

# BIRDEE Unit 1 Lesson Plans

## Unit 1 Modules & Themes

[tinyurl.com/birdeeunit1LP](http://tinyurl.com/birdeeunit1LP)

Module 1 Launcher: Connecting Nature to the Engineering Design Process				
Connect Nature to Engineering	Empathy & Customer Discovery	Reverse Engineering & Requirements	Define Problem Requirements	Ideate a Solution for Conceptual Design 1

Module 2 Launcher: The Lotus Effect				
Benchtop Prototyping	Testing the Lotus Effect	Conceptual Design 2	Design Review	Introduce EDPL

Module 3 Design Challenge: Identify & Understand				
Design Challenge Intro: BID & EDP	Understanding the Problem and EDPL	Understanding Existing Engineering Systems with SFM	Product Analysis and Reverse Engineering	Existing Products and Ideate

Module 4 Design Challenge: Heat Transfer & Thermal Regulation				
Understanding Thermoregulation Systems in Nature with SFM	Conceptual Design 1	Thermal Regulation Experiment Part 1: Intro & Setup	Thermal Regulation Experiment Part 2: Analyze Data	Thermal Regulation Part 3: Additional Data/BID Analogy

Module 5 Design Challenge: Ideation & Evaluation				
Design Challenge Part II	Conceptual Design 2	Ideate: Learn about the Morpho Matrix	Conceptual Design 3: Morpho Matrix	Evaluate to Prototype 1

Module 6 Design Challenge: Prototype & Test				
Prototype 1: Build	Prototype 1: Requirements Evaluation	Elaborate to Prototype 2	Prototype 2: Build	Finalize Design

Module 7 Design Challenge: Communicate Solution				

# BIRDEE Unit 1 Lesson Plans

<b>Create a Pitch Presentation</b>	<b>Class Presentations</b>			
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# BIRDEE Unit 1 Lesson Plans

<b>Unit 1 Module 3: Design Challenge Identify and Understand</b>	<b>Materials</b>
<b><u>Module 3 Overview:</u></b> 1.3.1. Design Challenge Intro: BID & EDP 1.3.2. Understanding the Problem and EDPL 1.3.3. Understanding Existing Engineering Systems with SFM 1.3.4. Product Analysis & Reverse Engineering 1.3.5. Existing Products and Ideate	<a href="#">1.3.0. EDPL Map</a>

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## 1.3.1. Design Challenge Intro: BID & EDP

*Students will review the EDP and BID processes in terms of the “dirty shoes” challenge. They will then be introduced to the new design challenge by a client memo. They will work in their groups to define the client’s problem from the client memo using the handout to guide their documentation. Students will begin to look at additional data from their client—interviews, survey responses, etc.—if time permits.*

**Teacher Notes:** Teachers will need to determine how they want to group their students (teacher choice, student choice, or random) to create project groups. They will remain in these groups for the next 4 ½ yrs. Students will be responsible for entering data in the EDPL as a group. Any hard copies of Individual and group work should be saved, with group work kept in a designated folder in the classroom.

### Engage: 5 min

#### **View:** [1.3.1. BID WOW!](#)

- How was velcro invented?
- **Class Discussion** on what students think
- **Play video:** [Velcro](#) (in ppt)

### Engage: 10 min

#### **Review the EDP and BID and Introduce the Design Challenge**

##### **View:** [1.3.1. BID, EDP, and a New Design Challenge](#)

- Remember BID fits into the EDP at the Ideation stage! When BID is used in the ideation stage of the EDP, it is called BIDI. Understanding how BID fits into the EDP will help us with our new design challenge from our client, the non-profit organization EatEZ. Today we will work to identify and understand our client’s problem. These are the first two stages of the EDP.

### Explore: 20 min (*Individual and Group*)

#### **Identify the Problem**

We will identify and define our client’s problem by first reading the [1.3.1. Client Memo](#).

- You will individually read the [1.3.1 Client Memo](#) reflecting on the problem and request of your client. You will highlight/take notes to begin *Identifying* and *Defining* the problem using Part 1 of the [1.3.1. Identify and Define the Client’s Problem Handout](#)
- Then, you will discuss the client memo with your group and complete Part 1 of the [1.3.1. Identify and Define the Client’s Problem Handout](#)
  - Who is the client?
  - What are the client’s needs?

### Student Handouts:

[1.3.1. Identify and Define the Client’s Problem Handout](#)

### Student Materials:

[1.3.1. Client Memo](#)

[1.3.1 Volunteer Opinions](#)

[1.3.1 Number 1 Complaint of Volunteers](#)

[1.3.1 Customer Satisfaction](#)

[1.3.1 Company Customer Satisfaction Data](#)

[1.3.1 Angry Customer Letter](#)

### Instructional PPT's & Materials:

[1.3.1. BID WOW!](#)

[1.3.1. BID, EDP, and a New Design Challenge](#)

### Teacher Resources:

N/A

### Web Resources:

[EatEZ Logo](#)

[EDP Flowchart Detailed](#)  
[BIDI Graphic](#)  
[EDP Simple](#)  
[EDP plus BIDI Simple](#)

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**Evaluate/Explain: 10 min** (Class Discussion)

**Teacher Note:**

**Class Discussion:** The teacher will facilitate a class conversation on problem definition, reviewing the responses to the questions asked in Part 1 of the 1.3.1. Identifying the Client's Problem organizer.

- Teachers may capture students' answers on big notes or on a slide that students can later reference.

Today we learned about the problem given by the client. We engaged in the problem definition stage of design. Throughout this unit, we are going to learn more about the problem and existing solutions which will help us better design the problem solution.

**Extend: 10 min** (Group)

**EDPL:** Begin filling out Identify and Understand in the EDPL. You will be working on the same sections of the EDPL tomorrow, so if you don't finish inputting all the information that is ok.

Log into your account and do the following:

- Create a Project Title (add group names)
- Identify the Problem by writing a problem statement
- Understand the problem by adding requirements (pulled from worksheet)

**Extend: 5 min** (Individual)

If you have extra time, you can get started on 1.3.2. Understanding the Problem and EDPL by looking at the 5 documents:

- [1.3.1 Volunteer Opinions](#)
- [1.3.1 Number 1 Complaint of Volunteers](#)
- [1.3.1 Customer Satisfaction](#)
- [1.3.1 Company Customer Satisfaction Data](#)
- [1.3.1 Angry Customer Letter](#)

and thinking about how these documents affect your understanding of the problem (Part 2 of the worksheet).

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## 1.3.2. Understanding the Problem and EDPL

**Students will look at additional data from their client–customer satisfaction data, volunteer data, etc.–and will add and adjust their problem requirements using Part 2 of the [1.3.1. Identify and Define the Client’s Problem Handout](#) that features the 4-box tool for problem specification. Students will start their EDPL for this design challenge.**

**Teacher Notes:** Some of the client and customer notes are contradictory or give specific materials the new solutions should be made out of. Be sure to emphasize that students don’t have to listen to everything that is said in all the customer quotes and notes. They should be sure to consider their comments since they are the customers and have used the food boxes for a long time, but that the students don’t have to listen to everything said in the additional materials.

### Engage: 5 min

#### **View:** [1.3.2. BID Ideation](#)

- You are trying to design and make a device for observing wildlife on the savannah. Make sure your wildlife doesn’t think your device is a toy!
- Name an animal you would like to observe. Where would it be best to place a device to observe that animal on the savannah?
- **Class Discussion** on what students brainstormed

### Explain: 5 min

Surveys and interviews are important and valuable sources of customer information that help us understand our problem and write problem requirements. We are going to look at some customer survey data and customer feedback provided by EatEZ in order to make sure we understand the problem and the design challenge.

### Explore: 25 min (*Individual and Group*)

#### **Part 2 of 1.3.1. Worksheet**

Review the additional information and materials from our client, EatEZ. This information includes survey data, an angry client letter, and feedback from clients and customers.

- [1.3.1 Volunteer Opinions](#)
- [1.3.1 Number 1 Complaint of Volunteers](#)
- [1.3.1 Customer Satisfaction](#)
- [1.3.1 Company Customer Satisfaction Data](#)
- [1.3.1 Angry Customer Letter](#)

With your group, analyze each of the five additional documents and write down any notes on Part 2 of the [1.3.1. Identify and Define the Client’s Problem Handout](#). Integrate what you learned from the client memo and

### Student Handouts:

N/A (use already printed 1.3.1 worksheet Part 2)

### Student Materials:

#### [1.3.1 Volunteer Opinions](#)

#### [1.3.1 Number 1 Complaint of Volunteers](#)

#### [1.3.1 Customer Satisfaction](#)

#### [1.3.1 Company Customer Satisfaction Data](#)

#### [1.3.1 Angry Customer Letter](#)

### Instructional PPT's & Materials:

#### [1.3.2. BID Ideation](#)

### Teacher Resources:

N/A

### Web Resources:

N/A

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what you learned from the additional documents into the four-box organizer.

**Evaluate: 10 min** (*Class Discussion*)

## **Class Discussion**

**Teacher Note:** *Facilitate a discussion on the additional client materials.*

- What did the students learn from the additional documents?
- How does this change their understanding of the problem?
- What is the most important information to take from the document and add to problem requirements?
- Why is it important to gather lots of information when defining and understanding a problem?

**Extend: 10 min** (*Group*)

**EDPL:** You will complete Identify and Understand in the EDPL based on what you learned from the client memo and the additional materials provided by the client.

# BIRDEE Unit 1 Lesson Plans

## 1.3.3. Understanding Existing Engineering Systems with SFM

*Students will understand what a system is and how to analyze a system using SFM. Students will understand that SFM is a tool. Students will understand how SFM is used in engineering and why it is helpful when analyzing systems. Students will use SFM to analyze thermal regulation systems.*

**Teacher Note:** If available, provide each table/group with a screw and a nail for this lesson.

**Engage/Hook: 5 min** (Class Discussion)

**View:** [Is a Screw a System?](#)

Teachers will provide a screw and a nail to each student. Look at both of the objects.

- Is a screw a system? (allow students to discuss...most students will say no, but the answer is yes) Click the slide to view the explanation - A set of things working together as parts/components of a mechanism or an interconnecting network
- Most students will see the screw as one thing - it is actually 5 different parts that work together. This will be explained in the mini lesson below.

**Explain: 20 min** (Guided Presentation)

Mini Lesson

**View:** [1.3.3. SFM: Understanding a System](#)

Today we will be learning more about the Structure, Function, and Mechanism (SFM) of systems and how SFM helps us to understand engineering systems using a screw as the example. (**Teacher Note:** [NGSS crosscutting concept](#))

- **Screw vs Nail Analysis: 3 min**
  - You will use [1.3.3 SFM Analysis of a Nail](#) to independently practice SFM analysis on a nail. (Slide 10)
  - **Class Discussion:** Teacher will discuss answers with students. (Slide 11)
  - **Class Discussion:** Complete Holding Objects Together as a group.

**Explore: 20 min** (Individual and with Elbow Partner)

**SFM Thermal Regulation Systems**

**View:** [1.3.3. Using SFM to Understand Thermal Regulation Systems](#)

SFM can help us understand our client's problem by analyzing different thermal regulation systems. Thermal regulation means maintaining a given temperature of an object for a period of time when the surrounding temperature is different. Analyzing existing thermal regulation systems

**Student Handouts:**

[1.3.3 SFM Analysis of a Nail](#)

[1.3.3 SFM Analysis of Thermal Regulation Systems](#)

**Student Materials:**

[1.3.3. Using SFM to Understand Thermal Regulation Systems](#)

**Instructional PPT's & Materials:**

[Is a Screw a System?](#)

[1.3.3. SFM: Understanding a System](#)

[1.3.3. Using SFM to Understand Thermal Regulation Systems](#)

(Extend) [1.3.3. SFM Extension: Fixed Pulley](#)

(Extend) [1.3.3. SFM Extension: Water Faucet](#)

**Teacher Resources:**

N/A

**Web Resources:**

N/A



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may help us come up with ideas on how to help our client keep their meals at the correct and stable temperature.

- You will use the [1.3.3 SFM Analysis of Thermal Regulation Systems](#) handout:
  - Choose 2 examples of thermal regulation systems from the Thermal Regulation Systems slides.
  - For each example, fill out the organizer with the structure, function, and mechanism.
  - After completing your own SFM analysis of two thermal regulation systems, discuss with your elbow partner and add to your SFM notes.

**Extend: (optional)**

[1.3.3. SFM Extension: Fixed Pulley](#)

[1.3.3. SFM Extension: Water Faucet](#)

# BIRDEE Unit 1 Lesson Plans

## 1.3.4. Product Analysis & Requirements

*Students will review existing products that could inform a response to the client's problem. Students evaluate the solution to capture the benefits and efficiencies of each of the products, and then share in their groups.*

### Engage: 5 min

#### **View:** [1.3.4. BID Ideation](#)

- You are trying to design and make better soles for shoes because people who stand all day at work complain of sore feet. What could you look to in nature for inspiration?
- List three functions of soles of shoes. Then, think about different structures that can accomplish these functions.
- **Class Discussion** on what students brainstormed

### Explain: 5 min (Class Discussion)

#### **Class Discussion**

**Teacher Note:** The teacher will engage students in a quick discussion/review through questioning. The teacher will ask the question and have students discuss (answers are below the question).

- What is insulation?
  - A material or an object that does not easily allow heat, electricity, light, or sound to pass through it. Air, cloth and rubber are good electrical insulators; feathers and wool make good thermal insulators.
- How does insulation act as a thermal regulation system?
  - Thermal insulation is one type of thermal regulation system.
- What are some examples of insulation?
  - Skin (barrier), Air Gap (fur), solid insulation (blubber), reflective surface (coloration)
- What existing products provide support insulation?

Today we will analyze existing products that are utilized for insulation of food. An important part of understanding the problem is looking at existing products to understand how they work and identify their successes and shortcomings.

### Explore: 20 min (Group)

#### **Part I: Existing Solution Analysis**

You will evaluate one Existing Product presented in 1.3.4. [Existing Products PPT](#) that has been randomly assigned by the teacher. You will complete Part 1 of the [1.3.4. Existing Solution Analysis](#) organizer to scaffold your analysis. You will identify:

- Overall Solution - what does it do?
- Component Structure, Material, Function
- Solution Analysis - Strength & Weaknesses

#### Student Handouts:

[1.3.4. Existing Solution Analysis](#)

#### Student Materials:

[1.3.4. Existing Product PPT](#)

#### Instructional PPT's & Materials:

[1.3.4. BID Ideation](#)

#### Teacher Resources:

N/A

#### Web Resources:

[Use this to show the photos of the existing solutions](#)

**Not for instructional use Individual Product Photos and Product Cards (taken from 1.3.4. Existing Solutions PPT):**

[Existing Solution 1: Insulated Cooler Bag](#)

[Existing Solution 2: Roll Top Lunch Bag](#)

[Existing Solution 3: Stanley Steel Lunch Box](#)

Existing Solution 4: No pics

Existing Solution 5: No Pics

[ES 1 Cooler Lunch Bag Product Card](#)

[ES 2 Roll Top Lunch Bag](#)

[ES 3 Stanley Steel Lunch Box](#)

[ES 4 Small Insulated Lunch Box Product Card](#)

[ES 5 Reusable Insulated Lunch Box Pro](#)

# BIRDEE Unit 1 Lesson Plans

- Understand how this solution can be applied to the client's problem

You will be giving a brief 1-2 minute presentation on your lunchbox and what you learned about it next. As you are doing the activity, think about the most important information you want to tell your classmates about the lunchbox you analyzed.

**Explain/Evaluate: 10 min** (*Group Student Presentation*)

### **Mini presentation**

You will give a brief presentation to the class on the existing solution you analyzed. Your presentation should be 1-2 min long and should focus on the defining characteristic of your lunchbox, the main strengths and weaknesses of the existing solution, what they learned from the existing solution, and how this knowledge impacts your understanding of the problem.

***Teacher Note:*** *The purpose of these short presentations is so that all students in the class are briefly introduced to each lunchbox.*

**Extend: 10 min** (*Group*)

**EDPL:** Update Research Notes & Understand (Requirements) as needed in the EDPL based on what you learned in this activity.

[Master File of LunchBox Existing Solutions 1-5 Videos and Worksheet](#)