LESSON PLAN: Paper Chain STEM challenge	
Grade Level: 4	**Subject/Strand:** STEM Investigations
Topic: Engineering Design	**Length of Period:** 30 minutes, with possible extension
Lesson Plan Description: This lesson gives learners an opportunity to make predictions, plan & create a paper chain using provided materials. They are challenged to consider not only how to best work as a team, but also to explore what strategies will lead to creating a longer chain.	

CURRICULUM CONNECTIONS

Curriculum Expectations	**A1.** STEM Investigation and Communication Skills **A1.3** use an engineering design process and associated skills to design, build, and test devices, models, structures, and/or systems
Learning Goals	☐ We will learn to use the scientific method to make predictions, plan, carry out an experiment and modify designs ☐ We will learn about efficient use of materials in design, and how the same amount of materials can lead to different final products. ☐ We will learn to think creatively with open minds to create the best possible chains.
Success Criteria	☐ Students will use critical thinking to predict, plan & design their paper chains efficiently. ☐ Students will communicate effectively with team members. ☐ Students will be able to identify the factors that contribute to the different types of chains produced in the class.

ASSESSMENT

Purpose of the assessment : FOR learning	**Assessment Mode:** Performance/Do
Achievement Chart categories being assessed: Thinking, Application	**Learning Skills/Work Habits:** Collaboration, Initiative

Assessment Strategy: - Students will reflect on and communicate what went well working as a team, and what could be improved in the future. They will identify the roles of each team member. - Learners will explain the thought process and rationale that led to their initial prediction. - Students will identify and justify the strategy and process used to create the longest chain, and reflect on its success.	**Assessment Tool:** - Group reflection as a class, guided by process questions - Self & Peer assessment in the form of a reflective exit card at the end of class

CONSIDERATIONS FOR PLANNING

Prior Learning:

- Students will have some previous experience and skill related to collaboration with peers
- Based on Ontario's grades 1 to 3 curriculum expectations, most students would have previously been introduced to aspects of the scientific research process and the engineering design process and have begun building skills related to prediction, initiating and planning, critical thinking and problem solving, and recording/communicating process and findings and evaluating/analyzing findings

IEP program implications: Accommodations can be made to help students succeed in this activity

Differentiation:

Content - The content of this lesson can be the same across all students, the only section that may be adjusted is the debrief after the activity, where the depth of the conversation varies on the students present in the class - i.e. the types of real world connections made to the activity.
Process - Instructions provided to the whole class verbally and on the board, but teacher will circulate the class to provide individualized support & repeat instructions as needed
Product - all students will be expected to produce the same final product. Students who may struggle with fine motor skills can be paired with other students with complementary skills to assist with cutting/taping etc. Even students who may not be as able to help construct the physical chain can contribute in terms of ideas & strategy.
Environment - Depending on student needs, group sizes can be modified. Groups can be spread out around the classroom/in the hall to suit their needs, if some students need a quiet workspace.

Resources and Materials

- Paper, (regular printer paper, enough for one piece per pair/group)
- Scissors, (one per pair/group)
- Tape (preferably masking tape)

As a 'back pocket' stem activity, no teacher resources or worksheets are essential, however a worksheet could be used for individual debrief in place of a classwide conversation if desired.

THREE PART LESSON

Instructional Strategy:	Small Group
Minds on:	**Motivational Hook;** - Present the compelling problem of challenging students to make the longest chain they can with one piece of paper. - They will be encouraged to strategize, and work in pairs to accomplish this challenge.
Action:	The activity involves students working hands on to complete the challenge, and this will take up the majority of the lesson time. As students work in groups, the teacher will circulate to assist students as necessary, & prompt them with questions to engage in thinking about what they are doing. Can also choose to have a midpoint class wide check in for students to share their ideas/progress.
Consolidation & Connection:	**After the time limit is reached, bring the class together to share each of their chains, and have a reflective conversation as a class.** ● How accurate was your prediction? ● What worked well? What would you do differently? ● What factors impacted your chain length? How did your group work together? ● Do we think there is a maximum length that chains can reach? ● Do you think that different types of paper would have any impact? **To check understanding;** can have students fill out an exit card with something they learned, & something they wonder (for extension in a future lesson).
Extension Activities:	- Order the chains by length and discuss similarities and differences - Try with different types of paper - Make the strongest and longest paper chain? Who's chain can hold the most weight - ie; using marshmallows - How can you make the shortest possible chain & still use all the paper
Next steps:	Taking the concepts from this experiment, extend to discussing real world connections - Ie engineering of larger structures, such as bridges in real life that cars will drive across. - What kind of considerations would be made in planning, selection of materials, length & strength etc?