artsNOW
Integrated learning solutions

ART BOTS
Grade Band: 9-12
Content Focus: STEAM



LEARNING DESCRIPTION

In this hands-on STEAM lesson, students will explore the relationship between electricity, motion, and unbalanced forces by designing and building their own wobbling art bots. Using hobby motors, battery packs, pool noodles, and markers, students will follow the **engineering design process** (Ask, Imagine, Plan, Create, Improve) to construct a bot that moves and draws in unpredictable patterns.

Through experimentation, students will discover how unbalanced forces affect motion, how simple circuits power their bots, and how small design changes can alter movement. They will analyze their bots' performance, make modifications, and reflect on their design choices. By combining science, engineering, and art, this lesson fosters creativity, problem-solving, and critical thinking while reinforcing foundational physical science concepts.

LEARNING TARGETS

Essential Questions	"I Can" Statements
How do unbalanced forces affect the motion of an object? How does a motor convert electrical energy into motion?	I can build and test a simple circuit to power a motor. I can explain how unbalanced forces influence motion.

What design choices impact the movement and artistic output of an art bot? How can the engineering design process help improve a design?	I can describe how energy is transformed in my art bot. I can use the engineering design process to test and improve my design.

GEORGIA STANDARDS

Curriculum Standards	Arts Standards
Physics: SPS8: Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion. SPS10: Investigate and explain the properties of electricity and magnetism. **Physical Science:** SPS7: Develop models to illustrate the transformation and conservation of energy.	VAHSAE.1: Incorporate elements and principles of design into artworks for intentional effects. VAHSCR.1: Apply creative thinking skills to develop ideas for personal expression. VAHSPR.1: Create original artworks using a range of materials, techniques, and processes. VAHSPR.2: Demonstrate proficient and safe use of tools, materials, and technology. VAHSAR.1: Analyze personal and others' artworks to evaluate meaning, intent, and technique. VAHSAR.3: Critique artwork using formal, contextual, and intuitive approaches.

SOUTH CAROLINA STANDARDS

Curriculum Standards	Arts Standards
Physics: P-PS2-4. Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects. P-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. P-PS3-2. Develop and use models to illustrate that energy can be explained by the combination of motion and position of objects at the macroscopic scale and the motion and position of particles at the microscopic scale. P-PS3-3. Design, build, and refine a device that works within given constraints to convert	**Anchor Standard 1:** I can use the elements and principles of art to create artwork. **Anchor Standard 2:** I can use different materials, techniques, and processes to make art. **Anchor Standard 7:** I can relate visual arts ideas to other arts disciplines, content areas, and careers.

one form of energy into another form of energy. P-PS3-5. Develop and use a model to illustrate the forces between two objects and the changes in energy of the objects due to their interaction through electric or magnetic fields.	

KEY VOCABULARY

Content Vocabulary	Arts Vocabulary
• Electric circuit – A closed loop through which electricity can flow. It includes a power source (like a battery), wires, and something that uses the electricity (like a motor or light) • Current – The flow of electric charge through a circuit, like water moving through a pipe • Voltage – The pressure that pushes the current through the circuit, like water pressure • Unbalanced forces – When the forces acting on an object are not equal, causing the object to start moving, speed up, slow down, or change direction • Rotational motion – Movement around a central point or axis, like a spinning top or a wheel • Center of mass – The point at which an object's mass is evenly distributed in all directions • Friction – The resistance between two surfaces that slows things down • Energy transformation – The process of changing energy from one form to another—for example, chemical energy in a battery turns into electrical energy, which becomes mechanical energy in the spinning motor • Vibration motor – A small motor with an unbalanced weight attached to its	• Conceptual art – Art in which the idea behind the work is more important than the finished product • Intentionality – The purposeful use of elements and design to express meaning • Process art – Artwork that emphasizes the act of making over the final product • Rhythm – The principle of design in an artwork that indicates a type of movement, often characterized by repeated shapes, lines or colors • Gestural mark-making – Marks that reflect movement or emotion, often expressive • Experimental media – Unconventional materials or techniques used in creative exploration • Collaboration – Co-creating with others or with tools (like art bots) in the creative process • Movement – This principle of design is associated with rhythm and refers to the arrangement of parts in an artwork that creates a sense of motion to the viewer's eye through the work. • Balance – This is a sense of stability in the body of work. Balance can be created by repeating the same shapes and by creating a feeling of equal visual weight. • Form – An object that is three-dimensional and encloses volume

shaft; as the shaft spins, it vibrates and shakes, which powers the art bot's movement	(cubes, spheres, and cylinders are examples of various forms) ● Kinetic art – Art that incorporates real motion ● Engineering Design Process – A problem-solving approach that involves identifying a need, researching, brainstorming possible solutions, developing and testing prototypes, and improving the design until the optimal solution is achieved; the steps are Ask, Imagine, Plan, Create, Improve

MATERIALS

- Hobby motors
- Battery packs (with AA batteries)
- Pool noodles (cut into sections)
- Thin markers
- Electrical tape or masking tape
- Hot glue
- Off-center weights (washers, clay, coins)
- Switches (optional for advanced circuits)
- Scissors
- Image of the Engineering Design Process

INSTRUCTIONAL DESIGN

Opening/Activating Strategy

- **Engage:**
  - Show a short video of various art bots and kinetic sculptures.
  - Facilitate a class discussion around the following question: "What do you think makes them move the way they do?".
  - Connect motion and circuits to previously learned physics principles.

Work Session

- Introduce the Engineering Design Process and explain that students will follow these steps to create their own art bots.

Explore – Building the Art Bots

- Have students use their sketchbooks or STEAM journals to record their process.
- **Ask:**
  - Where will you place the mass to make it wobble?
  - How do you ensure your bot stays powered and balanced?
- **Imagine:**
  - Students will brainstorm ideas and sketch potential designs for their bots.
- **Plan:**
  - Show students a list of materials that they have available to them to build their bots.

    - Students will create a sketch of their bot with materials labeled before beginning to build their bots.
- **Create:**
    - Provide time for students to create their bots.
    - If needed, show students one method to create their bots. Allow time for students to revise their designs as needed.
        - Connect the battery pack to the motor, ensuring a working circuit.
        - Insert the motor into the pool noodle.
        - Attach markers as "legs" using tape.
        - Add weights off-center on the motor shaft to create an unbalanced force.
- **Improve and Extend:**
    - Students will test and record how their bots move by placing the bot on plain white paper and turning it on to observe its movement.
    - Students should reflect on the following:
        - Do they rotate, scoot forward, draw erratically?
        - What happens when the mass is adjusted?
        - How does surface friction affect performance?
- **Introduce design constraints and goals:**
    - Ask students, “Can you get your bot to move in a figure-eight?”.
    - Have students find a partner and ask students, “Can your bot cover more surface area in one minute than your partner’s?”.

Engineering and Technology Pathways (optional extension): Design process, simple circuits, prototyping, and testing

Closing/Reflection

- Students will work with their partners to co-create an artwork with both of their bots.
- Each pair should give their piece a creative title and write a short “artist’s statement” that explains:
    - Their bot’s design
    - Its motion pattern
    - How they collaborated to create their artwork
    - What they learned about forces and energy
- Gallery walk: Display art and artist statements; allow an opportunity for students to provide peer feedback.

ASSESSMENTS

Formative

- Assess students’ learning through observations of building and testing, student questions and responses during discussions, and design STEAM journal/sketchbook entries with sketches, reflections, and improvements.

Summative

- **Design Report** (written or digital):
    - Sketches, circuit diagram, energy flow description
    - Data on motion (optional)
    - Explanation of what worked and what didn’t

- **Artist Statement** that includes a creative title and explanation of motion concepts and energy transformations

DIFFERENTIATION

Accelerated:

- Students can choose how to present their final work:
  - A short video montage showing the bot's drawing in action.
  - A sketchbook spread combining bot photos, drawn output, and written reflection.
  - A conceptual artist statement exploring the bot as collaborator or tool.
- **AP Physics or Engineering classes:** Add formal motion data collection (speed, revolutions, force diagrams).
- **Technology Integration:** Challenge students to control bots with microcontrollers (Arduino, micro:bit).

Remedial:

- Provide pre-made circuits.
- Provide extended time for building and reflecting.
- Offer verbal instructions paired with written guides.
- Allow for alternative methods of documentation (photos, audio).

ADDITIONAL RESOURCES

This integrated lesson provides differentiated ideas and activities for educators that are aligned to a sampling of standards. Standards referenced at the time of publishing may differ based on each state's adoption of new standards.

Ideas contributed by: Shannon Green

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