Teacher Preparation Lesson Plan

Subject Area: STEM/Engineering
Unit Title: Reverse Engineering and 3D Printing Discovery
Grade Level: 8th Grade (14-year-olds)
Lesson Number: 1 of 10

Duration: 90 minutes
Date: Ongoing
Teacher: STEM Instructor
Room: Engineering Lab

Curriculum Standards Alignment

Content Standards:

- MS-ETS1-1: Define the criteria and constraints of a design problem
- MS-ETS1-2: Evaluate competing design solutions
- MS-ETS1-3: Analyze data from tests to determine similarities and differences among solutions
- MS-ETS1-4: Develop a model to generate data for iterative testing and modification

Skills Standards:

- Technical Drawing and Measurement
- 3D Modeling and Digital Design
- Engineering Process and Documentation
- Safety and Tool Usage

Cross-Curricular Links:

- Mathematics: Measurement, Scale, and Proportion
- Physics: Forces and Motion
- Technology: Digital Design and Manufacturing
- Art: Technical Drawing and Visual Communication

Essential Questions & Big Ideas

Essential Questions:

- How can we understand complex systems by breaking them down into smaller components?
- How does reverse engineering help us learn about design and innovation?
- What role does 3D printing play in modern engineering and manufacturing?
- How can we use digital tools to recreate physical objects?

Enduring Understandings:

- Engineering involves systematic problem-solving and documentation
- Complex systems can be understood through careful analysis and observation
- Digital design and manufacturing are transforming how we create objects
- Safety and precision are crucial in engineering work

Pre-Lesson Preparation

Room Setup:

- Arrange workstations in groups of 4 students
- Set up demonstration area with projector and document camera
- Prepare tool stations with required equipment
- Set up safety equipment station
- Configure 3D printer for demonstration

Technology Needs:

- Computer workstations with Tinkercad software installed
- 3D printer with PLA filament loaded
- Digital calipers and measurement tools
- Document camera for demonstrations
- Digital storage for student work

Materials Preparation:

- Safety goggles (one per student)
- Basic tool sets for each group
- Sample mechanical objects for reverse engineering
- Technical drawing templates
- Documentation worksheets
- Digital and physical measurement tools

Safety Considerations:

- Review tool safety protocols
- Post safety rules and emergency procedures
- Check all power tools and equipment
- Prepare first aid kit and safety stations
- Review 3D printer safety guidelines

Detailed Lesson Flow

Pre-Class Setup (15 mins before)

- Power up all computer workstations
- Load demonstration files
- Distribute tool sets to workstations
- Start 3D printer warm-up sequence
- Display safety rules and procedures

Bell Work / Entry Task (7 mins)

- Students sketch a familiar mechanical object
- List questions about how it works
- Begin thinking about internal components

Opening/Hook (10 mins)

- Demonstrate 3D printer in action
- Show example of reverse engineered object
- Lead discussion on engineering process
- Connect to real-world applications

Engagement Strategies:

- Use think-pair-share for initial observations
- Incorporate visual aids and physical examples
- Connect to students' daily experiences
- Use guided questioning techniques

Direct Instruction (25 mins)

- Introduction to reverse engineering concepts
- Safety protocols and tool usage demonstration
- Technical drawing basics overview
- 3D modeling software introduction
- Documentation requirements explanation

Checking for Understanding:

- Quick tool identification quiz
- Safety procedure role-play
- Technical drawing practice exercise
- Software interface navigation check

Guided Practice (30 mins)

- Group formation and role assignments
- Simple object disassembly demonstration
- Measurement and documentation practice
- Basic 3D modeling exercise

Scaffolding Strategies:

- Step-by-step demonstration
- Guided worksheets
- Peer support structures
- Visual reference guides

Independent Practice (10 mins)

- Individual technical drawing practice
- Software interface exploration
- Documentation template completion
- Tool identification practice

> **Differentiation Strategies:**
>
> - Provide modified templates for different skill levels
> - Offer choice in practice objects
> - Allow digital or hand-drawn documentation
> - Provide multilingual support materials

Closure (8 mins)

- Review key concepts and vocabulary
- Preview next lesson's activities
- Collect exit tickets
- Clean-up procedures

Assessment Strategies

Formative Assessment:

- Observation of tool handling and safety procedures
- Quality of technical drawings and measurements
- Group participation and collaboration
- Understanding of software interface navigation

Exit Ticket Questions:

- What are three key safety rules for today's lesson?
- How does reverse engineering help us understand objects?
- What was the most challenging part of today's lesson?
- What questions do you still have about 3D printing?

Success Criteria:

- Correct use of measurement tools
- Accurate technical drawings with proper labels
- Safe handling of equipment
- Complete documentation of process

Differentiation and Support Strategies

Learning Styles Accommodation:

- Visual: Technical drawings, demonstrations, diagrams
- Auditory: Verbal instructions, group discussions
- Kinesthetic: Hands-on tool usage, object manipulation
- Reading/Writing: Documentation templates, technical guides

Support for Struggling Students:

- Pre-labeled technical drawing templates
- Step-by-step instruction cards
- Peer mentoring partnerships
- Modified measurement tools
- Additional guided practice time

Extensions for Advanced Students:

- Complex object analysis
- Advanced 3D modeling features
- Independent design modifications
- Leadership roles in group work
- Additional documentation challenges

Homework and Follow-up

Homework Assignment:

- Find and photograph an interesting mechanical object at home
- Complete initial observation worksheet
- Review safety procedures document
- Practice basic sketching techniques

Parent/Guardian Communication:

- Share unit overview and objectives
- Request permission for tool usage
- Provide safety guidelines
- Share online resources for support

Next Lesson Preview:

- Detailed object analysis
- Advanced measurement techniques
- Beginning 3D modeling
- Documentation refinement