FUTURA
MECHANICAL ENGINEERING

Force and Motion Engineering Internship:

Pods for Emergency Supplies

Engineering Notebook

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Developed by the Learning Design Group at the University of California, Berkeley's Lawrence Hall of Science.

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Name: _____ Date: _____

Force and Motion Engineering Internship: Pods for Emergency Supplies
Unit Overview

How can you get critical supplies to people in need after a natural disaster? If you drop a pod of supplies, what pod materials and features will make a safe and successful delivery of food and medical supplies?

That's what you will figure out as you and your classmates take on the role of mechanical engineering interns with Futura Engineering, a company that specializes in designing solutions for the world's problems. As an intern, you will work to apply your knowledge of forces and motion to help design a pod that will deliver emergency aid packages to people in remote areas where disasters such as earthquakes, landslides, or floods have made it dangerous or impossible to deliver aid by trucks. You will design and test your pod using a digital tool called SupplyDrop, and consider different design aspects: the pod's shell material, the type and amount of internal padding, and whether you will add additional external features like a parachute or landing legs to your pod. Your supply pod design must protect the cargo by minimizing damage to supplies, offer possibilities for reusing the pod's shell for shelter, and be as low-cost as possible.

Name: _____ Date: _____

Safety Guidelines

Workplace safety is always a concern, especially in the labs here at Futura. Please review and follow these safety guidelines. If you have any questions, ask your internship coordinator for assistance.

1. **Follow instructions and listen carefully.** If you don't know what to do, ask your internship coordinator.
2. **Don't taste things**. No tasting anything or putting it near your mouth unless your internship coordinator says it is safe.
3. **Smell substances like a chemist.** When you smell a substance, don't put your nose near it. Instead, gently move the air from above the substance to your nose. This is how chemists smell substances.
4. **Protect your eyes.** Wear safety goggles if something wet could splash into your eyes, if powder or dust might get in your eyes, or if something sharp could fly into your eyes.
5. **Protect your hands.** Wear gloves if you are working with materials or chemicals that could irritate your skin.
6. **Keep your hands away from your face.** Do not touch your face, mouth, ears, eyes, or nose while working with chemicals, plants, or animals.
7. **Tell your internship coordinator if you have allergies.** We want you to be safe and comfortable at work.
8. **Be calm and careful.** Move carefully and slowly around the office and labs.
9. **Report all spills, accidents, and injuries to your internship coordinator.**
10. **Avoid anything that could cause a burn.** Ask your internship coordinator for help with hot water or hot equipment.
11. **Wash your hands with soap and water at the end of the workday, especially if you've handled plants, animals, or chemicals.**

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Safety Agreement

By writing my name below, I agree to follow the rules outlined in the Safety Guidelines while working at Futura.

_____

Name: _____ Date: _____

Day 1: Welcome to Futura!

Hello interns,

Welcome to Futura's Mechanical Engineering Division! I'm Nisha Kar, your new project director.

We will work on a project for International Disaster Aid. They want to use helicopters to drop packages of water, food, and first-aid supplies in hard-to-reach places hit by natural disasters. You will use what you know about force and motion to design a supply pod that addresses three criteria. We want to:

1. minimize cargo damage;
2. maximize shell condition; and
3. keep costs low.

Today you'll learn more about collisions and impact forces by exploring the SupplyDrop Design Tool and reading the Futura Mechanical Engineer's Dossier. Note: Dossier (DAW-see-ay) is a term professional engineers sometimes use for a set of related documents. It includes a glossary to support you if you need help with unfamiliar words.

Deliverables

- Annotations for Chapter 2: "Collisions and Impact Forces"
- After-Hours: Annotations for Chapter 1: "Request for Proposals"

I'm excited to be working with you,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Name: _____ Date: _____

After-Hours Work

Return to Message 1 on page 3 from Nisha Kar and be sure you've completed all internship tasks for the day.

1. Read and annotate Chapter 1 in the Dossier: "Request for Proposals" (RFP).
2. Your internship coordinator may have asked you to complete additional tasks.
    - If you are required to read the Safety Guidelines and read and complete the Safety Agreement form, find those on page 2 of your Engineering Notebook.
    - Double-check the Daily Message to see if there are other deliverables that need to be completed after hours.

Name: _____ Date: _____

Day 2: Designing an Egg Drop Model

Hi interns,

Welcome back! I hope you found what you read in the Dossier useful, because today you will continue research on how to protect falling objects. Mechanical engineers often start by reading, and then they make physical models to test out ideas. This is what you will do today.

You'll be experimenting with how to best protect something small and fragile. Make careful decisions about the design based on what you learned from the readings in the Dossier. I expect you to take detailed notes on your design and test results—what you learn today will help make sure you design a top-notch supply pod for International Disaster Aid.

Deliverables

- Part 1: Egg Drop Design sheet
- After Hours: Reread and revise annotations in Chapter 2: "Collisions and Impact Forces"

Stay focused,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

Egg Drop Design

1. **Plan:** Choose the materials for your Egg Drop Model. Sketch and label your initial design in the space below.
2. **Build:** Make your design.
   - Before you test, record the mass of your Egg Drop Model in the Plan and Build section below. Be sure your egg is inside!
3. **Test:** Bring your Egg Drop Model to the test site. After you test, record the results.
4. **Analyze:** Reflect on your design in the Design Analysis (on page 7).

PART 1: DESIGNING AN EGG DROP MODEL

Plan and Build: Draw your design. Record your Egg Drop Model's mass.

Mass of the Egg Drop Model (grams): _____

Describe your design:

_____

_____

Test Results: Record your results in the space below. Sketch or describe what happened to the pod and to the egg when it collided with the ground.

Name: _____ Date: _____

Egg Drop Design (continued)

PART 2: ANALYZE YOUR EGG DROP MODEL

Design Successes: Which parts of your design worked? Why do you think they worked?

_____

_____

_____

Design Failures: Which parts of your design did not work? Why do you think they did not work?

_____

_____

_____

PLAN YOUR NEXT ITERATIVE TEST

Draw and describe your revised design.

What would you change?

_____

_____

_____

Why would you make these changes? Describe the science concepts that support your decisions.

_____

_____

_____

Name: _____ Date: _____

After-Hours Work

Return to Message 2 on page 5 from Nisha Kar and be sure you've completed all internship tasks for the day.

- Reread Chapter 2: "Collision and Impact Forces" in the Dossier.
- Add to or revise your annotations using this focus question:
  How can this information on collisions and impact forces help you revise your egg drop designs?
- Your internship coordinator may have asked you to complete additional tasks. Double-check the Daily Message and Daily Message Notes to see if there are other deliverables that need to be completed after hours.

Name: _____ Date: _____

Day 3: Revising Your Pods

Hi interns,

In this workday, you will be wrapping up the Research phase of your internship. You will read and annotate Chapter 3: "Velocity, Mass, and Impact Forces" in the Dossier to learn more about how impact forces can affect your design. You'll also have some time to plan how you would revise your Egg Drop Model design. After hours, you should reread and revise your annotations for Chapter 3 as you think about how this information on velocity, mass, and impact forces can help with your designs.

Take time to reflect on what you have learned in your work so far. Is there a way you can reduce the force of impact that you hadn't thought of before? This is important preparation before you begin working on your supply pod designs for International Disaster Aid!

Deliverables

- Read and annotate Chapter 3: "Velocity, Mass, and Impact Forces"
- Completed Egg Drop Design sheet
- After Hours: Reread and revise annotations in Chapter 3: "Velocity, Mass, and Impact Forces"

Regards,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

After-Hours Work

Return to Message 3 on page 9 from Nisha Kar and be sure you've completed all internship tasks for the day.

- Reread Chapter 3: "Velocity, Mass, and Impact Forces" in the Dossier.
- Add to or revise your annotations using this focus question:
  How can this information on velocity, mass, and impact forces help you plan your supply pod designs?
- Your internship coordinator may have asked you to complete additional tasks. Double-check the Daily Message and Daily Message Notes to see if there are other deliverables that need to be completed after hours.

Name: _____ Date: _____

Day 4: Entering the Design Phase

Hi interns,

Welcome to the Design phase! You will now use what you have learned about impact forces to design a supply pod using our design tool, SupplyDrop. You should already be familiar with this tool from your first day of work. Testing digitally will save time, materials, and money until Futura decides which designs to develop. We'll also save a whole lot of eggs!

For each of your iterative tests, you'll want to record your choices and how well they work. To help you organize this information, you'll have a SupplyDrop Data sheet which you will record your information on. At the end of the workday, be sure to decide which of your designs was the best. We'll be using it again.

Deliverables

- 3–6 iterations recorded on SupplyDrop Data sheet, with best design indicated
- After Hours: Project Summary

Happy testing,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

After-Hours Work

Return to Message 4 on page 11 from Nisha Kar and be sure you've completed all internship tasks for the day.

- Complete the Project Summary form on the next page. If needed, refer back to the RFP in the Dossier to review the project details.
- Your internship coordinator may have asked you to complete additional tasks. Double-check the Daily Message and Daily Message Notes to see if there are other deliverables that need to be completed after hours.

Name: _____ Date: _____

Project Summary: Defining the Problem

Summarize your understanding of the project by answering the following questions. You may wish to review the Dossier to help you respond to the questions.

1. What is the engineering problem you are trying to solve?

_____

_____

_____

2. Describe the first criterion—minimize cargo damage—and why it is important.

_____

_____

_____

3. Describe the second criterion—maximize shell condition—and why it is important.

_____

_____

_____

4. Describe the third criterion—keep costs low—and why it is important.

_____

_____

_____

5. Based on your research so far, which criterion do you think is most important for a successful drop pod design? Why?

_____

_____

_____

Name: _____ Date: _____

Day 5: Analyzing Your Data

Hi interns,

Today you will continue using your SupplyDrop Data sheets to conduct iterative testing. You'll also learn how to analyze your results in order to make your tests more meaningful. You will use your analysis to select a design version to submit to me for feedback.

Analyzing data is an essential skill for success that I make sure all my interns practice. If you don't look at your results and try to learn something from them, then there is no point to testing in the first place. More importantly, carefully planning your tests by changing only one thing at a time will allow you to see the results of individual choices on your design's success. I've provided a Results Analysis sheet on page 15 to help you with this.

Deliverables

- SupplyDrop Data sheet with one additional iterative test
- Results Analysis sheet
- SupplyDrop Design

Stay focused,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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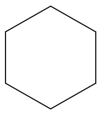
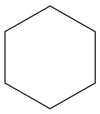
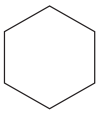
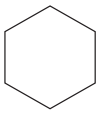
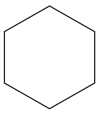
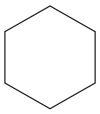
Name: _____ Date: _____

Results Analysis

	VERSION	VERSION	VERSION	VERSION	VERSION	VERSION
Force (N)						
Mass (kg)						
Velocity (m/s)						

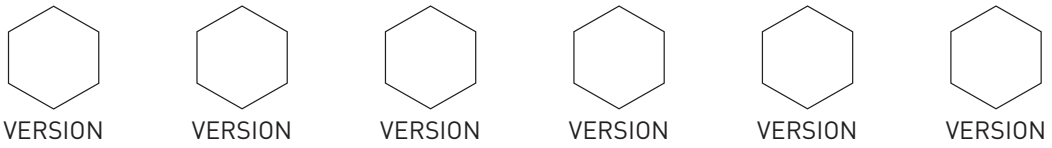
SHELL CONDITION						
Watertight Shelter						
Shade-Only Shelter						
Building materials						
Not reusable						

TOTAL POD COST						
($)						
$3000						
$2000						
$1000						
$0						

CARGO DAMAGE						
(%)						
60%						
50%						
40%						
30%						
20%						
10%						
0%						

Name: _____ Date: _____

Results Analysis (continued)



Force (N)						
Mass (kg)						
Velocity (m/s)						

SHELL CONDITION

Watertight Shelter						
Shade-Only Shelter						
Building materials						
Not reusable						

TOTAL POD COST

($)						
$3000						
$2000						
$1000						
$0						

CARGO DAMAGE

(%)						
60%						
50%						
40%						
30%						
20%						
10%						
0%						

Name: _____ Date: _____

SupplyDrop Design

Record your best design here. Then you will submit your best design in the SupplyDrop Design form in the Futura Workspace in order to receive feedback from the project director. Note: Only one partner needs to submit a form for feedback.

1. List the design details of your design.

   Version: _____

   Shell: (circle one) Acrylic Aluminum Fiberglass Steel Wood

   Padding: Air Bags (%): _____

   Padding: Feathers (%): _____

   Padding: Metal Foam (%): _____

   Padding: Packing Peanuts (%): _____

   Padding: Paper Pads (%): _____

   Add-on (Top): (circle one) Flaps Parachute: Large Parachute: Small None

   Add-on (Bottom): (circle one) Foam Blocks Springs Trestles None

2. Cargo Damage (%): _____

3. Shell Condition: (circle one)

   Watertight Shelter Shade-Only Shelter Building Materials Not Reusable

4. Total Pod Cost ($): _____

Name: _____ Date: _____

Day 6: Optimal Designs

Hello interns,

Today, you'll review my feedback on the supply pod design your team submitted. Your internship coordinator will help you understand my feedback so you can continue to work on the supply pod design that best addresses all the project criteria.

You might have noticed that each version you've designed has trade-offs—a design can strongly address one criterion, but weakly address another. After hours, you'll reflect on trade-offs in the optimal design you choose. When engineers select an optimal design, they consider priorities, results, feedback, and trade-offs.

Deliverables

- Design Feedback Summary
- Several additional iterative tests recorded on SupplyDrop Data sheet
- After-hours: Trade-Offs Reflection

Keep up the good work!

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

Design Feedback Summary

	CRITERIA		
	Cargo Damage (%)	Shell Condition	Total Pod Cost ($)
Submitted Version ☐ Test Results		☐ Watertight shelter ☐ Shade-only shelter ☐ Building materials ☐ Not reusable	
Feedback from project director			
Goal			
Redesign Strategy			

Name: _____ Date: _____

After-Hours Work

Return to Message 6 on page 18 from Nisha Kar and be sure you've completed all internship tasks for the day.

- Complete the Trade-Offs Reflection form on the next page.
- Your internship coordinator may have asked you to complete additional tasks. Double-check the Daily Message and Daily Message Notes to see if there are other deliverables that need to be completed after hours.

Name: _____ Date: _____

Trade-Offs Reflection

A *trade-off* happens in a situation where a design has good results for one criterion but not for another. Look at your optimal supply pod design. Describe some of the trade-offs you noticed while designing your incubator.

1. Which criterion did you prioritize? (check one)
   - ☐ Minimize cargo damage
   - ☐ Maximize shell condition
   - ☐ Keep costs low

2. Why did you prioritize this criterion?

_____

_____

_____

_____

_____

3. When you prioritized this criterion, what were some of the trade-offs? Describe what happened to the results of the other two criteria.

_____

_____

_____

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Name: _____ Date: _____

Day 7: Outlining Design Decisions

Hello interns,

By now, you should have picked the design that you believe is optimal. Today, you will explain why as you start working on your proposal. I want to know why you made each decision for this design, so you'll begin by outlining an important section of your proposal, the Design Decisions. You might also want to refer to the Dossier for information and resources to help you outline.

Engineering proposals explain how a design addresses the project criteria. Strong evidence will improve your argument, and make your design more likely to be considered by International Disaster Aid. The outline you prepare today will help you organize the evidence you have—evidence that supports the argument that your selected design is an optimal design.

Deliverables

- Proposal Outline

Cheers,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

Proposal Outline

For this outline, you need to list important information for the Design Decisions for each criterion. Refer to your SupplyDrop Data and the Dossier.

OPTIMAL DESIGN

List the design details of your proposed optimal design.

Version #: _____

Shell

Add-On (Top)

Padding

% Air Bags

% Packing Peanuts

% Feathers

% Paper Pads

% Metal Foam

Add-On (Bottom)

DESIGN DECISIONS

For each criterion, list the pieces of evidence from your data analysis and background research that support your optimal design.

Minimize Cargo Damage

DATA ANALYSIS

Final result (%):

Design goal (%):

Comparison to another design:

BACKGROUND RESEARCH

Think about how your design choices (materials and features) affected the percentage of cargo damage. How did the choices you made affect the percentage of cargo damage?

Name: _____ Date: _____

Proposal Outline (continued)

Maximize Shell Condition

DATA ANALYSIS

Final result:

Design goal:

Comparison to another design:

BACKGROUND RESEARCH

Think about how your design choices (materials and features) affected the shell condition. How did the choices you made affect the shell condition?

Keep Costs Low

DATA ANALYSIS

Final result ($):

Design goal ($):

Comparison to another design:

BACKGROUND RESEARCH

Think about how your design choices (materials and features) affected the supply pod cost. How did the choices you made affect the cost?

Name: _____ Date: _____

After-Hours Work

Return to Day 7: Design Decisions message on page 22 from Nisha Kar and be sure you've completed all internship tasks for the day.

- Read and annotate "The Physics of Falling" article in the "Additional Resources" chapter of the Dossier.
- Your internship coordinator may have asked you to complete additional tasks. Double-check Daily Message and Daily Message Notes to see if there are other deliverables that need to be completed after hours.

Name: _____ Date: _____

Day 8: Writing Design Decisions

Hello interns,

Today you'll review my feedback on your Proposal Outlines. Take a look at the feedback letter after you finish your Daily Message Notes. You will discuss my feedback with your colleagues in order to help you write a strong argument that explains why your design is an optimal one. You might also want to refer to the Dossier for information and resources to help you write.

Writing your argument can be difficult, but helping people understand your decisions is an important part of being an engineer. You know more about the science behind your design than most of the people who will be reading your proposal, so your writing should be clear and professional. Writing clear arguments that explain your thinking is an essential part of scientific communication.

Deliverables

- Design Decision paragraphs of the Final Proposal

Cheers,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

Proposal Feedback Notes

Use this page to take notes on your feedback letter.

Name: _____ Date: _____

Tips: Help with Your Proposal

Interns,

If you need some help getting started with your paragraphs, here are some ideas to choose from.

Design Decisions Paragraphs

About specific criteria:

- For our proposed design, the percentage of cargo damage was . . .
- After impact, the shell was able to be used for . . .
- We were able to maximize the shell condition by . . .
- The cost of our pod was . . .
- Using the Futura SupplyDrop Design Tool, we picked a design that . . .

When talking about your goals:

- Our goal was . . .
- Based on design feedback, we chose to set a goal to . . .

For comparing designs:

- In another design, we got _____ but . . .

For talking about background research:

- Background research told us that . . .
- Dossier research told us that . . .

Introduction

- This supply pod design used _____ (list types and amount of materials, and any add-ons used).
- The results showed the largest percentage of cargo damage at _____ %.
- The shell condition was _____, and the cost was _____.

Name: _____ Date: _____

Tips: Help with Your Proposal (continued)

Conclusion

- We think this is an optimal design because . . .
- Because we focused on the criterion/criteria of _____, our design . . .
- Our priority was the criterion _____ because . . .
- Our supply pod design is the optimal choice because . . .
- Our supply pod design will meet the needs of International Disaster Aid because . . .
- Even though our design does not _____, we think it is optimal because . . .
- This pod design will _____ (write something about one criterion here) well because . . .
- A trade-off we had to make in our optimal design was . . .

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Name: _____ Date: _____

Final Proposal

When writing your Final Proposal, remember to write in a clear and professional manner. Refer to these resources:

- The Proposal Rubric and Sample Proposal
- SupplyDrop Data sheet
- Results Analysis sheet
- Mechanical Engineer's Dossier
- Notes on Proposal Outline feedback letter

Introduction

Use your responses from the Project Summary to describe the project goal and criteria. Add one to two sentences to describe your optimal design.

Name: _____ Date: _____

Final Proposal (continued)

Design Decisions

Use your Proposal Outline and feedback from your project director to explain how your design addresses each criterion.

Minimize Cargo Damage

Maximize Shell Condition

Name: _____ Date: _____

Final Proposal (continued)

Keep Costs Low

Name: _____ Date: _____

Final Proposal (continued)

Conclusion: Considering Trade-Offs

Use your responses from the Trade-Offs Reflection to describe your design priority and the resulting trade-offs. Add your closing statement.

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Name: _____ Date: _____

Day 9: Finishing Your Proposal

Hello interns,

Today is all about the beginning and the end of your proposal. Your internship coordinator will help you take the work you have already done—in the Project Summary and Trade-Offs Reflection—and turn it into your Introduction and Conclusion paragraphs. You might also want to refer to the Dossier for information and resources to help you write.

These two paragraphs are the final parts of your proposal. The introduction shows the reader what you know about the project, while the conclusion shows that you've thought deeply about the trade-offs involved. Remember to use scientific and professional language to communicate your ideas.

Deliverables

- Final Proposal

Good luck,

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

Day 10: Thanks, Interns!

Hello interns,

Today marks the end of your internship with the Mechanical Engineering Division. There is one last task that I have for you: an Internship Exit Survey. Go ahead and begin it as soon as you've read the rest of this message.

I've been impressed by the work you've put into designing an optimal supply pod. I hope you'll be able to take some of what you learned here and apply it to your life and your studies. There are many opportunities for young people like you to become involved with engineering and help solve challenging problems.

Deliverables

- Internship Exit Survey

Good luck in the future!

Nisha

Nisha Kar, Project Director
Futura | Mechanical Engineering Division

Daily Message Notes

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Name: _____ Date: _____

Internship Exit Survey

Futura would like to improve the internship experience for future interns. Please complete this survey to give us feedback.

1. How comfortable would you feel explaining to a new intern how a student's job is different from an intern's job? (check one)

   ☐ Very uncomfortable. I don't understand this.

   ☐ Uncomfortable. I'm not sure I understand this.

   ☐ Pretty comfortable. I think I understand this.

   ☐ Very comfortable. I totally understand this.

2. How comfortable would you feel explaining to a new intern what criteria are and how they are related to designing something? (check one)

   ☐ Very uncomfortable. I don't understand this.

   ☐ Uncomfortable. I'm not sure I understand this.

   ☐ Pretty comfortable. I think I understand this.

   ☐ Very comfortable. I totally understand this.

3. How comfortable would you feel explaining to a new intern what a trade-off is and how a trade-off affects engineering designs? (check one)

   ☐ Very uncomfortable. I don't understand this.

   ☐ Uncomfortable. I'm not sure I understand this.

   ☐ Pretty comfortable. I think I understand this.

   ☐ Very comfortable. I totally understand this.

Name: _____ Date: _____

Internship Exit Survey (continued)

4. How comfortable would you feel explaining to a new intern why it is important to use models in engineering? (check one)

   ☐ Very uncomfortable. I don't understand this.

   ☐ Uncomfortable. I'm not sure I understand this.

   ☐ Pretty comfortable. I think I understand this.

   ☐ Very comfortable. I totally understand this.

5. Imagine you are giving advice to new a Futura Engineering intern. What would you tell them about the engineering design process?

   _____

   _____

   _____

6. Imagine you are giving advice to a new Futura Engineering intern. What was hard or challenging?

   _____

   _____

   _____

7. Imagine you are giving advice to a new Futura Engineering intern. What tips would you suggest for a successful internship?

   _____

   _____

   _____

Force and Motion Engineering Internship Glossary

air resistance: a force that slows an object down when it moves through the air

resistencia del aire: una fuerza que disminuye la velocidad de un objeto cuando se mueve a través del aire

analyze: to examine in detail for a purpose

analizar: examinar en detalle y con un propósito

CEO: C.E.O. stands for "Chief Executive Officer," the leader of an organization, group, or company

CEO: C.E.O. son las siglas en inglés para "Oficial Ejecutivo en Jefe", es decir, el director de una organización, grupo o compañía

collision: the moment when two objects hit each other

colisión: el momento cuando dos objetos chocan entre sí

constraint: a limit or restriction

restricción: un límite o condicionamiento

criteria: standards by which something may be judged

criterios: normas por medio de las cuales se puede juzgar algo

deliverable: a thing to be delivered, usually in a development or design process

entregable: una cosa que debe entregarse, usualmente durante un proceso de desarrollo o diseño

disaster relief: help, usually food and supplies, that is given to people who have survived disaster

ayuda en casos de desastre: ayuda, usualmente alimentos y provisiones, que se da a personas que han sobrevivido a un desastre

dossier: a set of related documents about a particular topic

expediente: un conjunto de documentos relacionados sobre un tema particular

engineer: a person who uses math and science to design things

ingeniero/a: una persona que utiliza las matemáticas y la ciencia para diseñar cosas

exert: to apply a force

ejercer: aplicar una fuerza

force: a push or a pull that can change the motion of an object

fuerza: un empujón o un jalón que puede cambiar el movimiento de un objeto

friction: a force between an object and the surface it is moving over

fricción: una fuerza entre un objeto y la superficie sobre la cual se está moviendo

gravity: the force that attracts a body toward the center of Earth, or toward any other physical body having mass

gravedad: la fuerza que atrae a un cuerpo hacia el centro de la Tierra o hacia cualquier otro cuerpo físico que tiene masa

impact: the moment during a collision when two objects hit each other

impacto: el momento durante una colisión cuando dos objetos chocan entre sí

impact force: the push exerted on one object when it has a collision with another object; just one of the pair of equal-sized forces in a collision

fuerza de impacto: el empujón ejercido sobre un objeto cuando colisiona con otro; es solo una de las dos fuerzas de igual intensidad presentes en una colisión

interns: beginners at a workplace who do work that is closely supervised because they are learning on the job

becarios: principiantes que hacen un trabajo estrechamente supervisado porque están aprendiendo durante el mismo

internship coordinator: the person who supervises interns during a project

coordinador/a de becarios: la persona que supervisa becarios durante un proyecto

iterative testing: repeating a process in a way that considers the results of a previous design

pruebas iterativas: la repetición de un proceso de manera que se consideren los resultados de un diseño anterior

mass: the amount of matter that makes up an object

masa: la cantidad de materia que forma un objeto

model: an object, diagram, or computer program that helps us understand something by making it simpler or easier to see

modelo: un objeto, diagrama o programa de computadora que nos ayuda a entender algo haciéndolo más simple o fácil de ver

optimal: most successful, considering the situation

óptimo: más exitoso, considerando la situación

pod: a self-contained unit on an aircraft, spacecraft, vehicle, or vessel that can be detached for a particular function

compartimento desprendible: una unidad autónoma en una aeronave, nave espacial, vehículo o embarcación que se puede desprender para realizar una función específica

project director: the person who is responsible for making sure a project's goals are addressed

director/a de proyecto: la persona responsable de asegurarse de que se cumplan las metas de un proyecto

proposal: a formal design that is supported by evidence, and submitted for discussion and review

propuesta: un diseño formal respaldado por evidencia y presentado para discusión y revisión

request for proposals: a document asking engineers to submit a well-supported, formal design describing how they would solve a problem

solicitud de propuestas: un documento para pedir a los/as ingenieros/as que presenten un diseño formal, bien sustentado, que describa cómo resolverían un problema

trade-off: when you have to give up one thing in return for another

concesión: una situación en la que se debe renunciar a algo para obtener otra cosa a cambio

velocity: speed in a particular direction

velocidad: rapidez en una dirección particular

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