Subject: Science
Grade Level: Middle School
DI Strategy: Split Screen/Flexible Grouping

Science - Work Calculations Split Screen

Recently, in class, students learned how to calculate the amount of work done on an object (work = force x distance). This is one of many calculations that students gain experience with throughout the year. Since this was a more straightforward multiplication calculation, I wanted to provide students with a challenge to tie together either calculations we had used in the past or calculations that asked students to solve for work at an angle (a more complicated calculation).

To determine which students would be assigned to which group I gave students a formative assessment to look at their basic calculations and checked for their understanding. If students tended to struggle or had more questions incorrect, they were put into the group that would be doing the work calculations packet that had a scaffold to help them understand the more complicated problems (group 1). The work was divided into 4 sections: easy, medium, hard, and expert. Each section had problems with different point values. Students needed to complete enough problems to reach 25 points.

Students who did well on the previous calculations, along with students who are planning on taking honors were placed into the group calculating work at an angle (group 2). This assignment was set up so that we could review the idea and a problem together, then they would work through problems with a partner, followed by trying problems on their own. Group 1's assignment can be found at the end of this document. Group 2's assignment follows Group 1's at the bottom of the page.

When students got into class I broke them into their groups and introduced the two assignments. As a class we reviewed our procedures for when we work in two groups. I asked students to share things they should do while working in their groups and things they should not do. To assist in the classroom management, the assignment for group 1 was set up so that students could at least get through half of the work without my help. During that time I was working to introduce work at an angle to group 2. With group 2, I walked through one sample problem. I then had them work with their partner to complete the next two problems. While they were doing that, I went to group 1 to check for questions and to see if students needed assistance. Once I had the opportunity to check in with group 1, I went back to group 2 to review the answers to the problems they had tried and to check for misunderstandings. When I was sure that they understood the information, I had them work on completing the rest of the work on their own. During the rest of the lesson I walked around the room to check in and assist any student that required individual help.

In each class, students did well managing themselves when I was not present. It does help that we have done Split Screen lessons before. Students knew my expectations and also held high expectations for each other. It was also helpful to remind students that they needed to complete any unfinished work for homework. Students in both groups enjoyed being challenged and did genuinely want to get each problem correct. Those that struggled some in the beginning felt very accomplished when they got problems correct (it was evident when I would hear a "Yes!" from the back). Students were both motivated and challenged at the correct level of difficulty, which was my goal.

Group 1 Worksheet

Name: _____ Period: _____

Challenging Work Problems

Background Information

1. Define work:

   _____

2. Draw the work triangle:

3. Check all of the situations where work is being performed:

   a. _____ You ride a skateboard down the street

   b. _____ You lift your books off of the table

   c. _____ You push against a stuck car, after 5 minutes it still did not move

   d. _____ You push a chair from one side of the room to another

   e. _____ You stand holding your books for 5 minutes

   f. _____ You move a piece of paper from one end of your desk to another

4. Define weight:

   _____

   __

5. How would you calculate the weight of an object on Earth? *Hint: Acceleration due to gravity is 10 m/s*

   _____

   __

Problems

Show all of your work using the 4-step process to solve the following problems. You must do enough problems to total **25 points.**

Easy (1 point each)

1. How much work does it take for a bodybuilder to lift a 300 N barbell 3 m into the air?

2. Calculate the amount of work done to move 20 N of books 30 m.

3. How much work is done to raise a 1525 N block 50 m?

4. If you are in a car that is being pulled down a 56.0 m path with a force of 12.5 N. How much work is done on the car?

5. Calculate the amount of work needed to move 79 N of bricks 62 m.

6. Amy uses 20N of force to push a lawn mower 10 meters. How much work does she do?

Medium (2 points each)
1. Calculate the force used to move an object 10 m when 40 J of work was done.

2. How far did a 72 N object move when 400 J of work was done?

3. A crane does work of 13,500 J with a force of 5200 N to lift a beam. How far was the beam lifted?

4. How much force would be required for you to lift an object with 1750J over a distance of 50m?

5. 50,250 J of work were done to move a 1500 N car. How far did the car move?

6. The baseball player does 1234 Joules of work when hitting a baseball into left field. Assuming the baseball landed 100 meters away from home plate, how much force did the player use to hit the ball?

Hard (4 points each)
Each of these problems involves more than 1 step. Make sure that you show the 4 step process for each calculation.

1. How much work is done by a person lifting a 53kg bag up a 12 m ladder?

2. Calculate the amount of work done by a crane that lifts 5000 kg of steel up 210 m.

3. What amount of work would be required to move a 62 kg object 100m?

4. You lift a 10kg book bag from the ground to the table, a distance of 1.7 m. How much work did you do?

Expert (5 points each)

1. What is the mass of an object that required 250 J of work to move 10m?

2. How far did a 50 kg object move if 325 J of work was done?

3. What is the mass of a rock lifted 60 m out of a hole when 462 J of work was done?

4. How far was an object lifted if it had a mass of 5kg and 350 J of work was done?

Group 2 Worksheet

Name: _____ Period: _____

Challenging Work Problems

1. A force of 50 N acts on a block at a 30 degree angle. The block moves a horizontal distance of 3.0 m. How much work is done by the applied force?

2. The same block with a force of 50 N is pulled at a 15 degree angle moving a horizontal distance of 3.0 m. How much work is done by the applied force?

3. The same block with a force of 50 N is pulled at a zero degree angle. The block is traveling in the same exact direction as the pull. The block moves a horizontal distance of 3.0 m. How much work is done by the applied force?

4. A student with a mass of 70.0 kg runs up three flights of stairs. The student has gone a vertical distance of 8.0 m. Determine the amount of work done by the student to elevate his body to this height. Assume that her speed is constant.

5. Jim is pulling on a rope to drag his school bag to school across the ice. He pulls upwards and rightwards with a force of 25 Newtons at an angle of 60 degrees above the

horizontal to drag his backpack a horizontal distance of 129 meters to the right. Determine the work (in Joules) done upon the backpack.

6. Jim then changes the angle at which he pulls to 30 degrees with the same amount of force and it moves the same distance. What is the work done to the school bag?

7. A powerlifting star wants to lift weights. Deadlifting involves raising a loaded barbell from the floor to a position above the head with outstretched arms. Determine the work done by the person in deadlifting 300 kg to a height of 0.9 m above the ground.

8. Omar carries a 300 N suitcase up five flights of stairs (a height of 20.0 m) and then pushes it with a horizontal force of 60.0 N at a constant speed of 0.5 m/s for a horizontal distance of 25.0 meters. How much work does Ben do on his suitcase during this <u>entire</u> motion?

9. Jessica has just arrived at the airport and is dragging her suitcase to the luggage check-in desk. She pulls on the strap with a force of 1000 N at an angle of 65 degrees to the horizontal to displace it 45 m to the desk. Determine the work done Jessica on the suitcase.