ENGINEERING & INVENTING

TRAINING FOR K-12 TEACHERS

SESSION 1

GOALS & OBJECTIVES

By the end of this presentation, you should know

1) How *Science Fairs* and *Invention Fairs are* similar
2) The steps in the Engineering Design Process
3) What we did (pilot program)
4) About Mission: Invent at Andrews University

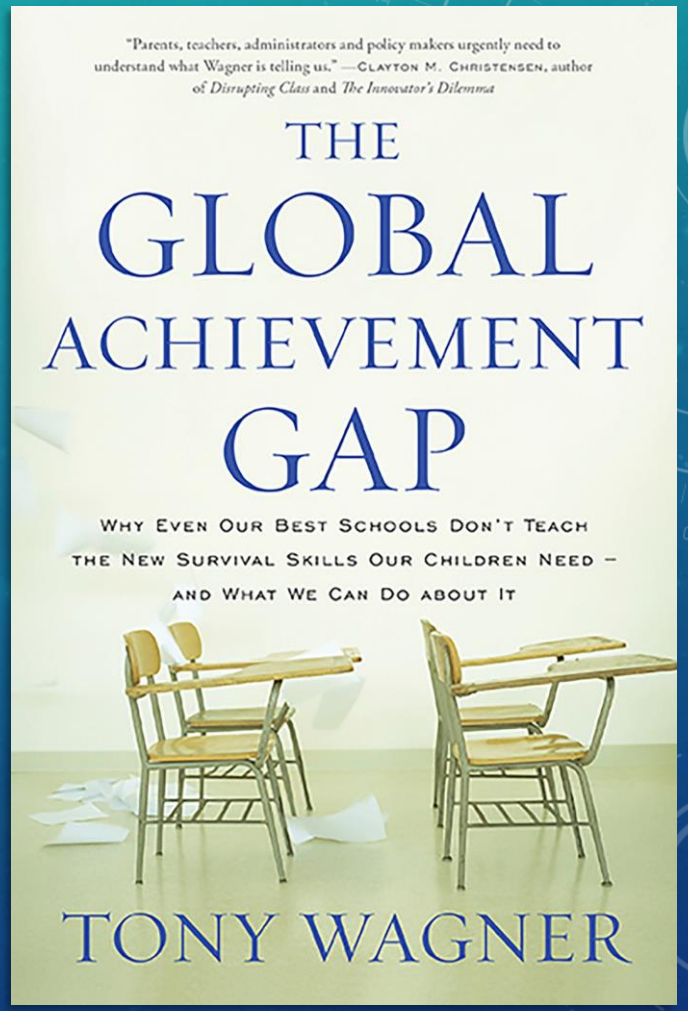
Materials needed: paper/pen or pencil

Q & A: please write down your questions or put them in the chat

WHY IS ENGINEERING & INNOVATION NEEDED IN OUR SCHOOLS NOW?

Seven Survival Skills for Teens Today

1. Critical Thinking and Problem-Solving
2. Collaboration across Networks and Leading by Influence
3. Agility and Adaptability
4. Initiative and Entrepreneurialism
5. Effective Oral and Written Communication
6. Accessing and Analyzing Information
7. Curiosity and Imagination



Educator, Senior Research Fellow at the Learning Policy Institute, former professor at Harvard

HAVE YOU EVER PARTICIPATED IN A SCIENCE FAIR?

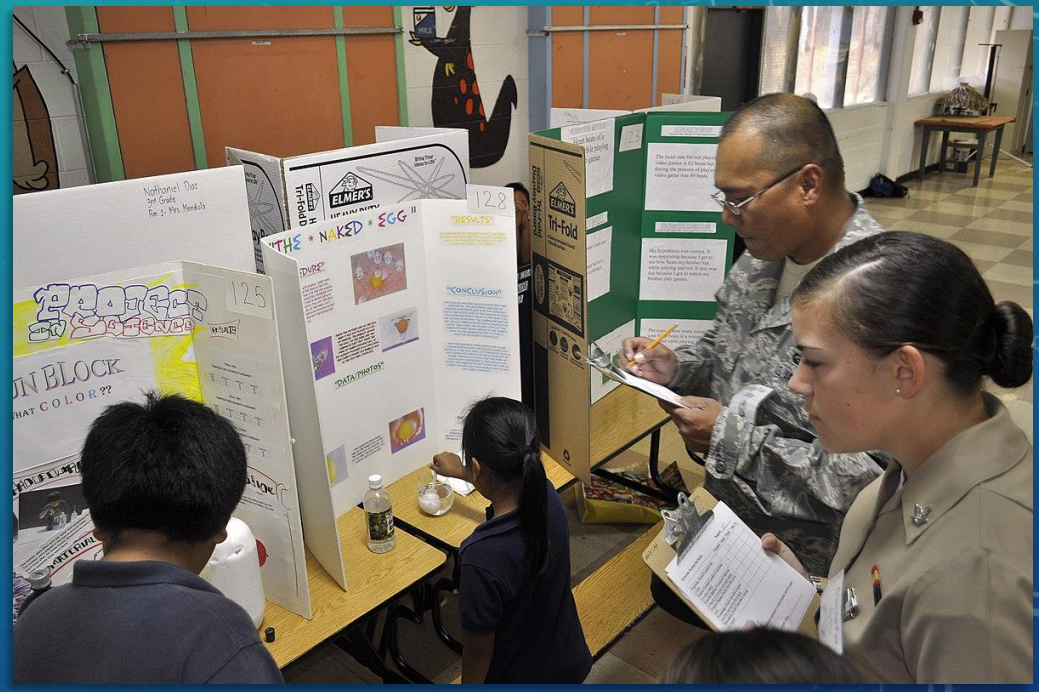
WHY AREN'T SCIENCE FAIRS POPULAR TODAY?

Parents do all the work.

Order an "experiment" online and student just puts it together.

Projects typically done at home, which parents don't like.

Any other reasons?



Traditional Science Fair illustration

INVENTION FAIR

- An annual event patterned after the Invention Convention (K-12) by the Henry Ford: inventionconvention.org

- Preparation for the event will be integrated into science class (elementary/middle/high school levels)

https://youtu.be/fYCOf61pJUc

REFLECTION & REACTION

What did you think of the video?

How does this compare to a science fair?

Scientific Method

- Observe
- Question
- Research
- Hypothesis
- Experiment
- Analyze
- Communicate

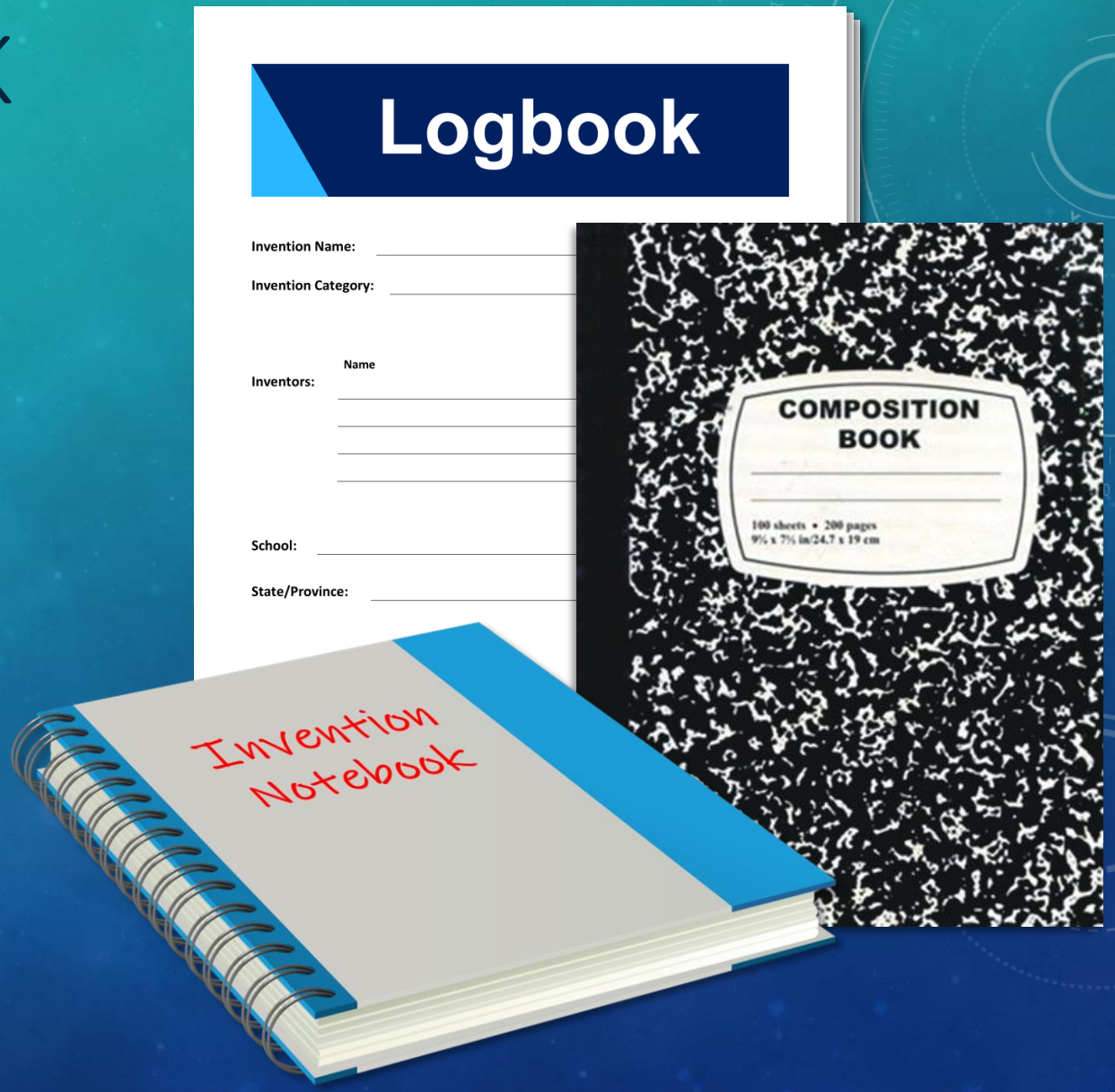
Engineering Design Process

- Problem
- Research
- Requirements
- Solution
- Prototype
- Testing
- Communicate

LOGBOOK/NOTEBOOK

Document your…

- Ideas
- Plans
- Drawings
- Notes
- Research
- Etc.



SOUTH BEND JUNIOR ACADEMY

PILOTED: MARCH - MAY 2021

Small groups (3-4 students)

Students select a real-world problem

Designed and built a unique prototype

How Much In-Class Time: One Quarter, twice a week

7th & 8th Graders pictured here

South Bend, Indiana

HILLTOP ADVENTIST SCHOOL

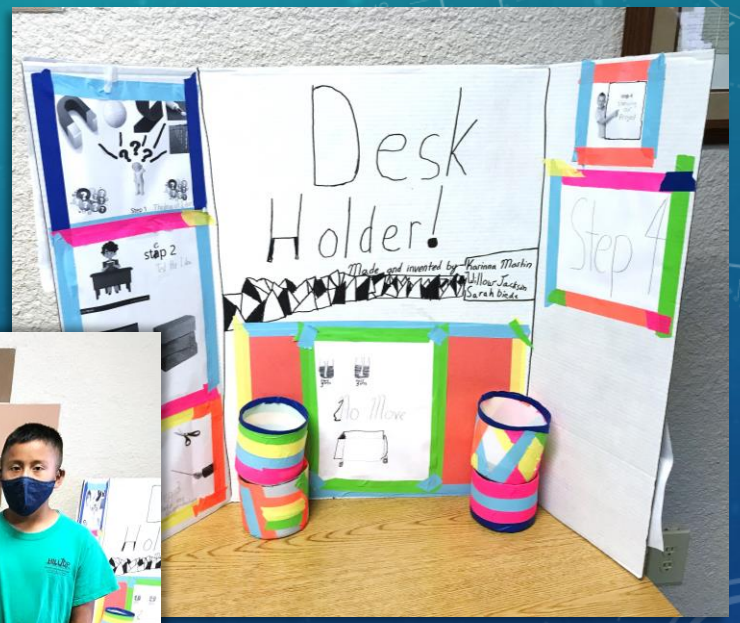
PILOTED: APRIL - MAY 2021

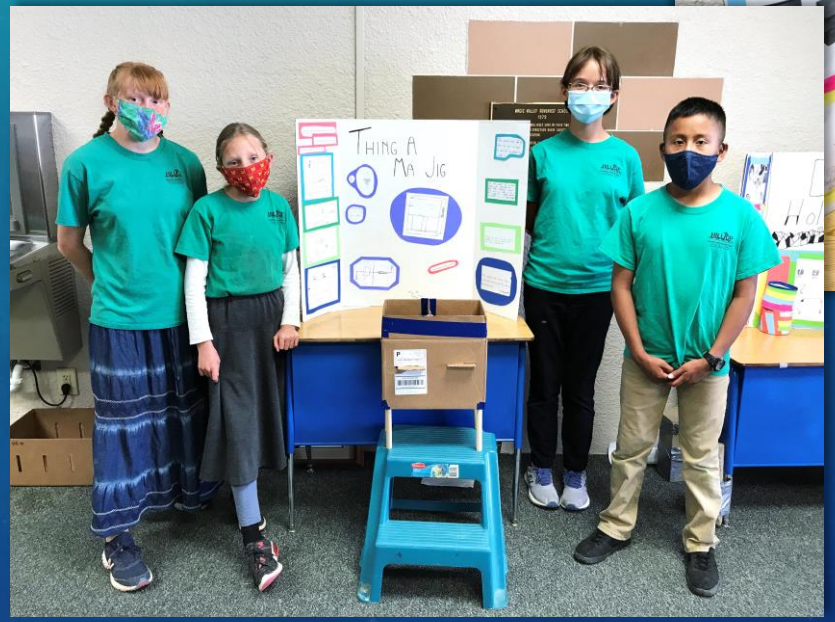
12 week minimum

Opportunity to become an ongoing project over several years

Small or Large Class Size

Scalable: PreK-12th grade





3rd - 8th Graders pictured here

Twin Falls, Idaho

EXAMPLE PROBLEM

Dogs Leave their Toys Lying around the House

EXAMPLE PROBLEM

Dogs Leave their Toys Lying around the House

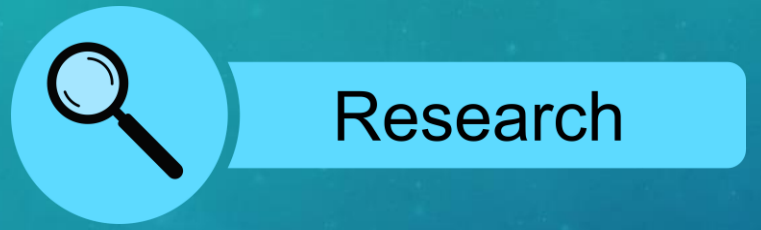
Problem

DEFINE:

- Tripping/slipping hazard
- Looks messy
- Germs
- Toys get lost
- Toys mostly in one room
- Toys on the floor
- Variety of toys
- Carpet and hard floors

EXAMPLE PROBLEM

Dogs Leave their Toys Lying around the House



- Who or what has this problem?
- What solutions already exist?

EXAMPLE PROBLEM

Dogs Leave their Toys Lying around the House

Requirements

CRITERIA & CONSTRAINTS:

- Picks up the toys
- Convenient/easy to use for everyone
- Make easier to locate toys
- Store toys and be accessible to dog
- Safe for everyone
- Works for different toy sizes/types
- Cost effective

EXAMPLE PROBLEM

Dogs Leave their Toys Lying around the House

Solution

- Brainstorm ideas
- Talk with your team
- Think of new ideas

COLLABORATION/TEAMWORK

Breakout Rooms

Share your Solutions
(no bad ideas at this point)

EXAMPLE PROBLEM

Dogs Leave their Toys Lying around the House

Solution

CHOOSE THE BEST SOLUTION:

- Compare ideas with requirements
- Discuss and choose the best idea

REQUIREMENTS:

- Picks up the toys
- Convenient/easy to use for everyone
- Make easier to locate toys
- Store toys and be accessible to dog
- Safe for everyone
- Works for different toy sizes/types

COLLABORATION/TEAMWORK

Breakout Rooms

Choose the Best Solution

EXAMPLE PROBLEM

Can anyone be innovative?

How can we encourage problem solvers to be resilient?

DESIGN AND BUILD

Materials Needed:

- Cardboard/Paper
- Tape/Glue
- Disposable Cups, Bottles, & Containers
- Scrap Wood
- Nails & Screws (if available)
- Additional special items if necessary
- Tools

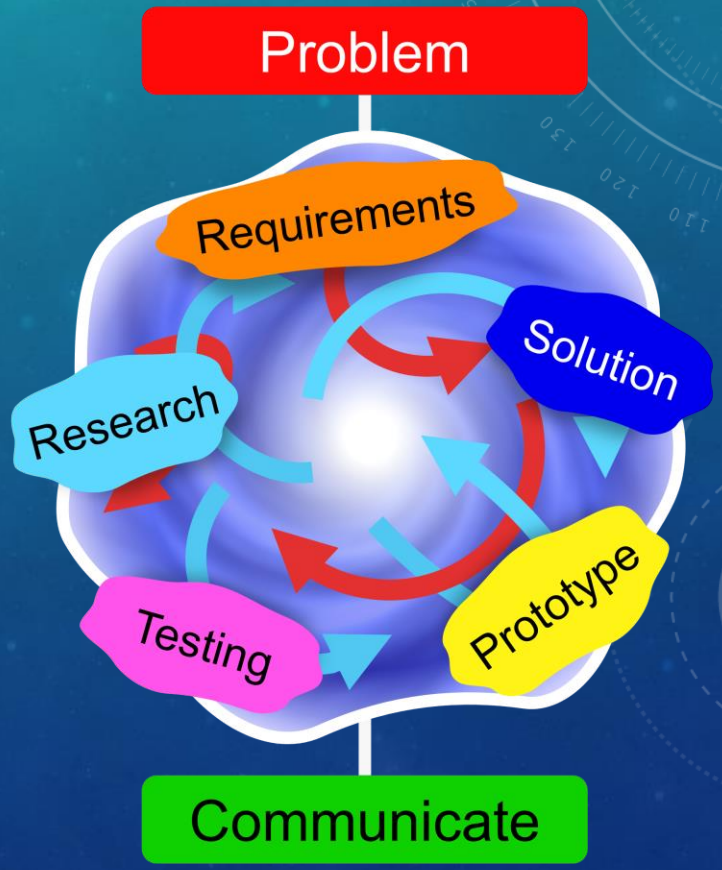
Cost?

- Cheap is ok/good

TESTING, RE-DESIGNING, CONCLUSIONS

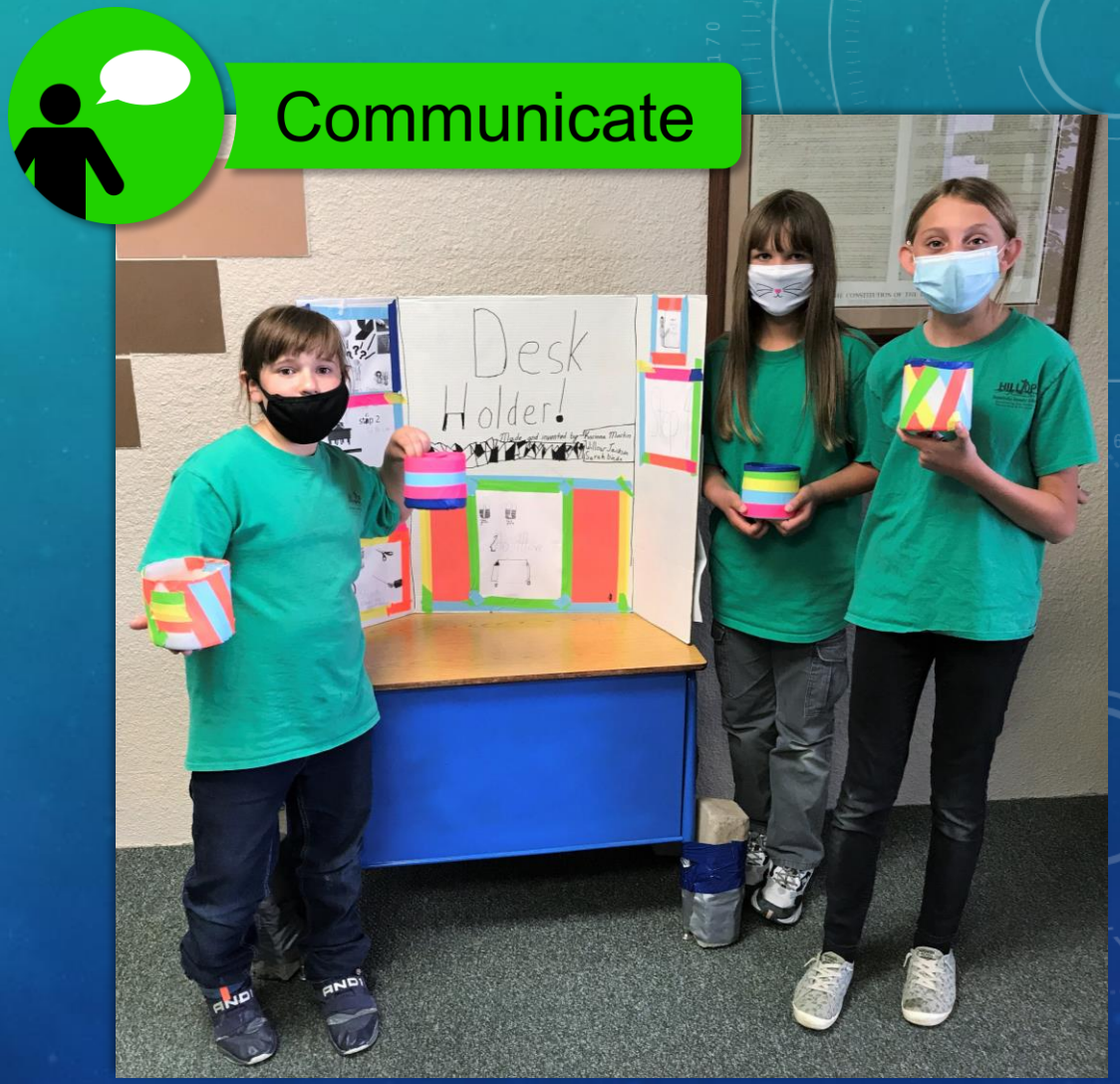
Testing

Engineering Design Process



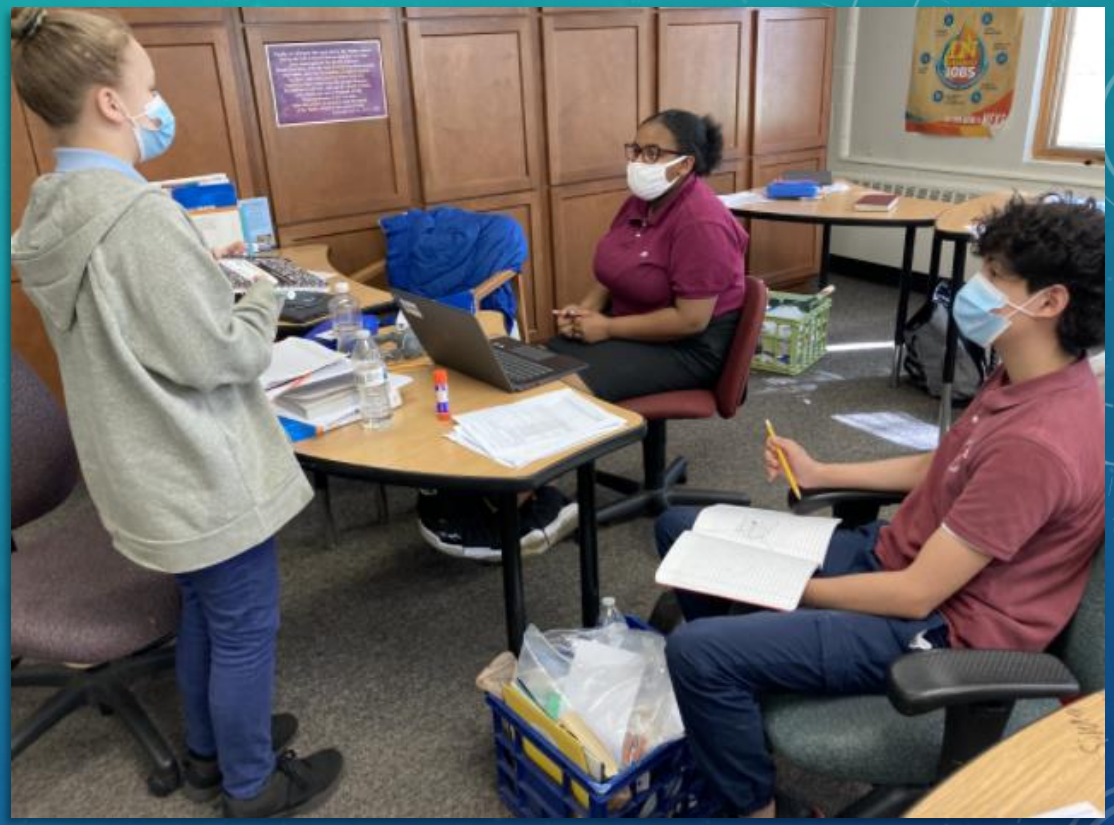
COMMUNICATE/PRESENT

- Oral presentation skills
- Teamwork- outline of presentation
- Tri-fold board



OUTCOME: PROBLEM SOLVERS

- Build Confidence
- Resilience
- Perseverance
- Oral Presentation Skills
- Spiritual Application



PROBLEMS THAT OUR STUDENTS CHOSE

- Lunch line time crunch
- Desks Holders
- Tupperware organizer
- Room surveillance
- Closing room door
- Ice cream sticky fingers

CAUTIONS & PITFALLS

- Students struggle to choose a problem
- Students try to do too much at once
- Students can get overwhelmed

SOLUTIONS

- Example Problems, Brainstorming, Deadlines
- Narrow the focus
- Provide next steps

THE WORD

"I can do all this through him who gives me strength."

- Phil 4:13 (NIV)

"It is the work of true education to develop this power, to train the youth to be thinkers, and not mere reflectors of other men's thought"

- White, E. G. (2002). In Education (p. 17). essay, Pacific Press.

ANNUAL EVENT

NAD-wide event hosted at Andrews University or other University

MISSION: invent

We invite your school to plan an Invention Fair in the spring

QUESTIONS & ANSWERS

SUMMARY

- Scientific Method & Engineering Design Process are similar
- Anyone can be an inventor, teach basic engineering skills
- Build Problem Solvers who are resilient
- No expensive equipment needed
- Plan a school Invention Fair in the spring
- Participate in Mission: Invent in the summer (details coming soon)
- Visit andrews.edu/go/invent: resources, videos, etc.

ENGINEERING & INVENTING

TRAINING FOR K-12 TEACHERS

SESSION 2

GOALS & OBJECTIVES

By the end of this presentation, you should know:

1) How to start to implement basic engineering/inventing in your classroom
2) How to plan
3) Finding/deciding on a problem to solve
4) Resources

Materials needed: paper/pen or pencil

Q & A: please write down your questions or put them in the chat

START WITH STANDARDS

K-12 Engineering Standards

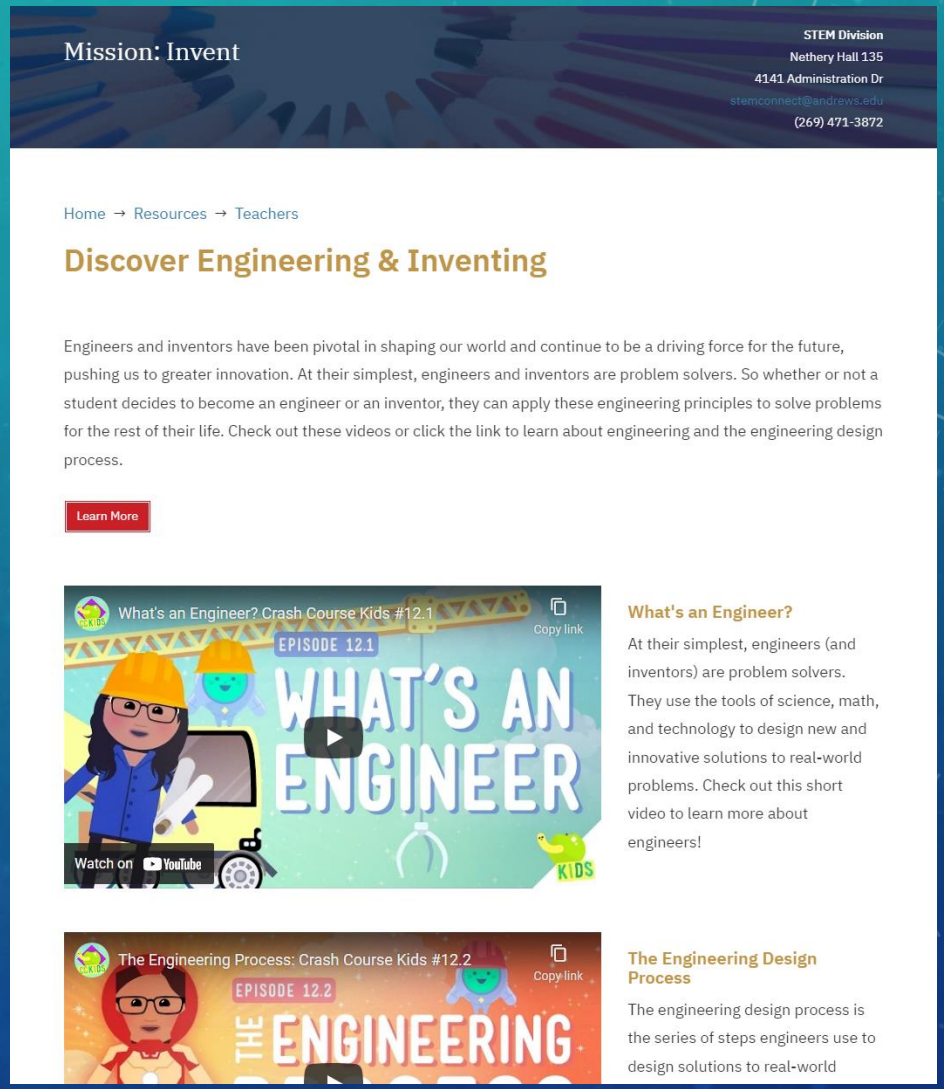
- Adventist Standards (K-8)
- Next Generation Science Standards (9-12)

By Grade Level

DO YOUR RESEARCH

What is Engineering?

Go over the *Engineering Design Process*



MAKE A PLAN

When will you start?

- Recommend 2nd or 3rd Quarter

How much time will you need?

- 2 Days per Week
- At least 12 in-class days

Materials needed:

- Notebooks for each student
- Tri-fold board (1 per group)
- Recyclable materials

7th & 8th grade students planning

START WITH A HOOK

- Inventors and Engineers
- Show a video
- Problems are all around us
- Example problem
  - Dog toys

FIND/DECIDE ON A PROBLEM

Provide examples

Brainstorm together

Encourage students to brainstorm alone or in small groups

Talk to family, friends, grandparents

REAL-WORLD PROBLEMS

SET DEADLINES

Stick with deadlines

Expect the first prototype to fail

Allow for time to try again

TEACH COOPERATIVE SKILLS

Teamwork:
communication,
everyone has a task, etc.

Teamwork Rubrics

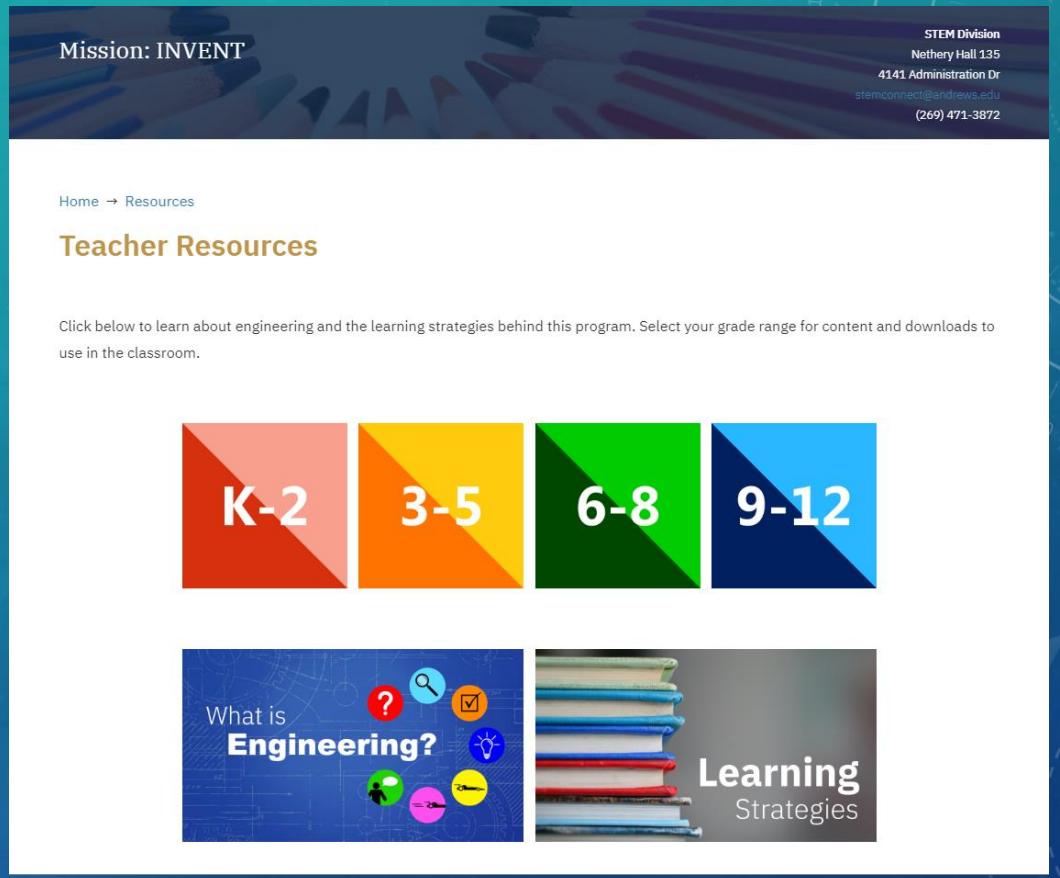
Learning throughout
the process

7th & 8th Graders
pictured here

South Bend, Indiana

RESOURCES

- LOGBOOK
- WORKSHEETS
- ACTIVITIES
- VIDEOS
- TEACHING GUIDES
- RUBRICS
- MORE…



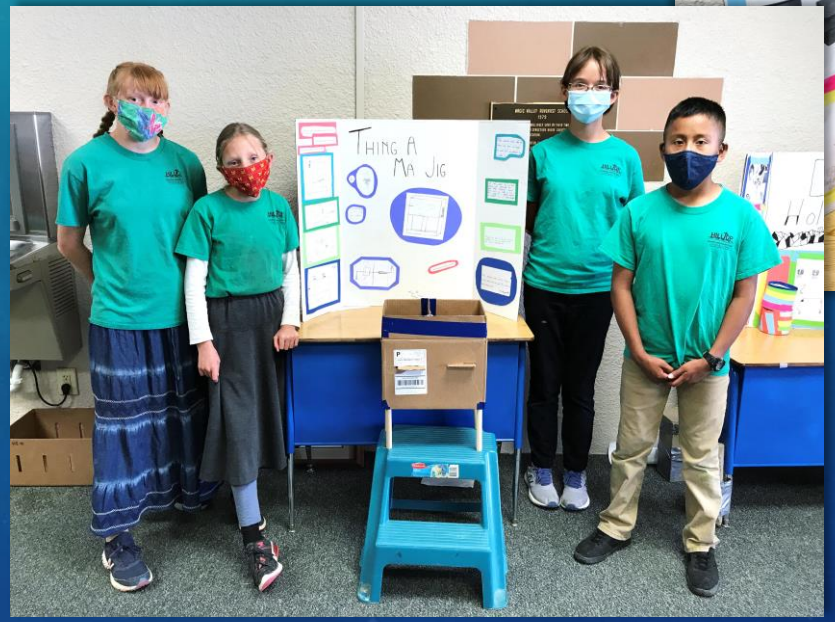
ANDREWS.EDU/GO/INVENT

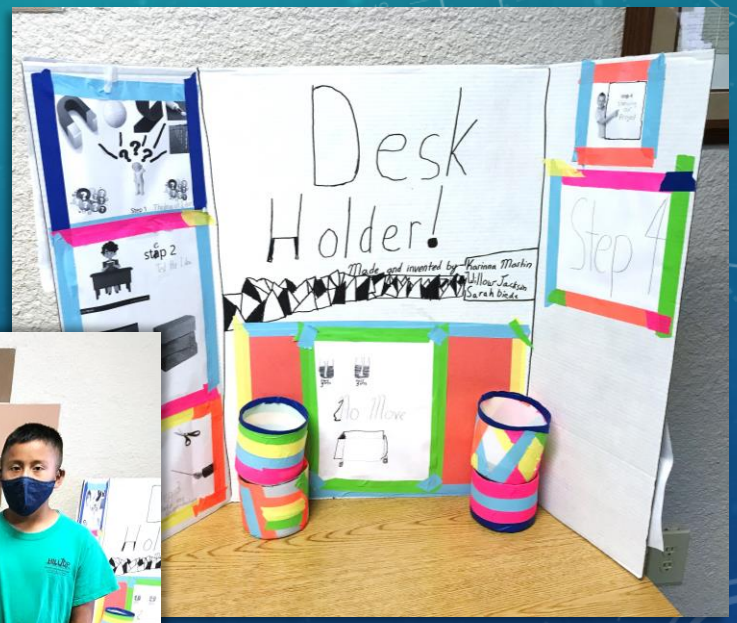
PLAN A SCHOOL INVENTION FAIR

Provide an opportunity for students to share their process and results

Similar to a science fair

Suggested - April



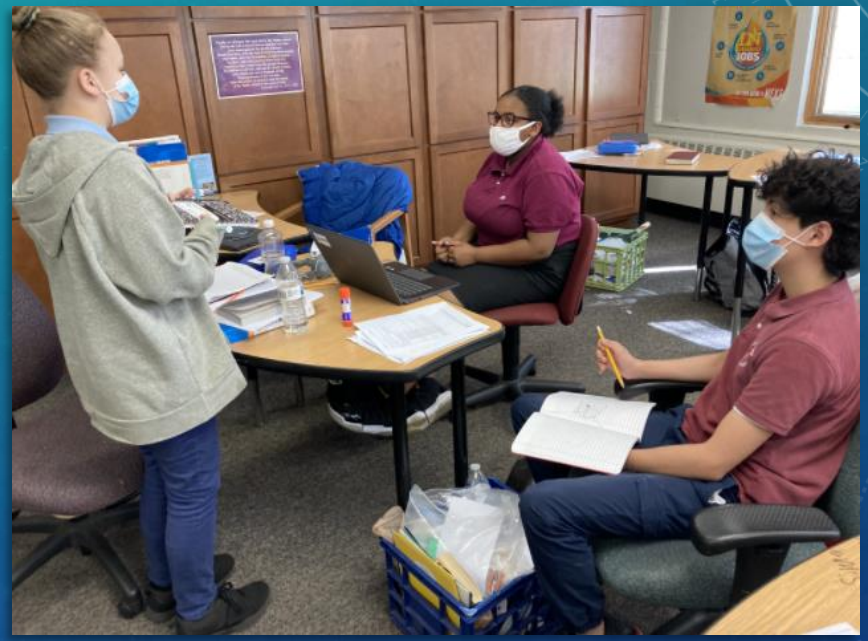


3rd - 8th Graders pictured here

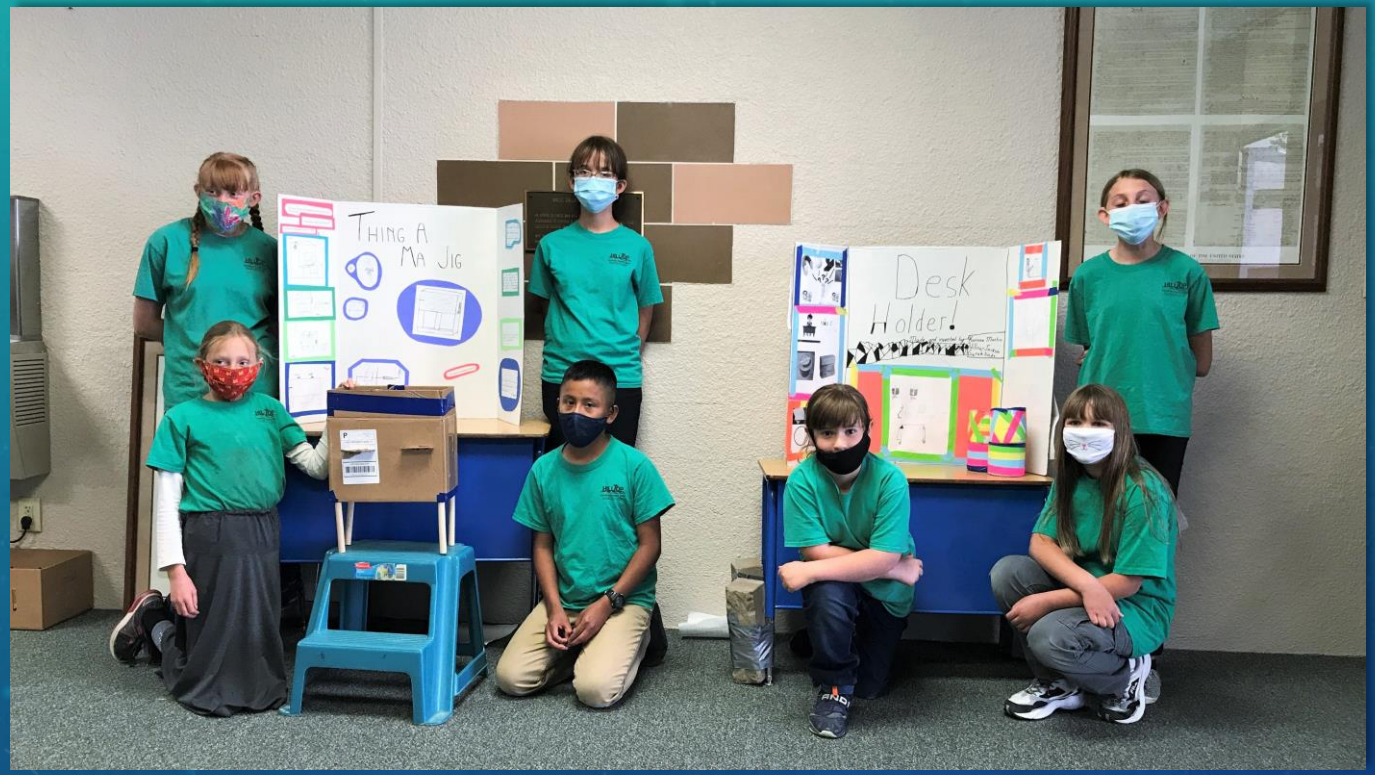
Twin Falls, Idaho

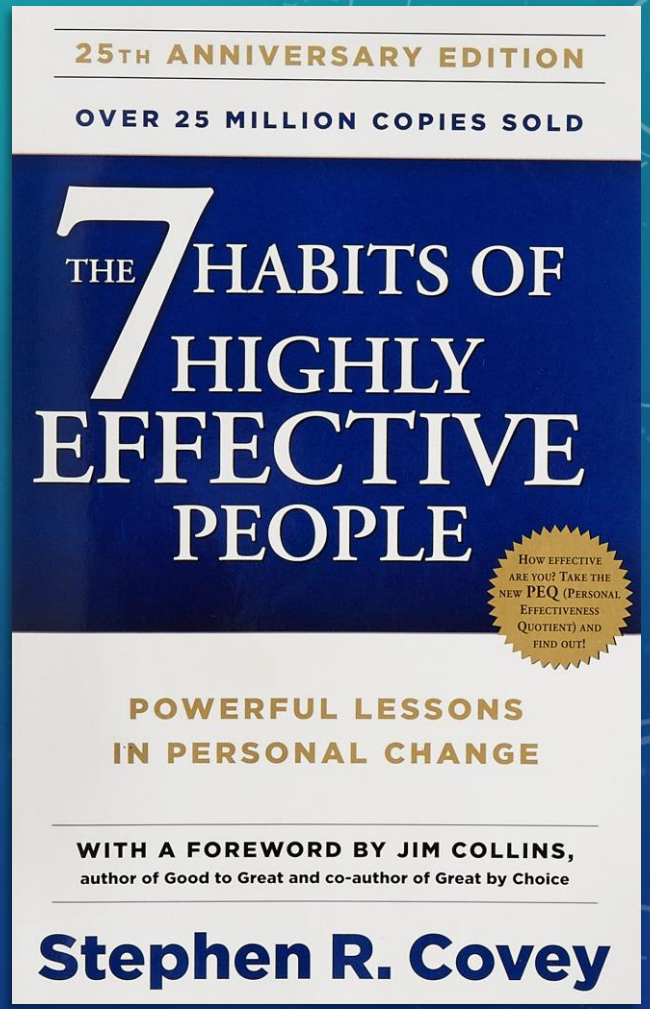
REMEMBER THE WHY
OUTCOME: PROBLEM SOLVERS

- Build Confidence
- Celebrate Creativity
- Developing Resilience
- Perseverance
- Cooperation
- Oral Presentation Skills
- Spiritual Application

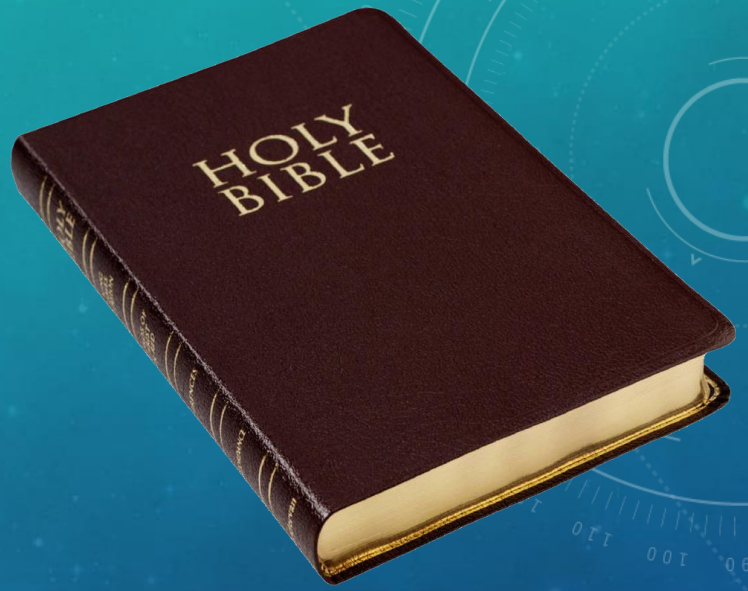


BEGIN WITH THE END IN MIND





THE WORD



"See, I am doing a new thing! Now it springs up; do you not perceive it? I am making a way in the wilderness and streams in the wasteland."

- Isaiah 43:19 (NIV)

"Two are better than one, because they have a good return for their labor: If either of them falls down, one can help the other up." *- Ecclesiastes 4:9-10 (NIV)*

TURN & TALK

WHERE WILL YOU START?
WHAT DO YOU STILL HAVE QUESTIONS ABOUT?

QUESTIONS & ANSWERS

SUMMARY

- Start with the standards
- Make a plan
- Stick to deadlines
- Help students select a problem to solve
- Teach collaboration and cooperative skills along the way

- Visit andrews.edu/go/invent: resources, videos, etc.
- Plan an Invention Fair for your school in the spring
- Remember why we are doing this
- Contact us if you get stuck: monica.nudd@gmail.com