GLOSSARY

ACOUSTIC DOPPLER CURRENT PROFILER
A sonar that attempts to produce a record of water current velocities for a range of depths. They are made of ceramic materials, and contain transducers, an amplifier, a receiver, a mixer, an oscillator, a clock, a temperature sensor, a compass, a pitch and roll sensor, and computer components to save the information collected.

BIOMIMICRY
The copying or imitation of a natural phenomenon's or the environment's efficiency and survival mechanisms in manufacturing.

DOPPLER SHIFTS
The change in frequency of a wave for an observer moving relative to the source.

GULF STREAM CURRENT
The Gulf Stream is a strong, fast moving, western boundary warm ocean current originating in the Gulf of Mexico and flowing into the Atlantic Ocean. It makes up a portion of the North Atlantic Subtropical Gyre.

HYDROFOIL
A surface form creating a thrust against water in a direction perpendicular to the plane approximated by the surface.

KINETIC ENERGY
The energy possessed by a system or object as a result of its motion.

RUN-OF-THE-RIVER
Hydropower that involves placing small, mini, or micro hydro turbines into waterways without large dams.

STATOR
A portion of a machine that remains fixed with respect to rotating parts.

SUBTROPICAL GYRE
A large system of ocean currents. The center of a subtropical gyre is a high pressure zone. Circulation around the high pressure is clockwise in the northern hemisphere and counterclockwise in the southern hemisphere, due to the Coriolis effect.

WESTERN BOUNDARY CURRENT
Warm, deep, narrow, and fast flowing currents that form on the west side of ocean basins due to western intensification. They carry warm water from the tropics poleward. Examples include the Gulf Stream, the Agulhas Current and the Kuroshio.

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SYNOPSIS:

Water constantly moves through an immense global cycle, evaporating from lakes and oceans all over the world, condensing to form clouds, precipitating as rain and snow, which then flows back to the oceans. Hydroelectric power takes advantage of this water cycle to drive machinery or create electricity. Hydroelectric power uses moving water as energy. Because the water cycle is an endless and constantly recharging system, it is an excellent source of renewable energy. Traditional hydroelectric power takes the energy of moving water to turn hydraulic turbine blades. The blades then turn a generator shaft that produces mechanical energy. The generator converts this energy into electricity. Engineers have developed innovative technologies that take advantage of other sources of energy from water including ocean currents, tides and waves.

CURRICULUM UNITS:

- Ecology
- Engineering
- Environmental Science
- Physical Science
- Physics

CAREER OPPORTUNITIES:

- Electrician
- Engineer
- Physicist
- Plant Technician or Manager

PROGRAM OVERVIEW:

Hydroelectric power is a clean, non-polluting source of electricity. It is an essential contributor to the power grid in the United States. It has been used all over the world for centuries and is one of the most efficient methods of producing energy. Turbines are used in dams to convert the kinetic energy from the water moving in rivers and lakes to electricity. Propelled by gravity, the water travels through a penstock, which is a pipe that leads to the turbines. Water strikes the turbine blades, which are connected to a shaft that leads to generator. As the turbine blades turn, a series of magnets inside the generator rotate past copper coils, called the stator, producing alternating current by moving electrons. The Gulf Stream is a result of the wind patterns acting on most of the North Atlantic Ocean. It is a fast, intense current with peak velocities near 2.5 meters per second. Scientists and engineers are studying the potential energy of this fast moving current. They are developing and testing infrastructure and protocols for components and complete generating systems. They are also setting up environmental monitoring systems so that they can better understand the nature of the Gulf Stream before there is a full-scale installation of commercial sized generators.

ISSUES & CRITICAL THINKING:

1) Scientists and engineers have learned to efficiently use moving water to generate power in lakes and rivers using dams. Why are scientists now exploring other moving water options?

2) How will the newly designed ocean turbine systems differ from the technology currently used in dams?

3) Detail the environmentally negative aspects of hydroelectric power generation on the surrounding ecosystems. Do the newly designed ocean systems offer a less invasive option compared to dams?

4) Have students diagram and explain how a turbine generates electricity.