TATA CONSULTANCY SERVICES | Discovery EDUCATION

IGNITE MY FUTURE

THINK | SOLVE | CREATE | CONNECT

SUBJECTS

Engineering
Math

COMPUTATIONAL THINKING PRACTICE

Developing and Using Abstractions

COMPUTATIONAL THINKING STRATEGY

Analyze Data
Decompose

MATERIALS

Computers with Internet access

Concentration Toys student capture sheet

Build Your Own Concentration Toy student capture sheet

Graph paper

Pencils

Whiteboard or chalkboard

Focusing toys: stress balls, Zen gardens, fidget rings, thinking putty, fidget foot bands, etc. (optional)

Optional extension: Students can use 3D modeling software or applications to design and print concentration toys. Necessary materials include computers with Internet access and the ability to use 3D modeling software (TinkerCAD, Inkscape, etc.) and 3D printers.

LESSON TITLE

Find Your Focus

Guiding Question: How can technology improve our lives?

Ignite Curiosity

- Have you ever had a great idea for a new toy?
- Why is play important for health and wellness?
- What helps you focus when you need to study?

In this lesson, students will think like computers to decompose the real-world problem of designing a toy that helps students focus while studying. In **THINK**, students act as toy designers challenged to create a new toy that helps students focus on studying for an extended amount of time. Because there are so many different learning styles, the toy designers have decided that instead of manufacturing the toy themselves, it is better to publish an instruction guide that teaches someone how to make a generic concentration toy and modify it to suit their unique needs. Students will analyze current concentration toys available now and assess the benefits and drawbacks of different designs. They will discuss the diversity of learning styles and why a more generic toy design helps to solve a variety of problems. In **SOLVE**, students will brainstorm different toy designs and decompose the process of designing a concentration toy. In **CREATE**, students will create an instruction guide that breaks the process of building a custom concentration toy into manageable steps. Classrooms with access to 3D printing technology may choose to extend this lesson by printing a 3D artifact of a concentration toy. In **CONNECT**, students will explore how 3D modeling connects to careers, production, and the problems of tomorrow.

Students will be able to:

- **Evaluate** different toy designs,
- **Understand** the process of decomposing complicated problems into manageable sub-problems, and
- **Create** an instruction manual that teaches someone how to construct a unique concentration toy.

Students act as toy designers challenged to create a new toy that helps students focus on studying for an extended amount of time. Students will analyze concentration toys currently available and assess the benefits and drawbacks of different designs. They will discuss the diversity of learning styles and why a more generic toy design helps to solve a variety of problems.

1. **Read** the following scenario to students:
   Imagine that you are a designer working for a toy company. Your job is to generate creative ideas for new toys and communicate these ideas to the people who build the toys. After a conversation with middle school students, you learn that focus toys are very popular with students who are trying to concentrate on their studies. You decide that you want to build a new focus toy that any student can use while studying in any environment. The problem is that students have a wide range of learning styles and study in lots of different environments, so it would not work to create one toy that every student could use. You decide that instead of building one toy design, you will create an instruction manual that teaches students how to customize a generic concentration toy to fit their needs and learning style. You think that new 3D modeling software and 3D printers are a great way to make this idea a reality. Can you decompose the problem of designing a concentration toy that anyone can build and use?

2. **Ask** students to name some different toys that might help someone focus while studying. Answers might include stress balls, putty, fidget spinners/rings, elastic bracelets, chewable bands, etc. Write the answers on a chalkboard or whiteboard.

3. **If you have any focus toys** in your classroom, pass them out and have students examine them. Ask students to describe the toys and identify different design characteristics. Write these characteristics on the board. They might include things like "squishy" or "soft" or "spins."

4. **Ask students** why they think focus and concentration toys are so popular. What benefits do they offer? What are some drawbacks? Write these on the board. Explain that these benefits and drawbacks are helpful in determining the criteria and constraints of their focus toy design.

5. **Explain** that different students have different learning styles. While learning is unique to each person, many learners can be assigned into one of three categories:
   - Visual learners—learn best by seeing. Helpful tools include colors, maps, and writing things out.
   - Auditory learners—learn best by hearing. Helpful tools include songs and recordings.
   - Kinesthetic learners—learn best through hands-on experiences. Helpful tools include acting things out, taking notes, and drawing.

6. **Have students pair up** with a partner to discuss which learning style they feel best fits them. Ask each student to think of three toys or techniques that help them learn.

7. **Pass out** the Concentration Toys student capture sheet. Divide students into groups of three or four. Have groups work together to identify a variety of toys that could be used to help students with different learning styles focus. Ask students to record design features of the different toys on the Concentration Toys student capture sheet. Allow student groups 15 to 20 minutes to brainstorm different toys and characteristics.

8 **Once students have completed** the Concentration Toys capture sheet, lead the class in a discussion about how some focus toys are better for certain learners than others. For instance, kinesthetic learners might benefit from a focus toy that allows them to manipulate it, like putty. Ask how different environments also change what focus toys might work best. For instance, fidget spinners can be loud and might be distracting in a library environment.

9 **Re-read** the initial prompt to students. Ask them to summarize the problem in the prompt (designing a concentration toy that someone can make at home that works for any learner in any situation). Explain to students that this problem is complex and includes many sub-problems. When computer programmers design new software programs, they write the code for the program in chunks. That helps to break a big program out into smaller, more manageable pieces and allows the programmer to copy or replicate some of the chunks. The computational thinking strategy of decomposing helps us take large problems and break them down into manageable sub-problems. Lead students through the process of identifying the sub-problems in the prompt:

- Designing a concentration toy
- That can be made at home
- That helps students with different learning styles
- And can be used in many different situations

10 **Ask** students how they think it might be possible to design a toy that fits all these different criteria. Explain that by making a generic toy that users can modify, they can meet the criteria of the prompt. Explain to students that decomposing is a form of abstraction. When we abstract something, it means that we have removed layers of detail so that we can make one solution work in many situations.

Students brainstorm designs and decompose the process of building a concentration toy.

1. **Ensure** that students are still in groups of three or four. Provide groups with 5 minutes to identify the criteria and constraints of the challenge.

2. **When they have finished,** ask groups to share their answers. Criteria should include considerations such as the toy should be easy to make and use materials that are commonly available. Constraints include the fact that the toy must be appropriate for use in a variety of scenarios, so toys with noises, excessive motion or bright lights will not work. Write the criteria and constraints on the board.

3. **Instruct** groups to review their Concentration Toys capture sheet and identify which toy on the sheet best meets the criteria and constraints of the problem. When they have selected a toy, provide students with 15 to 20 minutes to brainstorm the following:
   - How the toy solves each of the sub-problems identified in the prompt
   - Three modifications they could make to the toy to customize it for different learning styles

Students create an instruction guide that breaks the process of building a custom concentration toy into manageable steps.

1. **Distribute** the Build Your Own Concentration Toy student capture sheet.

2. **Explain** to students that they will decompose the process of creating the concentration toy they have selected by creating an instruction guide. They will use the Build Your Own Concentration Toy student capture sheet to record their instructions. Remind students that the guide, like the toy, must include aspects that work well for each learning style. The instructions should be clear, easy, and accessible (using materials that are inexpensive and commonly found in the household).

3. **Provide** groups with 30 minutes to create their instruction guides, offering help as needed.

4. **When groups have completed** their instruction guides, ask students the following questions:
   - How did the computational thinking strategy of decomposing help you solve the challenge in the prompt?
   - How can computers help individuals with learning disabilities like autism or ADHD to focus in school or work?
   - What happens when you haven't had a chance to exercise or play in a while? How does your concentration change?
   - Could you use 3D modeling software to design a concentration toy that's tailored to your learning style?

Optional Extension: Classrooms with access to 3D printing technology may choose to extend this lesson by printing a 3D artifact of a concentration toy.

Select one of the strategies listed below to help students answer these questions:

- **How does using modeling and prototypes to communicate relate to me?**
- **How does modeling using technology connect to real-world careers?**
- **How does using modeling and prototypes to communicate relate to our world?**

1. **Write** the three questions on PowerPoint or flip chart slides and invite students to share out responses.
2. **Display** pieces of chart paper around the room, each with one question written on it. Ask students to write down their ideas related to the questions on each sheet.
3. **Assign** one of the questions to three different student groups to brainstorm or research, and then share out responses.
4. **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Most products that students use every day began as abstract ideas. Students probably don't consider the process required to transform an idea into a product.

Every aspect of a product—its size, color, materials, and functionality—is carefully considered. Designers work with manufacturers to make prototypes and modify them until they create the best possible product. Guide students to think about the creative and practical processes behind the objects around them, from cars to chairs to smartphones. If students have ideas for creating or improving objects, they can consider careers in design and manufacturing in which they could make their ideas reality.

How does this connect to careers?

Industrial Designers develop the concepts for manufactured products, such as cars, home appliances, and toys. They combine art, business, and engineering to make products that people use every day. Industrial designers consider the function, aesthetics, production costs, and usability of products when developing new product concepts.

Software Developers are the creative minds behind computer programs, including modeling programs and other programs that help people communicate their ideas. Some develop the applications that allow people to do specific tasks on a computer or another device. Others develop the underlying systems that run the devices or that control networks.

Machinists and Tool and Die Makers set up and operate a variety of computer-controlled and mechanically controlled machine tools to produce precision metal parts, instruments, and tools. These workers use specialize machines to create products based on a prototype.

How does this connect to our world?

Before something new can be manufactured, it has to be described in great detail. 3D modeling and printing is a way to provide this detail.

Today, most products are produced far from where they are designed. Designers working anywhere in the world need to be able to communicate their ideas clearly and precisely so that the products that are based on them exactly match their inspiration. Technology like 3D modeling software enables this communication.

National Standards

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
▪ Asking questions and defining problems ▪ Developing and using models ▪ Constructing explanations and designing solutions	**MTS1-4** ▪ Develop a model to generate data for iterative testing and modification of a proposed object, tool or process such that an optimal design can be reached.	**MS-ETS1-2** ▪ Evaluate competing system design solutions to determine how well they meet the criteria and constraints of the problem.

COMMON CORE STATE STANDARDS CONNECTIONS

Mathematics

- **MP.2** Reason abstractly and quantitatively.

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 4. Developing and Using Abstractions

Abstract ideas are converted from visual images that exist only in the mind of the inventor to a digital form that can be transformed to a standard format appropriate as input to a 3D printing device. The use of 3D models and 3D printers is especially for the new generation of "makers."

Concentration Toys

Identify a toy that meets the specific criteria for each of the cells in the chart below. The left side of the chart includes criteria for where the toy will be used. The top of the chart includes criteria for what type of learner should benefit from the toy. Each toy must meet both criteria.

	Works for Visual Learners	Works for Auditory Learners	Works for Kinesthetic Learners
Good for traveling			
Good for use at home			
Good for use in the library			
Good for use outside			
Good for use in the classroom			
Good for use during a quiz or test			
Good for use while in a busy area			
Good for use while walking			
Good for use while sitting still			

Build Your Own Concentration Toy

Toy Name:

This Toy Is Great Because:

Where You Can Use This Toy:

Materials Needed:

How to Make It:

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

How to modify this toy for different learning styles:

- **Visual learners:**
- **Auditory learners:**
- **Kinesthetic learners:**