Understanding by Design*

The *Understanding by Design* template focuses on the three stages of backward design:

- **Identify desired results**
- **Determine acceptable evidence**
- **Plan learning experiences**

What overarching understandings are desired?

People living on the Moon for extended periods of time will need to stay physically fit. Differences in the acceleration due to gravity lead to required modifications for sports played on the Moon.

- Physics principles are identical on Earth and the Moon.
- The acceleration due to gravity is 1/6 that of Earth.
- The weight of an object changes on the Moon but its mass remains the same.
- Air resistance, which may be negligible on Earth, may be quite important on the Moon in an indoor stadium.
- Walking can be modeled and analyzed as a compound pendulum and by comparing experimental observations of the swing of a pendulum and a leg.

What will students understand as a result of this chapter?

- All sports have some common features.
- The acceleration due to gravity on the Moon is 1/6 that on Earth.
- An object's mass and inertia is identical on Earth and the Moon, but its weight is much less on the Moon.
- Projectiles will travel six times as far and be in the air six times as long on the Moon if they leave and return to the ground.
- A person can jump at least six times higher on the Moon.
- Conservation of momentum and conservation of energy are both valid on the Moon.
- The force of friction is 1/6 on the Moon due to the decrease in an object's weight.
- A walking stride will be different on the Moon in the same way that a pendulum's period will be different.
- Air resistance forces can be comparable to gravitational forces and generate terminal velocities.

What are the overarching "essential" questions?

- How do the laws of physics on Earth and the Moon compare?
- How is the Moon different from Earth?
- How would a sport have to be modified to be played on the Moon?
- How does the Moon's smaller acceleration due to gravity affect an object's weight on the Moon?
- How high can someone jump on the Moon?
- How can a pendulum be used as a model for a swinging leg?
- What is terminal velocity and how does it relate to air resistance?

What "essential" questions will focus this chapter?

- What is a sport?
- How can the acceleration due to gravity on the Moon be measured?
- Why is an object much easier to lift on the Moon but just as hard to push as it is on Earth?
- What determines the range of a projectile on Earth and the Moon?
- How can the conservation of energy be used to explain differences in jumping height on Earth and the Moon?
- How can equipment for golf and other sports be modified to limit the distance the ball travels?
- What factors determine the force of friction on Earth and the Moon?
- Why is walking on the Moon different from walking on Earth?
- How is terminal velocity achieved?

* Grant Wiggins and Jay McTighe, *Understanding by Design* (Merrill/Prentice Hall, 1998), 181.

CHAPTER 9