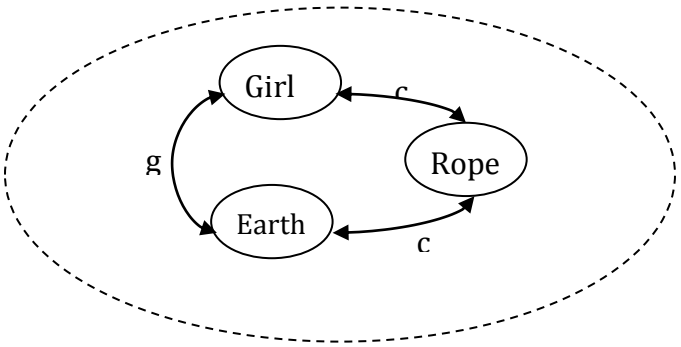
Force notation in Modeling Instruction

The coordination of representations is a key feature in building models. We have developed force notation that is consistent with the use of system schema and the language used in the Modeling Instruction classroom.



The system schema describes all the objects of interest and the interactions between them.

F^{g}Earth on girl

"The Gravitational Force by the Earth on the girl."

F^{c}rope on girl

"The Contact Force by the rope on the girl."

F^{N}Earth on girl

"The Normal Force by the Earth on the girl."

F^{c}Earth on girl

“The Frictional Force by the Earth on the girl.”

The superscript indicates the interaction and the subscript describes the objects exerting and experiencing the force. You can further simplify by only using the first letter of each object.

Traditionally, this force is referred to as the normal force, which is an ambiguous term that is not intuitive for students. The force is a result of two objects physically touching, a “contact interaction” as shown in the schema.

The contact force is equal to the normal force when there is no frictional force. The normal force and frictional force are the two components that make up the contact force. This is explained further in the friction lab. In the case of friction, the normal force is necessary. The normal force is perpendicular to the surface because it is in the direction that the contact force would “normally” be in the absence of friction.

Other Benefits

Note that one can look at the system schema and immediately identify the interaction responsible for and the number of forces acting on any object of interest.

Newton’s 3rd Law- In Modeling Instruction 3rd law is defined as “Two forces describing the same interaction are equal in magnitude and opposite in direction”

$$F^{g}_{\text{girl on Earth}} = - F^{g}_{\text{Earth on girl}}$$

By using this definition the notation it makes the identification of 3rd law pairs much easier for students. The superscripts must be the same, since the forces must describe the same interaction, and the subscript are the same two object reversed respectively in their roles.