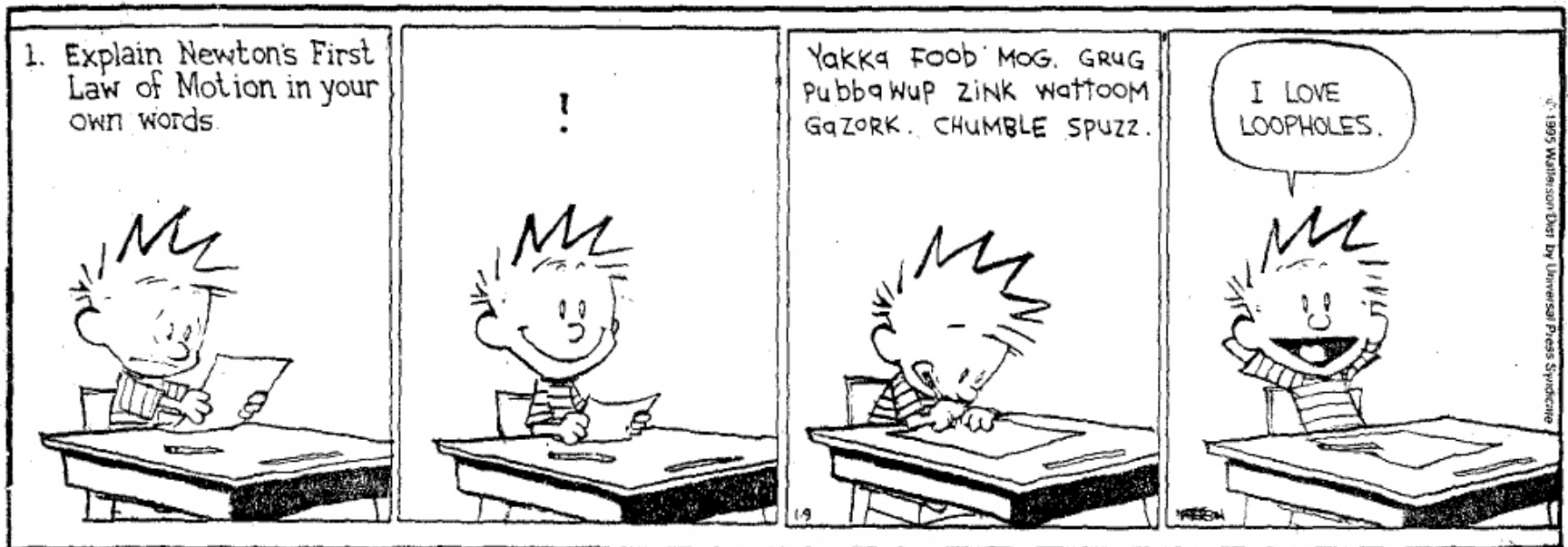


- **Today's Topics:** Newton's Laws & Free body diagrams
- **Cartoon:** Bill Waterson  
*Calvin & Hobbes*

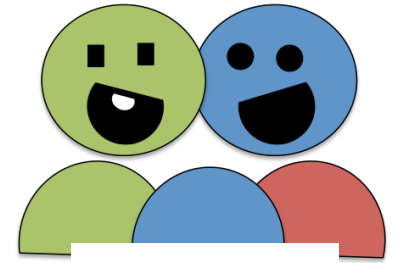
CALVIN AND HOBBS BILL WATTERSON



Which of Newton's Laws does this best demonstrate?

- A. Newton's 1st
- B. Newton's 2nd
- C. Newton's 3rd
- D. None of them!

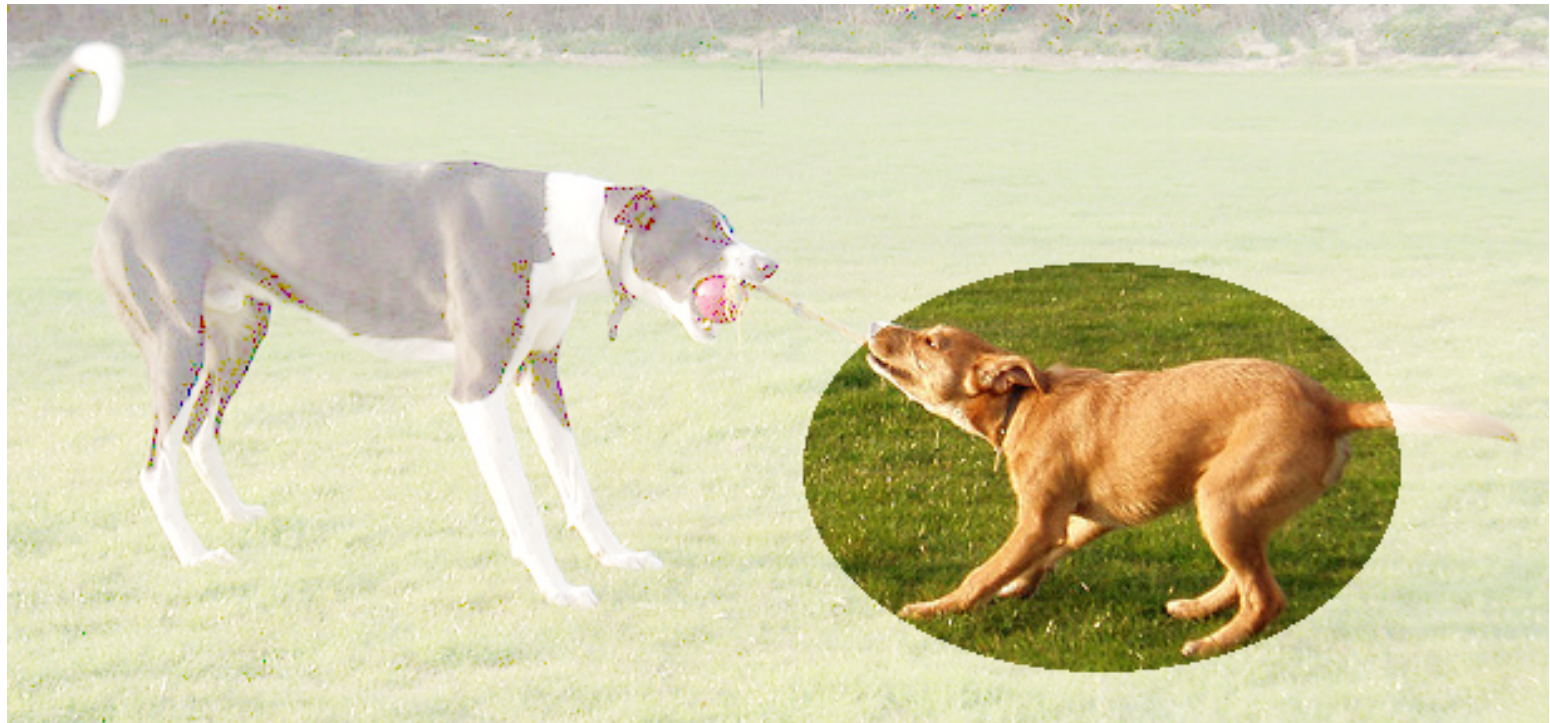




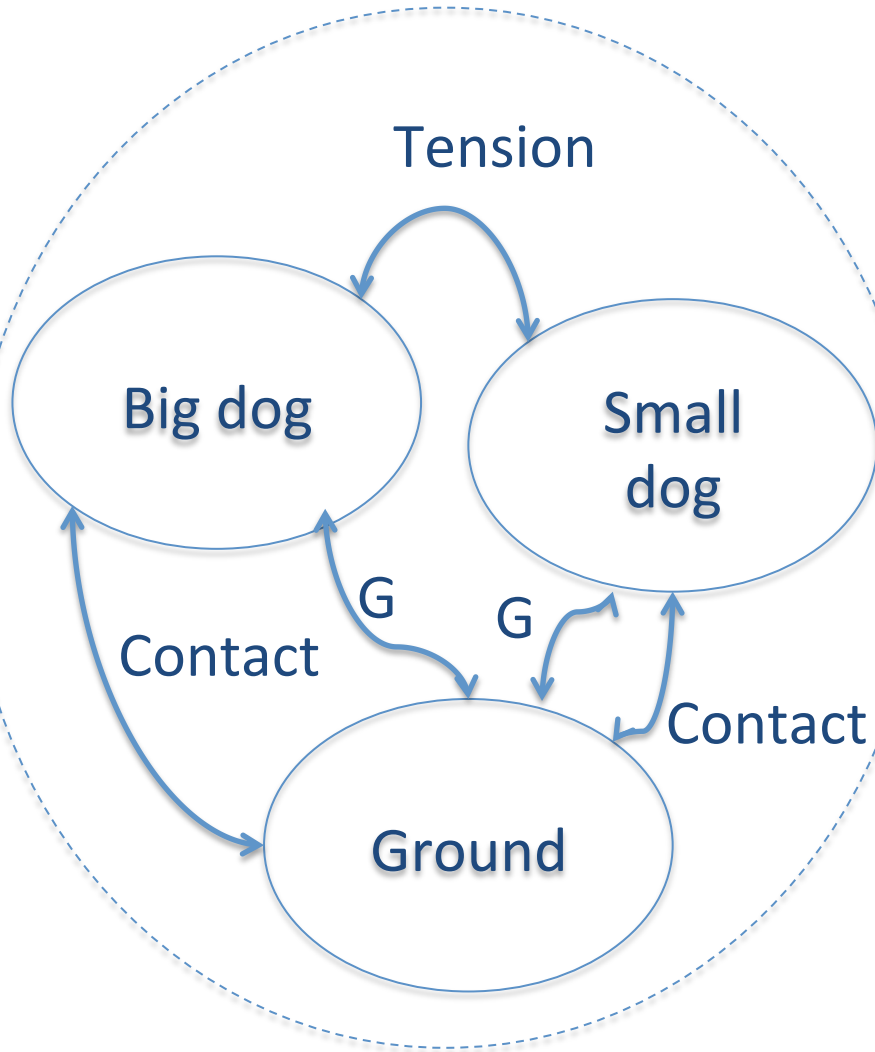
Discuss It!

- Consider dog 2 in the two-dog tug-of-war. He isn't moving. Why not?
- Come up with a representation that shows why he isn't moving.

## Thinking about motion

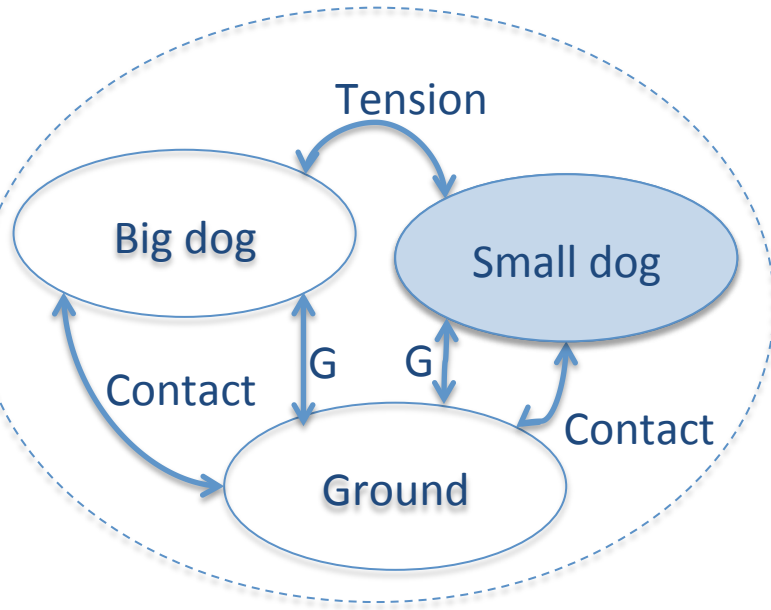


# Analysis Tool: System Schema

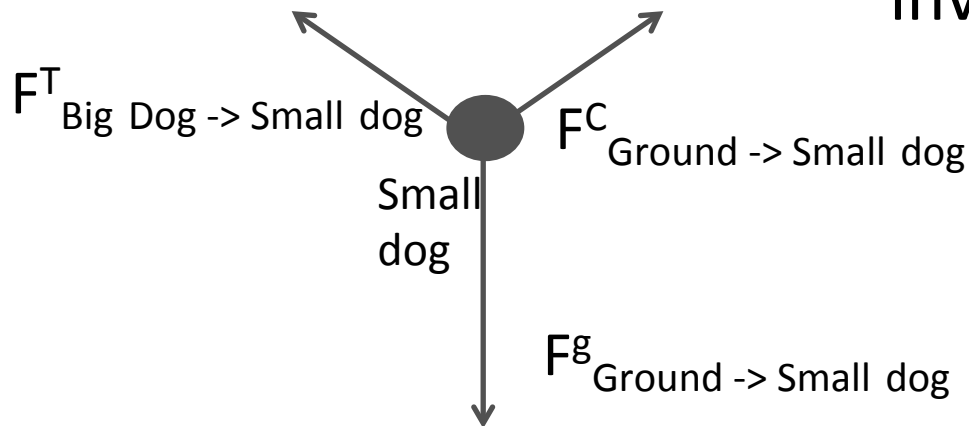


1. Identify and all objects that influence the situation you are describing, represent each object with a circle and a label.
2. Identify all interactions between the objects. Represent each interaction with a two headed arrow, and label the interaction

# Free Body Diagram



- Identify the object you are considering.
- Use a dot to represent the object of concern.
- Identify all interactions that the object is involved with.



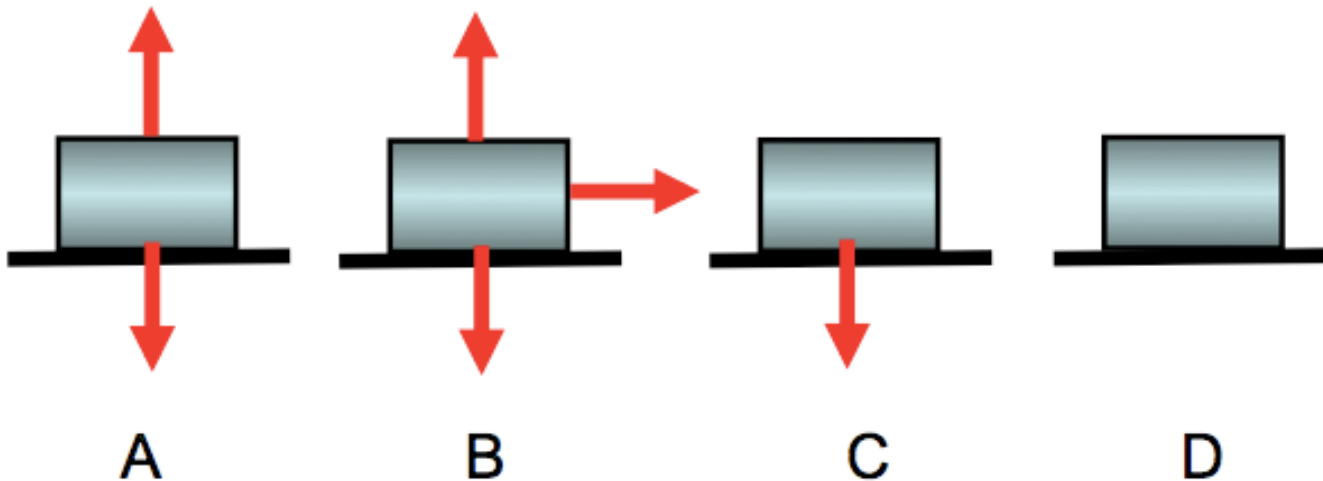


A block sits at rest on a frictionless surface. Which of the following sketches most closely resembles the correct free-body diagram for all forces acting on the block? (Each red arrow represents a force. Observe number and direction, but ignore lengths)

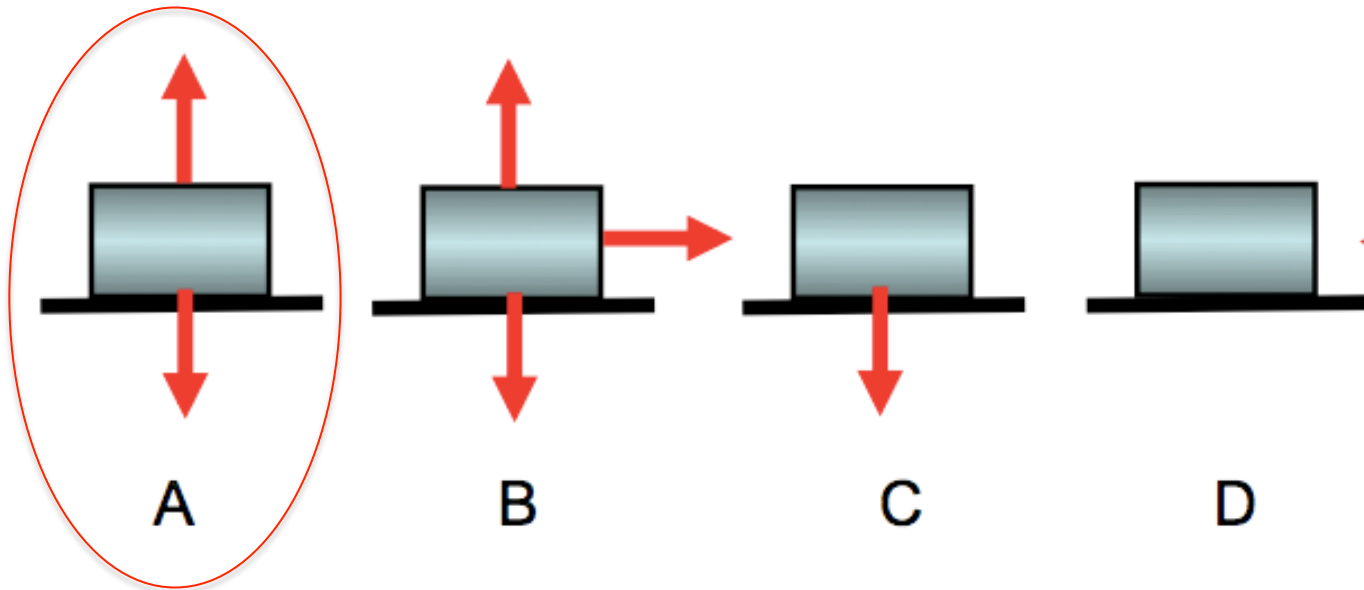


Draw it first!

A block sits at rest on a frictionless surface. Which of the following sketches most closely resembles the correct free-body diagram for all forces acting on the block? (Each red arrow represents a force. Observe number and direction, but ignore lengths)

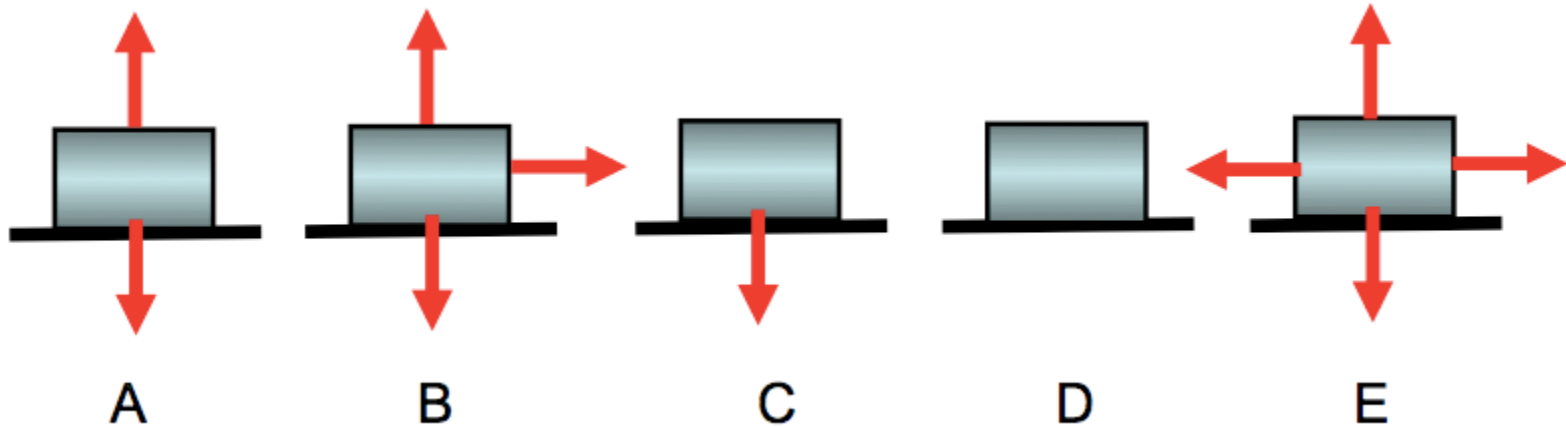


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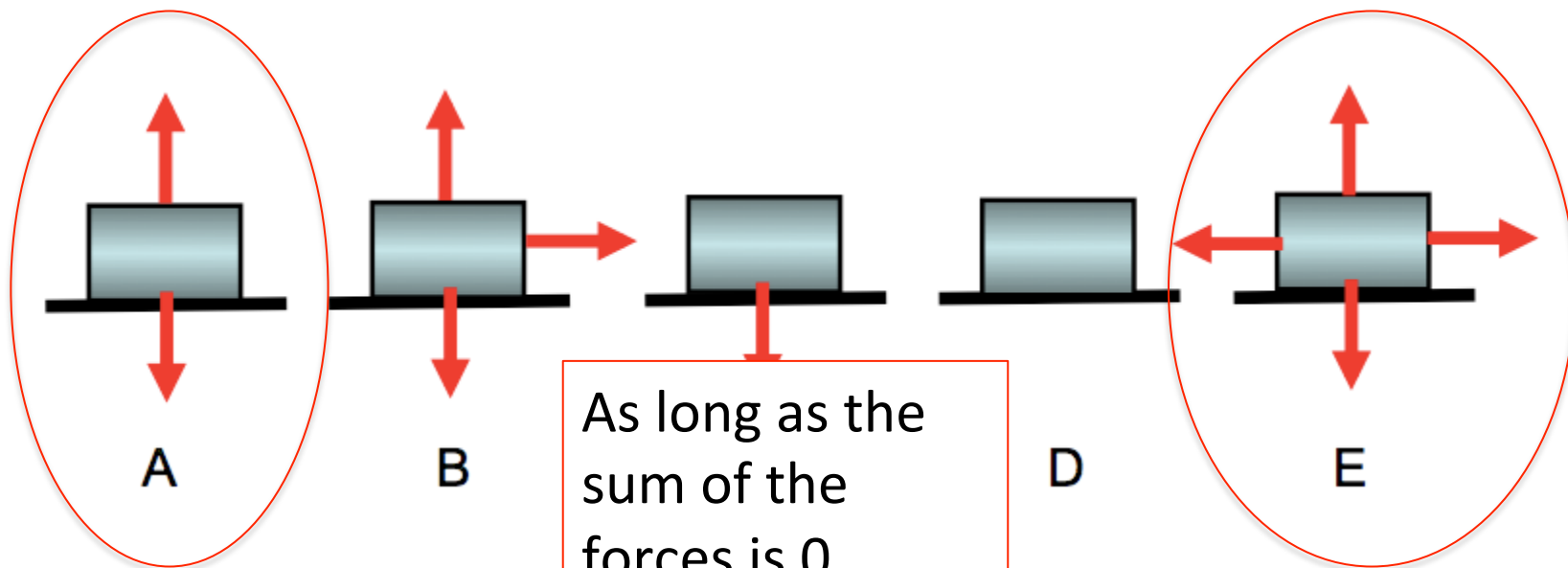




Now, the same block moves with a constant velocity to the right on the **frictionless** surface. Which of the following most closely resembles the correct free-body diagram for all forces acting on the block?

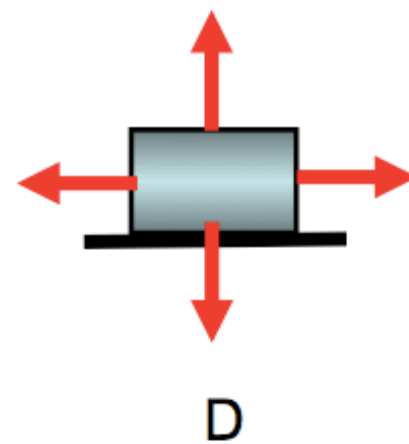
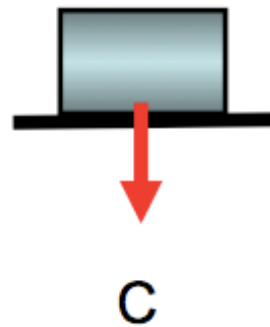
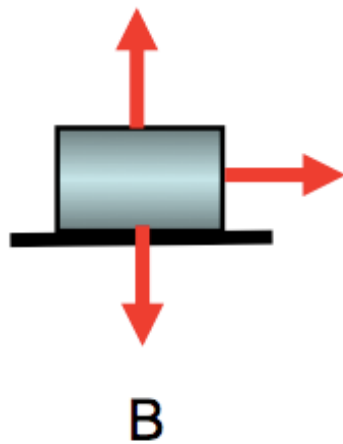
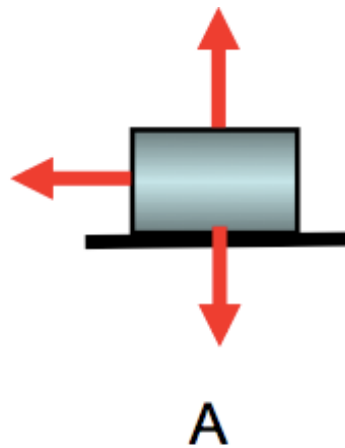


Now, the same block moves with a constant velocity to the right on the **frictionless** surface. Which of the following most closely resembles the correct free-body diagram for all forces acting on the block?



As long as the sum of the forces is 0, either FBD is correct

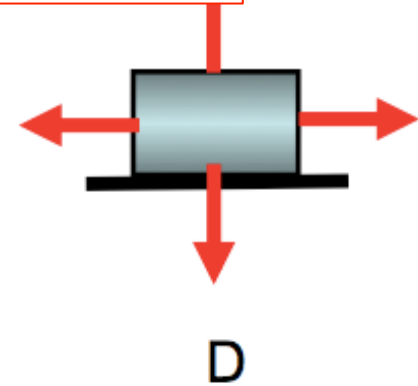
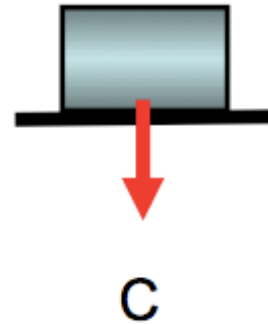
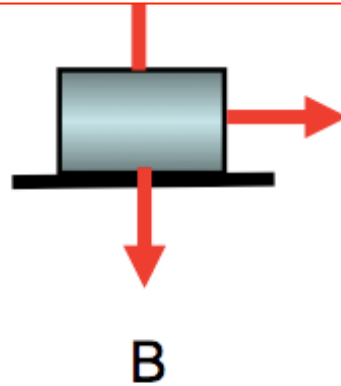
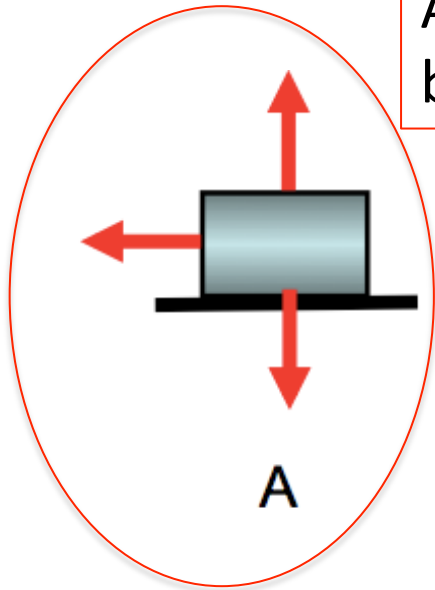
Now, the block moves to the right with a on a surface **that has friction**. Which of the following most closely resembles the correct free-body diagram for all forces acting on the block?





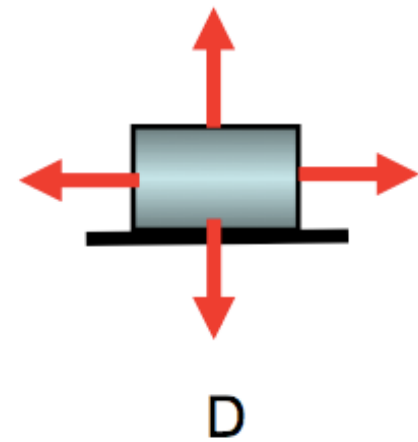
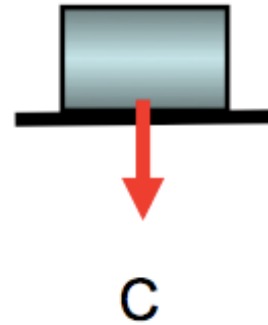
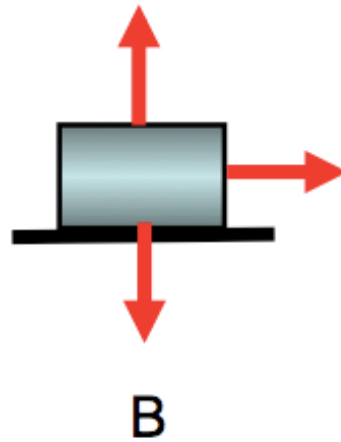
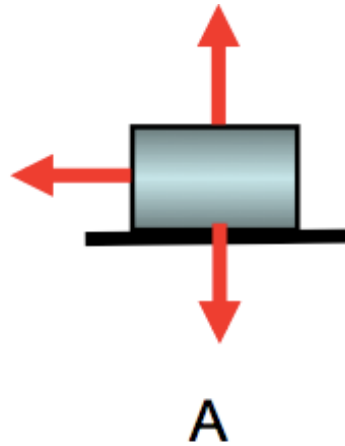
Now, the block moves to the right with a on a surface **that has friction**. Which of the following most closely resembles the correct free-body diagram for all forces acting on the block?

Assuming the block is slowing down, but still moving to the right.





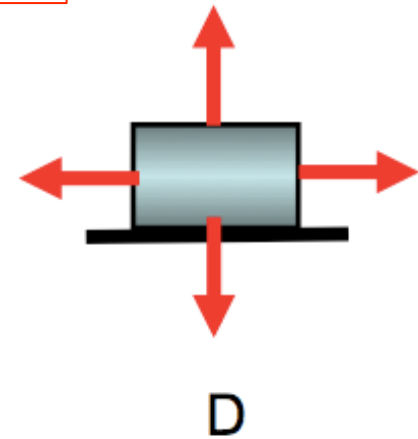
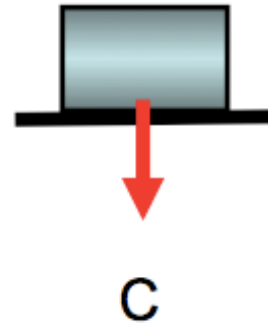
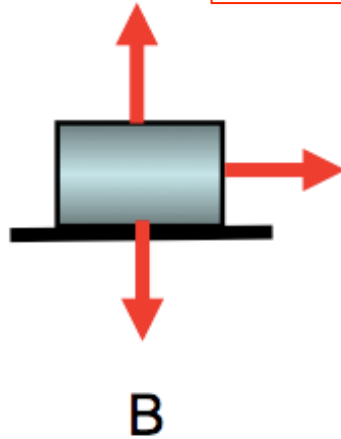
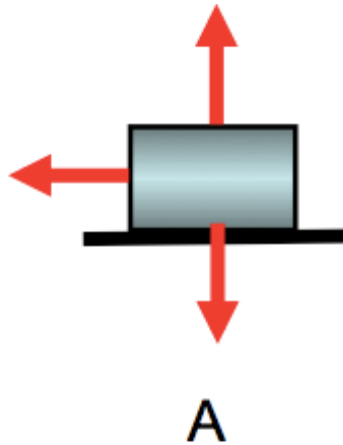
What is the net force for free body diagram D?





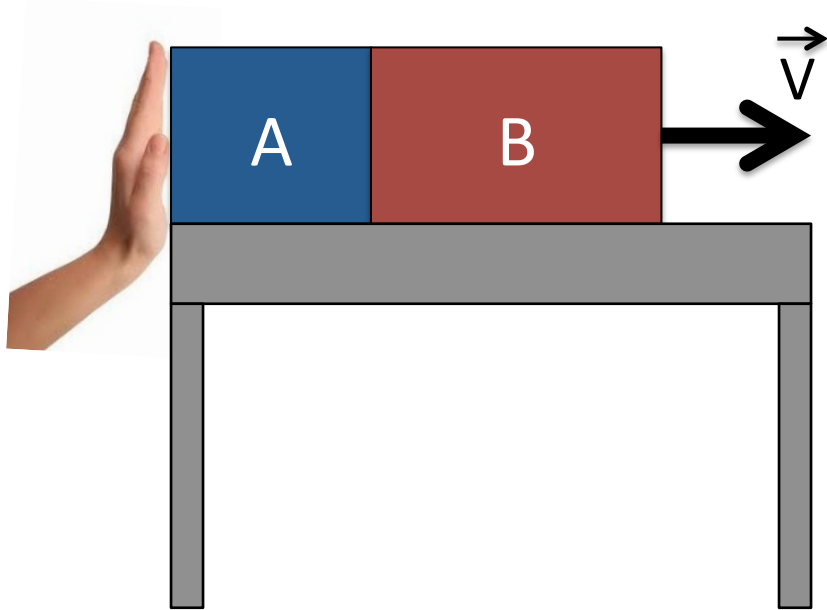
What is the net force for free body diagram D?

0, assuming all the force arrows are equal.



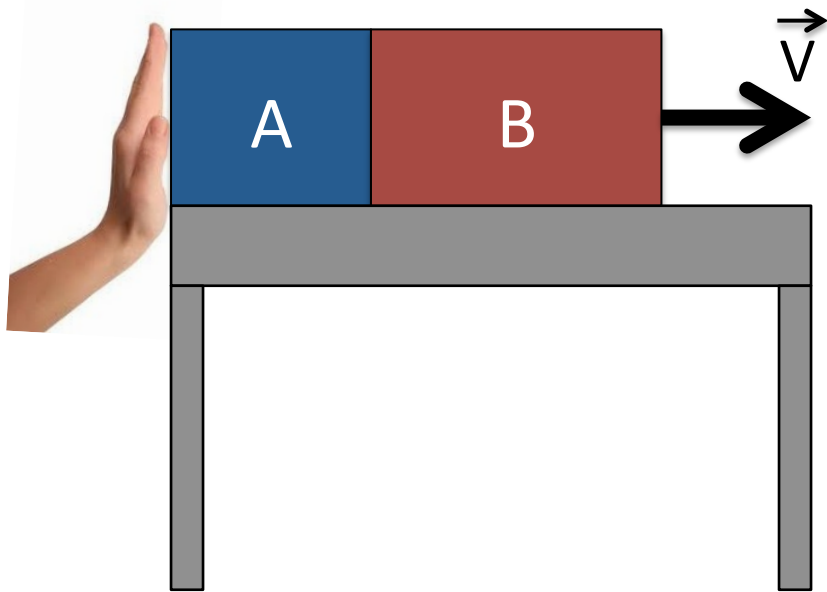


Suppose two blocks are being pushed at constant speed, which of the following is the correct free-body diagram for block B?

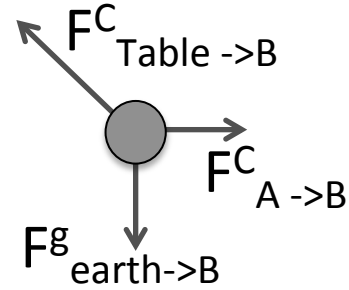


Draw it!

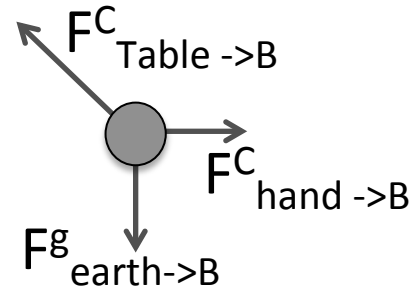
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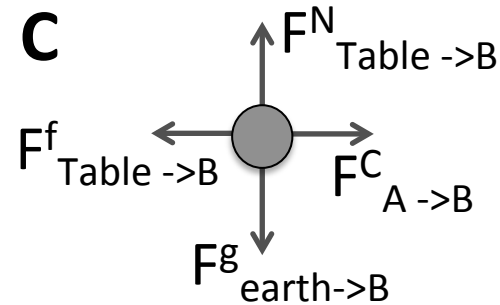
**A**



**B**



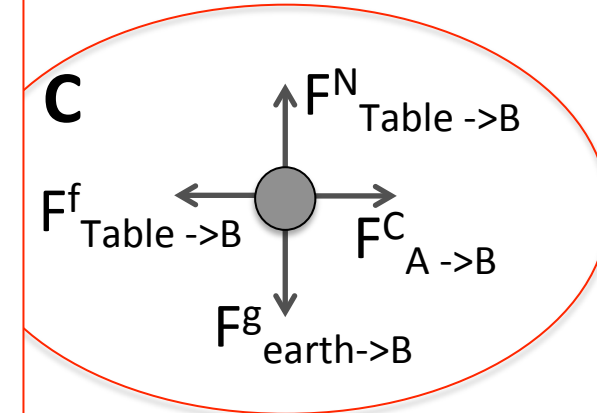
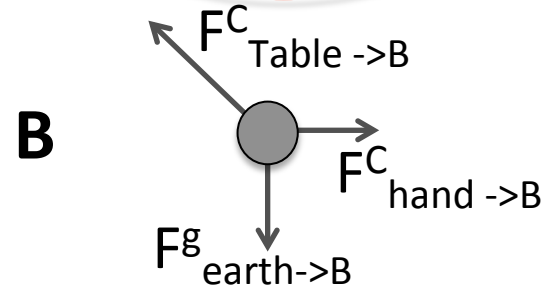
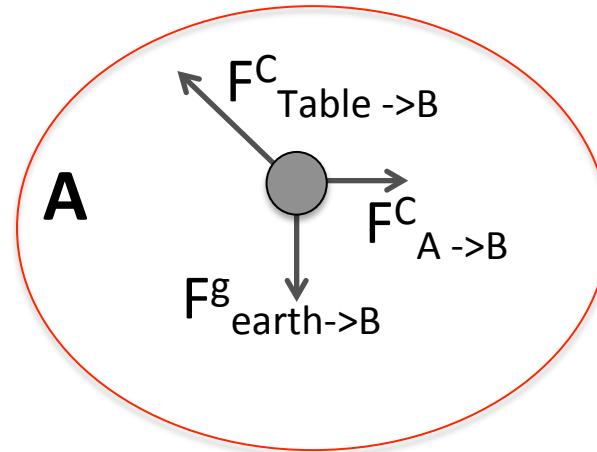
**C**



**D** None of these



Suppose two blocks are being pushed at constant speed, which of the following is the correct free-body diagram for block B?



**D** None of these

Because the block is moving at a constant speed, the sum of the forces are 0.

Both A and C show net force of 0, where A is just the two table->B forces combined.