags</p> <p>(4) Groups of Children with the same ideas (2) Sandbags, poles, and other equipment based on the children's ideas (3) Worksheet: Children's Utterances</p>	
	<p>Part 2: What Kind of Rules Govern the Balance of the Lever?</p> <hr/>		
	<p>5.</p>	<ul style="list-style-type: none"> ○ Let's discover the rules of the lever when it is tilted <ul style="list-style-type: none"> • Let's think about which way it tilts when we change the distance between the fulcrum and the point of resistance and fulcrum and point of effort, and when we vary the weight of the object to be lifted. 	<p>(3) Worksheet Children's utterances</p>
	<p>6.</p>	<ul style="list-style-type: none"> ○ Let's discover the rules of the lever when it is balanced <ul style="list-style-type: none"> • Let's try to balance the lever by changing the distance between fulcrum and point of resistance and between fulcrum and point of effort, and by varying the weight of the object to be lifted. 	<p>(3) Worksheet Children's utterances</p>
<p>7.</p>	<ul style="list-style-type: none"> ○ Let's put together the rules of the lever when balanced and when tilted <ul style="list-style-type: none"> • Let's put together our understanding: the lever tilts or balances according to the value on the left and right arms on: "Weight of the Object" x "Distance from the Fulcrum" 		

Part Three: Let's Search for Tools that Use the Lever Principle		
8.	<ul style="list-style-type: none"> ○ Let's try using some tools that employ the principle of the lever when it is balanced <ul style="list-style-type: none"> • Let's try using a balance scale 	(1) Strategies for the Learning Process: The Balance Scale
9.	<ul style="list-style-type: none"> ○ Let's try using some tools that employ the principle of the lever when it is tilted <ul style="list-style-type: none"> • Let's try a can-crusher • Let's try a bottle-cap remover • Let's try prying nails • Let's try pliers • Let's try scissors • Let's try tweezers 	(2) Strategies for Curriculum Materials: The Can-Crusher
(1) Strategies for Learning Process (2) Strategies for Curriculum Materials (3) Strategies for Support and Evaluation (4) Strategies for Student Activities		

7. Today's lesson

1) The aims of this lesson

1. For students to actively consider how to use objects easily after finding that it's really hard to lift a heavy object by hand.
2. For students to deepen their own thinking by expressing their ideas to others.
3. For students to pay attention to safety and to cooperate with their friends while conducting experiments.

2) The development of this lesson

Teacher 1 Activity	Learning Activity	Means and Points to Notice	Teacher 2 Activity
<p>Overall Guidance: Check the conditions of the experiment</p> <p>Give guidance and help to each of the groups</p> <p>Overall Guidance: Direct their progress toward the next experiment.</p> <p>Give guidance and support to groups working on “Floor Sandbag #1”</p>	<ul style="list-style-type: none"> ○ Try lifting the “Floor Sandbag #1”: <ul style="list-style-type: none"> • Using tools from their everyday environments • Having just one person lift it • By taking turns, make sure that every group member can lift it ○ Make sure to see that it has really been lifted. <ul style="list-style-type: none"> • The group that lifted it tries “Floor Sandbag #2” • If they could not lift it, they try finding an easier way to lift “Floor Sandbag #1,” and then take the challenge again. ○ Discover that a pole can be put to good use in order to move heavy objects 	<p>(“Sandbag #1” weighs about 30 kg)</p> <p>The groups, based on the ideas they came up with earlier, carry out their experiments.</p> <p>Take turns to fill out their results on the worksheets, referring to each other’s ideas.</p> <p>(“Floor Sandbag #2 weighs about 100 kg)</p> <p>Take turns to fill out their results on the worksheets, referring to each other’s ideas.</p>	<p>Give guidance and help to each of the groups</p> <p>Give guidance and support to groups working on “Floor Sandbag #2”</p> <p>Overall Guidance: Point out the groups that have used the pole and lifted the weight.</p>

3) Evaluation of this Lesson

1. After finding that it’s very hard to lift a heavy object by hand, did the students actively consider how to use the pole to lift heavy objects easily?
2. Were the students able to deepen their thinking process by talking about their ideas with friends?
3. Were the students able to cooperate and attend to safety while performing the experiments?

8. Student Groups for Experiments

[The original lesson plan provides the names of all students in each group. It also provides 8 examples of student]



