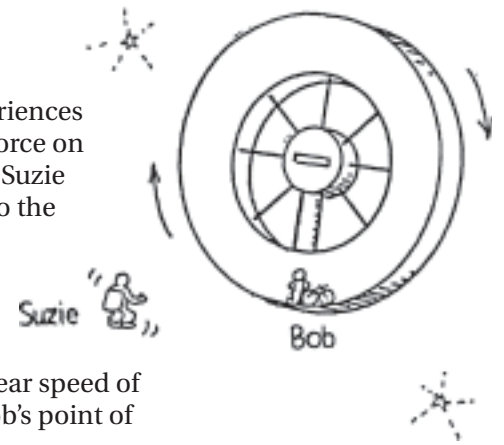


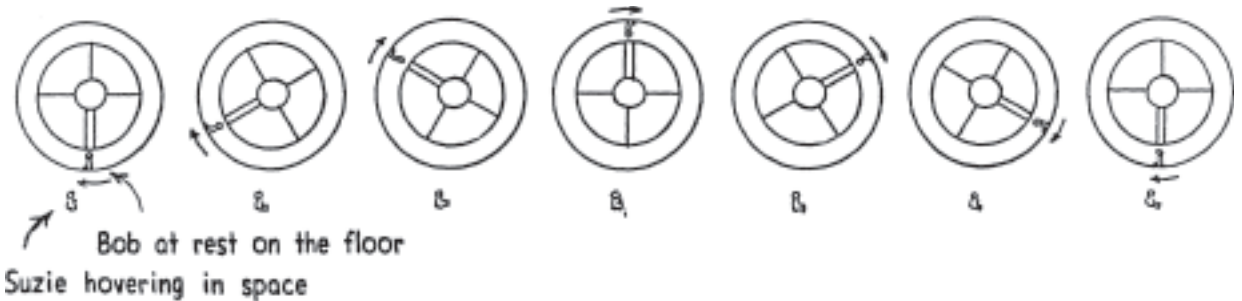
Concept-Development Practice Page 12-2

Simulated Gravity and Frames of Reference

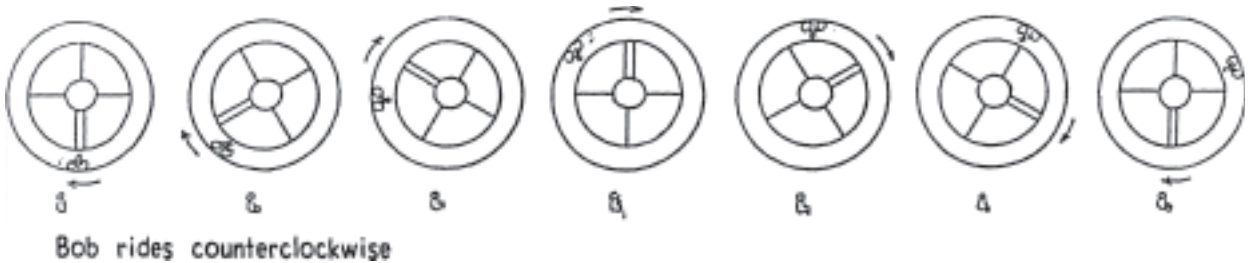
Susie Spacewalker and Bob Biker are in outer space. Bob experiences Earth-normal gravity in a rotating habitat, where centripetal force on his feet provides a normal support force that feels like weight. Suzie hovers outside in a weightless condition, motionless relative to the stars and the center of mass of the habitat.



1. Suzie sees Bob rotating clockwise in a circular path at a linear speed of 30 km/h. Suzie and Bob are facing each other, and from Bob's point of view, he is at rest and he sees Suzie moving
(clockwise) (counterclockwise).



2. The rotating habitat seems like home to Bob—until he rides his bicycle. When he rides in the opposite direction as the habitat rotates, Suzie sees him moving (faster) (slower).



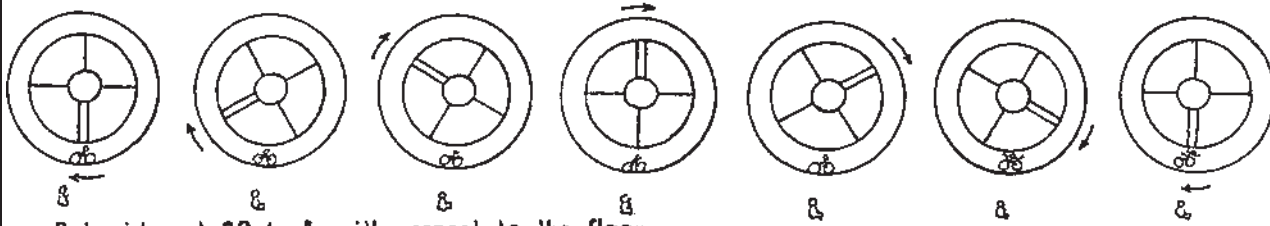
3. As Bob's bicycle speedometer reading increases, his rotational speed
(decreases) (remains unchanged) (increases) and the normal force that feels like weight
(decreases) (remains unchanged) (increases). So friction between the tires and the floor
(decreases) (remains unchanged) (increases).

4. When Bob nevertheless gets his speed up to 30 km/h, as read on his bicycle speedometer, Suzie sees him
(moving at 30 km/h) (motionless) (moving at 60 km/h).



thank to Bob Becker

CONCEPTUAL PHYSICS



Bob rides at 30 km/h with respect to the floor

5. Bounding off the floor a bit while riding at 30 km/h, and neglecting wind effects, Bob

- (hovers in midspace as the floor whizzes by him at 30 km/h)
- (falls as he would on Earth)
- (slams onto the floor with increased force).



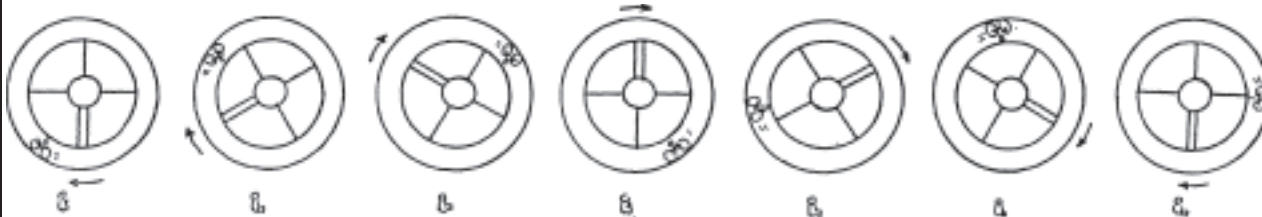
and he finds himself



- (in the same frame of reference as Suzie)
- (as if he rode at 30 km/h on Earth's surface)
- (pressed harder against the bicycle seat).

6. Bob maneuvers back to his initial condition, whirling at rest with the habitat, standing beside his bicycle. But not for long. Urged by Suzie, he rides in the opposite direction, clockwise with the rotation of the habitat.

Now Suzie sees him moving (faster) (slower).



Bob rides clockwise

- 7. As Bob gains speed, the normal support force that feels like weight
 - (decreases) (remains unchanged) (increases).
- 8. When Bob's speedometer reading gets up to 30 km/h, Suzie sees him
 - (moving at 30 km/h) (motionless) (moving at 60 km/h)

and Bob finds himself

- (weightless like Suzie)
- (just as if he rode at 30 km/h on Earth's surface)
- (pressed harder against the bicycle seat).

Next, Bob goes bowling. You decide whether the game depends on which direction the ball is rolled!

CONCEPTUAL PHYSICS