Motion Commotion: A Station Lab

Student Activity 1B

Station 1 A Well-Turned Ankle: Ankle Flexibility and Muscle Endurance

Introduction:

Friday night…all of your friends are out having a good time but where are you? Stuck at home babysitting your niece, that's where. How did your sister talk you into this anyway? "She's just a little baby," your sister says. "She's no trouble at all and I haven't been out in FOREVER," she says with a pleading look on her face. Whatever… you said "yes" and now she's out having a good time like everyone else and you're here with the baby. Actually, she's not really a baby anymore. Your sister says that she's been standing on her own all week and is probably going to start walking any day now.

Though you wouldn't admit it to anyone, you really like watching the baby. It's fun to observe her playing with her toys and her own fingers and toes. As you watch her playing she gets her feet under her and rises to a squatting position then slowly stands up, looks at you, and grins. She stands in place for a few seconds just trying to keep her balance, swaying slightly forward and backward. Whenever she leans forward her toes scrunch up and grab the floor and when she sways backward she digs in her heels to catch herself before she falls. Her feet sort of remind you of tiny little see saws.

You can tell she wants to take a step but just isn't quite confident enough to try it. So you decide to see if you can help her along by calling to her and enticing her with her favorite toy. First she just smiles then her little face squishes into a frown like she's concentrating really hard. Then it happens! She picks up her foot, wobbles a little like she's about to fall but then puts it down quickly and catches herself…her first step! She tentatively takes one … two…three more steps but on the fourth one she can't catch herself and "plop" down she goes. Fortunately the thick diaper cushions her fall. At first you think she's going to cry but when you start to laugh so does she. Pretty cool – you got to see your niece's very first steps.

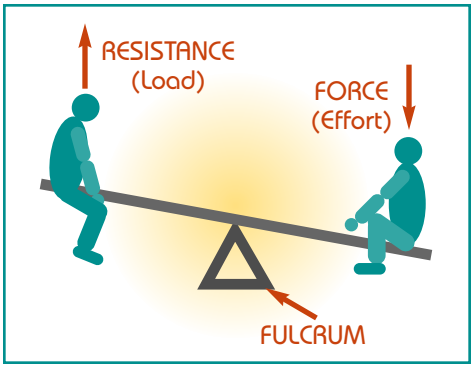


Figure 1- Typical First Class Lever

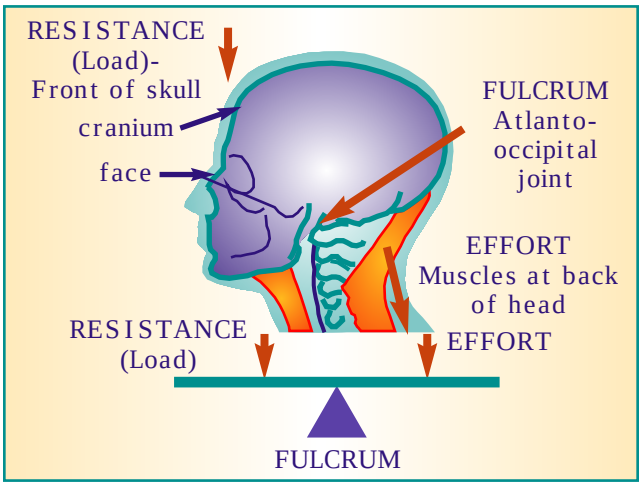


Figure 2-First Class Lever In Body

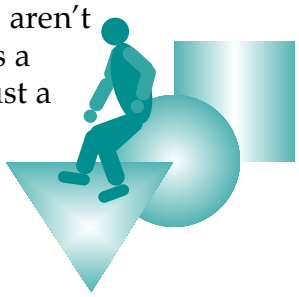
Watching a baby walk is similar to watching a grown person walk but in very slow motion – frame by frame. When you thought your niece's feet looked like see saws you were right. The point where our leg and ankle bones meet creates a first class lever system* – a kind of upside down see saw (*Figures 1 and 2*). We sway back and forth just like your niece

* This motion should not be confused with rising on the toes, which can be correctly modeled as a first or second-class lever, if all forces involved are included.

Fenn, W.O. 1957. *The mechanics of standing on the toes*. Am. J. Phys. Med. 36: 153-56.

to keep our center of gravity in equilibrium, but our movements are less noticeable. The muscles in the front and backs of our legs are stronger and more coordinated so our movements are more refined, not as exaggerated. These muscles keep us, with our much higher center of gravity, balanced on the little see saws we call feet.

In reality, standing up is just one big **balancing act**. In fact, in order to walk we must first push ourselves off balance —- in other words, we must start to fall. If the muscles in our legs didn't help us recover our balance when we put our foot down we **would** fall – like when we aren't paying attention and we miss a step. In essence, walking is just a series of falling and catching ourselves —- losing and then recovering our center of gravity. No wonder it's so difficult for babies to learn to walk and so easy for us to fall down.



This lab is designed to test your balance and how quickly you can shift your center of gravity by exaggerating the see saw movement of our feet and ankles. It's tricky but fun, so give it a try.

Materials: (per group)

- 1 stopwatch
- 1 balance board

Procedures: (Read all instructions and check off each step as it is completed.)

❒ 1. Follow the rotation below to insure that each lab participant serves in every role at least once:

Cooperative Group Letter	First Rotation	Second Rotation	Third Rotation
A	Test Subject	PT (Tester)	PT (Tester)
B	PT (Tester)	Test Subject	Technician (Recorder)
C	Technician (Recorder)	Technician (Recorder)	Test Subject

I. Balance Test

❒ 1. For the **Ankle Flexibility and Muscle Endurance Test** place the balance board about an arm's length from a wall or table. The **PT** serves as the **timer** for this test. Have the test subject stand on the board and center his or her feet across the line marked on the board (Figure 3). To steady the board the test subject can place his or her hand lightly on the wall.

Figure 3- Good Front Touch

2. Once the **Test Subject** feels the board is balanced he or she lets go of the wall and tries to keep the board balanced for five seconds.

3. The **PT** starts the stopwatch when the **Test Subject's** hand leaves the wall and stops it when either the front or back of the board touches the floor.

4. The **Technician** circles either "yes" or "no" on the **Test Subject Chart**. "Yes" indicates the board was balanced for at least 5 seconds. "No" indicates the board touched down before the five seconds was up. There is no in-between– balancing for three seconds deserves a pat on the back but it doesn't count for this test.

5. Each person gets three tries so good luck but be forewarned **– this is a VERY DIFFICULT test. Few people can actually keep the board balanced for five seconds so don't become frustrated if you can't do it.**

II. COG (Center of Gravity) Shift Test

1. For this test, the **Test Subject** again centers his or her feet across the line on the board and holds themselves steady against the wall or table.

2. The **PT** again serves as the timer. This time the goal is not to balance the board but to make the front and back edges touch the floor 10 times. Touching front AND back counts as one time. ***Figures 4 and 5*** show a complete front and back touch.

3. If the board touches in only one direction but not the other, that try is not counted in the ten.

4. The **Technician** serves as the count referee. He or she counts the number of successful touches out loud for the **PT** to hear.

5. The **PT** gives the test subject a *Ready, Set, Go* countdown and starts the stopwatch.

6. When the **Technician** reaches the touch count of 10 the **PT** stops the stopwatch.

7. The **Technician** records the total time for 10 touches on the **Test Subject Chart**.

8. Trade roles and repeat both the **Ankle Flexibility and Muscle Endurance Test and COG Shift Tests** until all group members have recorded measurements.

Figure 4- Good Front Touch

Figure 5- Good Back Touch