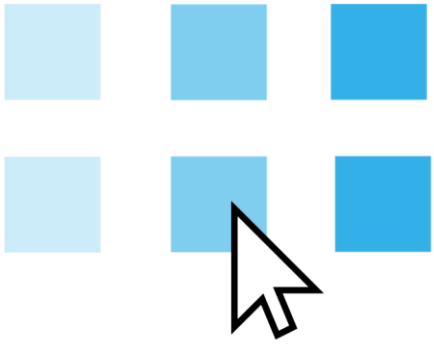
CES EduPack Active Learning Projects:

Quick Materials Selection Projects



Kaitlin Tyler
ANSYS Granta

The Education Hub aims to support teaching of materials-related courses in Design, Engineering and Science. Resources come in various formats and are aimed primarily at undergraduate education.

www.grantadesign.com/**education**

These prompts were designed to be used during short (approximately 20 minute) group activities in class. Each prompt includes a product description and a short list of constraints. The purpose of this resource is to encourage students to participate in collaborative learning, combining fundamental concepts of material properties and the CES EduPack software's ability to compare properties for materials selection. There are no specific right or wrong answers to these projects—the goal is for students to use their new and existing materials knowledge to make materials selection decisions as a group and rationalize those choices using facts, not necessarily to find the "best" choice.

Minimum one student from each group will need access to CES EduPack in order to complete this activity. A Level 2 database is recommended to restrict selection choices with this time-constrained activity. Example use instructions for two class cases are shown below.

Example use instructions—No project overlap:

1. Split class into small groups (suggested group size: 3)
2. Assign each group a prompt
3. Give students 20 minutes to identify key material properties and identify a list of three materials that could meet the criteria of their design prompt.
4. Have one representative from each group explain their top three materials choices in maximum two minutes. Allow time for questions and discussion (approx. 15-20 minutes total, depending on class size)

Example use instructions—Project overlap:
*recommended for maximum understanding and information transfer

1. Split class into small groups (suggested group size: 3)
2. Assign each group a prompt. Each prompt must be given to minimum two groups
3. Give students 20 minutes to identify key material properties and identify a list of three materials that could meet the criteria of their design prompt.
4. Have groups with the same prompt come together and share answers. Allow 10 minutes for discussion. At the end, have one representative from the combined prompt groups share the finalized material choice and their rationale. Allow time for questions and discussion (approx. 15-20 minutes, depending on class size)

Prompt: Portable Bike Storage Shed

Your design team has been charged with the task of designing a portable bike storage shed. It will be sold to people who live in apartment buildings and do not have access to a garage to store their bikes. As a materials engineering, your job is to select the top three material candidates for the job.

Constraints:

- Lightweight
- Cheap
- High durability—needs to withstand a variety of weather

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Cooking Spatula for a College Student

© OpenClipart-Vectors at Pixabay

Your design team has been charged with the task of designing a cooking spatula. This cooking utensil will be marketed towards college students as a good "first" spatula to buy. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Cheap
- Temperature resistant—able to withstand cooking temperatures
- High flexure strength—will not break when making the world's best pancakes
- Non-Toxic—compatible with food

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Inside of an Outdoor Oven

© Jazella at Pixabay

Your team has been tasked with designing an outdoor oven for someone's home. It is a special commission; budget is not a concern. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Temperature resistant—able to withstand extremely high cooking temperatures (>600°F)
- Durable—withstand being outdoors and occasionally hit with cooking tools
- Non-Toxic—compatible with food
- Environmentally friendly—Eco design is important to the buyers

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Playground Monkey Bars

© Clker-Free-Vector-Images at Pixabay

Your design team has been charged with creating the monkey bars for a local playground. This project was funded locally by the community, so the budget is quite small, but the users are very invested. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Strong—must withstand the weight of many small children (and possibly some adults)
- Thermal resistance—must not get too hot during the summer months
- Cheap—small budget project
- Durable—must withstand a variety of weather

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: The Best Toy Boat

© PublicDomainPictures at Pixabay

Your design team has been tasked with making a children's' toy boat based on a recent movie release. This product will be mass produced and sold around the world. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Processing—must be easily mass produced
- Cheap—it is a children's toy
- Low density—it must float, otherwise it is not a very good boat

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Improved Ice Hockey Mask

©Camera Eye Photography at Flickr (CC BY 2.0)

Your design team has been tasked with making an improved ice hockey goalie mask for the next Stanley Cup finals. This product is for professional athletes, so cost is not an issue. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- High impact resistance—must protect against flying hockey pucks
- Low density—the goalie must wear the mask the entire game, so it cannot be too heavy
- Processing—hockey masks are a relatively complex shape, so the material must have a high formability

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Racing Sailboat Mast

© **pixel2013** at **Pixabay**

Your design team has been tasked with designing the mast for a racing sailboat for a new college team. This boat will be raced on both lakes and ocean bays as far of a yearlong competition. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Durability—must withstand weather, fresh water, and seawater
- Cost—this team is made up of poor college students
- Strength in bending—a mast should flex slightly in the wind, but not too much!

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Beginner Child's Swimming Goggles

Your design team has been tasked with making the lenses for some beginner children swimmer goggles. They should appeal to both the swimmer and their parent, who will most likely have to buy a second pair when the first one is lost. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- UV resistant—will be left outside on the pool deck often
- Transparent—they would not be good goggles if they aren't see-through!
- Fracture resistant—it is near people's eyes, so it needs to be safe

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Aircraft Cargo Door

Your design team has been tasked with making an aircraft cargo door. This door is opened multiple times a day to load and unload heavy luggage. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Strength—this door will have a lot of weight on it at times
- Thermal Stability—will be on the outside of an aircraft, where it undergoes many thermal cycles of hot to cold
- Durability—must withstand a variety of weather from all around the world

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Prompt: Custom Broken Wrist Brace

Your design team has been tasked with designing a new brace to be worn after a fractured wrist is set. Each of these braces will be custom to the person's body, hopefully aiding in the healing process. As a materials engineering, it is your job to select the top three material candidates for the job.

Constraints:

- Processing—the material must be easily formed around a person's wrist
- Biocompatible—must be worn against the skin
- High stiffness—the broken wrist must not be jostled during healing

Key Material Properties:

-
-
-
-
-

Possible Material Candidates:

1.
2.
3.

Author

Kaitlin Tyler
ANSYS Granta
www.grantadesign.com

Reproduction

Accuracy

We try hard to make sure these resources are of a high quality. If you have any suggestions for improvements, please contact us by email at granta-education-team@ansys.com.

Open Educational Resources include:

- Interactive Case Studies
- Getting Started Guides
- Materials Property Charts
- Engineering Data Booklets

You can register for a username and password for these resources here:
www.grantadesign.com/education

Other Resources Available:

- 25 PowerPoint lecture units
- Exercises with worked solutions
- Recorded webinars
- Posters
- White Papers
- Solution Manuals

Granta's Teaching Resources website aims to support teaching of materials-related courses in Engineering, Science and Design.

The resources come in various formats and are aimed at different levels of student. This resource is part of a set of resources created by Professor Mike Ashby and Granta Design to help introduce materials and materials selection to students.

The Teaching Resources website also contains other resources donated by faculty at the ~1000 universities and colleges worldwide using Granta's CES EduPack, and includes both resources that require the use of CES EduPack and those that don't.