THE SCIENCE BEHIND THE FAIRYTALE (STRUCTURES & MECHANISMS)

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Classroom Catalyst (Elementary)

The Science Behind the Fairytale

TITLE: STRUCTURES AND MECHANISMS

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Grade Level: Grade 5

Strand(s) and Unit(s): Understanding Structures and Mechanisms -

Forces Acting on Structures and Mechanisms

Overview:

Inquiry Focus: List key words and/or key question(s) that reflect the focus of the inquiry-based learning experience/approach.

Use technological problem-solving skills (see page 16) to design, build, and test a frame structure (e.g., a bridge, a tower) that will withstand the application of an external force (e.g., a strong wind or simulated vibrations from a train) or a mechanical system that performs a specific function (e.g., a building crane)

Timeline:

The timeline for this unit will be as follows: 3-4 weeks

Instruction on structures and mechanisms in the environment and the forces which act upon them (Begin Mid-May)

Design, build and test a frame structure that will withstand an external force or a mechanical system that performs a specific function (Begin June 1 with testing by Mid-June)

Big Ideas:

1. Structures and mechanisms throughout our environment have forces that act on and within them. (Overall expectations 1 and 3)
2. We can measure forces in order to determine how they affect structures and mechanisms. This information can be used to guide the design of new structures and mechanisms. (Overall expectations 1 and 2)
3. Forces that result from natural phenomena have an effect on society and the environment. (Overall expectations 1 and 3)

Overall Expectations:

1. analyse social and environmental impacts of forces acting on structures and mechanisms;

2. investigate forces that act on structures and mechanisms;

3. identify forces that act on and within structures and mechanisms, and describe the effects of these forces on structures and mechanisms.

Learning Goal:

We are learning to compare natural and human forces on structures of different materials for a sophisticated understanding of the concept of force acting internally and externally on structures and/or mechanisms.

Prior Knowledge:

Students will have studied pulleys and gears in grade 4. There should a basic understanding of pulleys and gears make it possible for a small input force to generate a large output force (so the pulleys and gears do the work).

Students will have studied strong and stable structures in grade 3. There should be a basic understanding of structures are affected by forces acting on them. Structure, strength and stability.

Inquiry Based Science

Inquiry-based science adopts an investigative approach to teaching and learning where students are provided with opportunities to investigate a problem, search for possible solutions, make observations, ask questions, test out ideas, and think creatively and use their intuition. In this sense, inquiry-based science involves students doing science where they have opportunities to explore possible solutions, develop explanations for the phenomena under investigation, elaborate on concepts and processes, and evaluate or assess their understandings in the light of available evidence. This approach to teaching relies on teachers recognizing the importance of presenting problems to students that will challenge their current conceptual understandings so they are forced to reconcile anomalous thinking and construct new understandings. (Dr. Gillies)

Instructional Planning and Delivery: This section should fully describe the lesson sequence on how you apply the inquiry-based strategy/approach in your classroom and the steps teachers can follow to adapt for use in their classrooms. Where ever possible, embed teacher tips and hints throughout the lessons/approaches.

Here are some helpful ideas:

- How did you start the process?
- What were the guiding questions? Backwards design process:
    - What is it that you want your students to learn or to be able to do?
    - How will you know that they learned what you wanted them to learn (or do)?
    - How will you get them there?

- How did you scaffold the instruction of required skill sets and knowledge-building? Use sub-headings to describe the sequence of teaching/learning strategies and discussion outlines with suggested timelines.
- What were the Inquiry experiential and hands-on opportunities? Use sub-headings to describe these teaching/learning opportunities with suggested timelines.

Student Support Resources:

Classroom-ready student support materials have been included. Handouts for students and rubrics for assessments have also been included for all inquiry based lessons. Handouts have been numbered and referenced.

Assessment Opportunities:

Classroom assessment strategies and tools have been incorporated into the lessons to reflect how well students are achieving the curriculum expectations by assessing for learning and as learning.

Future Opportunities / Extensions: Structures to support learning in Science strands in later grades could be built using the skills and knowledge obtained in this earlier build. For example, structures in grade 6 science (car frame) could be built on which electricity (small motor, battery), wheels and axles could be added to create movement of the structure.

Grade 4 Science investigates pulleys and gears. Students could build simple structures on which their pulley system could work (example: base and stand for pulley system). Ancient civilizations are also part of the grade 4 curriculum. Student investigations could explore and build simple machines and devices.

Guest speakers could include: professionals involved in engineering, construction, weather reporting, municipal emergency services (downed trees, building damage due to extreme weather.)

Learning Activities

Key Concepts	Learning Activities/Resources	Materials and Equipment

Effect of Natural Phenomena on natural and built environments.

Terminology

tornadoes, hurricanes, earthquakes, tsunami, flood, wildfire

suspension, arched, cantilever, truss, beam, tension, compression, stability, gravity

Concepts

- The frame (not the walls) supports the structure.
- Engineers must use strong shapes.
- Triangles and arches are strong
- A-frame is very strong
- bridges - truss, beam, suspension, arch, cantilever

Mini-Inquiry/Research:

What is the phenomena?

How does it impact the city, environment, buildings, etc.?

What can we do to protect ourselves?

Identify structural features that overcome these forces? ex. cross supports for roofs, steel beams in a roof.

Teacher Reference 1 - Mini Inquiry

Handout 1 - students

Mindomo

BYOD - Junior Resources

Science and Technology Activities Resource (

Beam, truss, suspension bridges(3 min)

https://www.youtube.com/watch?v=oVOnRP

Bill Nye - Structures(25 min)

https://www.youtube.com/watch?v=fp1bVW

Strong Structures with Triangles (5 min)

https://www.youtube.com/watch?v=mBHJtW
v=mBHJtWbsiaA)

Making Structures Strong (7 min)

https://www.youtube.com/watch?v=SQtlAcV

Peer Feedback - Student Handout 2A

Exit Ticket -Student Handout 2B

Construction Techniques and Materials to withstand natural phenomena	(Choice of video for student) video prompt for questions bridge in california shopping mall in Japan shopping mall in Canada snow tornado and house article about too many people on a roof - collapse http://www.queensjournal.ca/story/2018-03-23/news/st-patricks-day-sees-unprecedented-crowd-size-collapsed-roof/ (http://www.queensjournal.ca/story/2018-03-23/news/st-patricks-day-sees-unprecedented-crowd-size-collapsed-roof/) video about calgary arena roof collapse https://globalnews.ca/video/4037907/fairview-arena-roof-collapses (https://globalnews.ca/video/4037907/fairview-arena-roof-collapses) houses under construction collapse https://globalnews.ca/video/4123970/homes-under-construction-in-niagara-falls-ont-collapse-under-strong-winds (https://globalnews.ca/video/4123970/homes-under-construction-in-niagara-falls-ont-collapse-under-strong-winds) group research gathering see document below. Safety Considerations	Handout 3 article -extreme weather and design https://blog.houseplans.com/article/designi (https://blog.houseplans.com/article/design article -extreme weather and design https://blog.houseplans.com/article/designi (https://blog.houseplans.com/article/design article - extreme weather and design https://www.motherearthnews.com/green-h (https://www.motherearthnews.com/green-h website and images - home construction http://www.lushome.com/modern-house-des (http://www.lushome.com/modern-house-de Washington Post Article on building https://www.washingtonpost.com/realestate mother-natures-fiercest-outbursts/2016/02/(noredirect=on&utm_term=.1dd8c01f8ab1 (ht finding-ways-to-make-homes-stand-up-to-m c53b-11e5-a4aa-f25866ba0dc6_story.html?n videos: https://www.youtube.com/watch?v=3Ge-9rAI hurricane proof home https://www.youtube.com/watch?v=c4fKBGs earthquake proof https://www.youtube.com/watch?v=mBHJtW v=mBHJtWbsiaA) stronger structures - triangles Teacher Resource 3

1.2 impact of society and environment on structures and mechanisms? Not sure Concepts Persuasive Letter taking different perspectives into account (e.g., the perspectives of golfers, local bird-watching groups, families, a school board), and suggest ways in which structures and mechanisms can be modified to best achieve social and environmental objectives Sample issues: see attached task.	Persuasive Letter Students will choose the scenario and then in groups they will brainstorm possible solutions and arguments for both sides of the issue/solution. Identifying different perspectives from various groups/stakeholders. Then each student will write their persuasive letter. Prior to writing, students will be analysing sample persuasive letters or teacher could model persuasive letter writing.	Handout 4A & 4B Teacher Resource 4 Idea: provide descriptive feedback specifical they use the feedback.

Measure Load: measure and compare quantitatively or qualitatively the force to move a load. Concepts force to move a load - comparing the use of a mechanism. Force to move load from stationary position up, force to move load up a ramp, force to move load using a lever and finally using a pulley system. Using a mechanism gives you an advantage (developed after experiment) Terminology • load • lever • work • newtons • inclined plane • pulley system • spring scale • mechanism • mechanical advantage	eg. lift a book, open a drawer, Using different mechanical systems relationship between force and distance Experiment with pulley systems and spring scales	Science and Technology Activities Resource (Student Handout 5 only do 1-6 on experiment steps
concepts advantages and disadvantages of mechanical systems (hoist, 4 pulleys the more pulleys the less force needed in a system.	Extend student investigation by prompting them to build another pulley system that will raise the load with even less work (number 7 page 23).	Students will create their own observation cl system.

Science and Technology Vocab/Concepts Concepts • internal force (compression/tension) • external force (weight, furniture in house, movement caused by train) Terminology • tension • compression • system • load	FORCES ON STRUCTURES page 11-14 forces on structure science and tech Students will review concepts and terminology of tension and compression and gravity. Students will build a bridge out of straws, string and tape.	Student Handout 6 Partners: 40 straws 1 metre of tape 1 metre of string task: to build a strong bridge to cross a 20-cr
Using Building Materials - The Pre-Build	Pre-build for culminating task Picture frame for Father's Day use of saw, clamp, hot glue gun creation of mitred corners videos for use of tools safely (STAO) STAO instructions for picture frame	picture frame https://docs.google.com/document/d/1Xpux (https://docs.google.com/document/d/1Xpux safety slide deck https://docs.google.com/presentation/d/1j5v usp=sharing (https://docs.google.com/presentation/d/1j5 usp=sharing)

Culminating Task - The Build	build a fairy tale structure and write a fairy tale. 1. analyse social and environmental impacts of forces acting on structures and mechanisms; 2. investigate forces that act on structures and mechanisms; 3. identify forces that act on and within structures and mechanisms, and describe the effects of these forces on structures and mechanisms. Planning Document - students will create a planning document which answers the following questions: Structure: What strategies will you use to ensure that you build a structure capable of withstanding an external force? How will you test your structure? What safety measures do you need to consider when testing it? How will you know if your structure was successful? sketch? tools Device: What function is your device intended to perform? How will you test your device? What safety measures do you need to consider when testing it? How will you know if your device was successful? sketch tools	Student Handout 7A - Assignment Student Handout 7B - Graphic Organizer Student Handout 7C - Planning Document Student Handout 7D Student Handout 7E Reflection (written) after build (Part of Planning Document) What changes might you suggest to improve Teacher Handout 5A and 5B

RESOURCES

A compilation of visuals showing the progress of students building their structures. (https://connex.stao.ca/sites/default/files/phototable.docx)

ELEMENT

Inquiry (/expert-elements/inquiry)

(/classroom-catalysts) RETURN TO CATALYSTS (/classroom-catalysts)

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