BENCHMARK AND SLC#  
SLC 6: Students will identify the differences between work and force as they relate to each of the 6 simple machines.

OBJECTIVE:  
Students will be able to identify the 3 classes of levers and explain what makes them different.

MATERIALS  
For each group:  
- 30 cm rulers (2)  
- Tape  
- Pencils  
- Rubber bands (thin, not thick)  
- 20 pennies or washers  
- Film canisters  
- Lever worksheets

INITIAL DEMONSTRATION:  
Have the three different classes of levers set up at the front of the room using a pencil for the fulcrum, a ruler for the lever arm and pennies or washers for the load. Demonstrate each of the three levers using the same load for each. Use a rubber band to lift up on one end of the ruler; this will help to demonstrate the amount of effort (force) needed to move the load. Ask the class what they observed.

TARGET OBSERVATIONS:  
- The three set-ups are all levers.  
- The levers all have the same parts (fulcrum, lever arm, load, and effort), but they change position.  
- Some levers require less effort to lift the load.

TARGET MODEL:  
- Levers can make it easier to move a load (require less effort than if not using a lever).  
- There are several different types of levers.

PROCEDURE:  
Organize the class into 3 small groups and have each group perform the following experiments:  
FIRST CLASS LEVER:  
Place a pencil near the edge of the desk and tape it down. Cut a rubber band and tie it to one end of the ruler (this will be used to measure force). Measure the length of the
rubber band after it is tied on and record this measurement. Place the ruler on top of the pencil so the 15cm mark is directly over the pencil and the rubber band end is free to be pulled down. Fill a film canister with 20 pennies and place it on the end of the ruler that is on the desk. Pull the lever arm down with the rubber band, measure how long the rubber band is and record this value. Repeat with the fulcrum at varying places under the lever (ex. 8cm and 22cm). Review with the class what happened as the fulcrum was moved.

Second Class Lever:
Place the pencil in the middle of the desk so that the entire set-up will be on a flat surface. Tape down the pencil and place the ruler with one edge taped on top of the pencil. This time the load will be in the middle and the fulcrum and effort will be at opposing ends. Place the load (canister with 20 pennies) at three different spots on the ruler (ex. 29cm, 19cm and 9cm). Record the results and then discuss what happened as the load was moved and if it was easier to move the load with the first-class or second-class lever.

Third Class Lever:
Keep the pencil/ruler set-up as before but now the load and the fulcrum are at opposite ends and the effort is in the middle. Remove the rubber band from the end of the ruler and tie it around the middle of the ruler. Make sure that the rubber band is pulling up on the ruler from the center and is not skewed to one edge or the other. Place the canister and pennies on the very edge of the ruler and then move it close to the rubber band. Record results. It is advisable for this lever to have a student holding the ruler down on the end that is over the fulcrum and also to tape the canister down to the ruler because a much larger force is required to move the load and it can go catapulting off the end of the ruler! Review with the class what happened and where it was easiest to move the load, and how this compares with the other two classes of levers.

Discussion/Summary:
Ask the class for examples of the three different classes of levers and have them describe where the fulcrum, load and effort are for their examples. Some examples of first-class levers are a seesaw or scissors. Examples of second-class levers include a wheelbarrow or nutcracker. Examples of a third class lever include a human arm, fishing pole, crane, or tweezers.

Target Model:
- There are several different types of levers:
  - First Class Levers: The fulcrum is between the effort and the load.
  - Second Class Levers: The load is between the fulcrum and the effort.
  - Third Class Levers: The effort is between the fulcrum and the load.
- Levers make it easier to move a load (require less effort than if not using a lever)
- To lift a load with the least amount of effort:
  * Place the load as close to the fulcrum as possible
  * Apply the effort as far from the fulcrum as possible