CRRAFT PARTNERSHIP

SCHOOL CURRICULUM
PHASE 2

PHASE 2

WE CAN DO STEM

Phase 2 is all about using strategic approaches to solve challenging problems.

PHASE 2 POWERFUL IDEAS

Design Process | **Hardware/Software** | **Debugging**
for more on these powerful ideas:

The design process is a series of steps used to solve complex problems. The steps included help us solve the problem in strategic and organized ways. Solving the problem will mean determining how robots work and how they can be communicated with, addressing **hardware/software**. Regardless of how the problem is solved, issues are almost certain to arise so it is important to use **debugging** to be able to identify and solve those issues.

PHASE 2 LEARNING STANDARDS

PK.AL.CB.14 Demonstrate a willingness to collaborate with others to solve a problem.2 Focal standards in phase
PK.AL.CT.8 Seek additional clarity to further own knowledge (e.g., asks what, how, why, when, where, and/or what

PK.SL.PKI.5 Create representations and extensions of experiences or stories through writing, drawing, and open-ended materials in centers, and discuss them with others.
PK.ETS2.01a. Recognize that tools have specific characteristics that determine their use.

PHASE 2 GOAL

*Children will understand that using **the design process** helps us solve complex problems in our daily lives. This means STEM is everywhere and for everyone!*

PHASE 2 MATERIALS

- Design Process Anchor Chart
- Code & Go Mouse
- Botley/Code-a-pillar
- Loose parts materials
- Art/design materials
- Chart paper
- Engineering materials (ramps, tubes)
- Community pictures

CRRAFT PARTNERSHIP

SCHOOL CURRICULUM

PHASE 2

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PHASE 1 OVERVIEW

Phase 2 Focal Experiences	Phase 2 Small Groups	Phase 2 Centers	Phase 2 Focal Texts
Build a Community Robot *Work together to design a robot to solve problems*	Robot vs. Robot Problems We Can Solve (ABC Tree) Designing Your Robot Welcome Home, Robot	• Art *loose parts, design materials* • Blocks *tangram blocks or other puzzle-type blocks; magnatiles* • Books *books featuring robots and STEM figures* • Computer *ABCya Robot Builder (web)* • Dramatic Play *Astronaut costumes/props* • Puzzles/Games *Pattern blocks, shape puzzles* • Writing *Clipboards, graph paper (for design)*	 *Computer Decoder* (Real life STEM users)  *The Astronaut with a Song for the Stars* (Real life STEM users)  *Robots, Robots, Everywhere* (What are robots and what do they do)  *Pete the Cat: Robot Pete* (What are robots and what do they do)

PHASE 1 TIMELINE

*Each CRRAFT phase lasts approximately 6 weeks. Phases can and should overlap or be extended or shortened as needed in your classroom. This timeline is a **suggestion**.*

week 1

Wrap up Phase 1 Focal Exp, Small Groups, and Centers
Transition to Phase 2
Make connections between Phases

Phase 2
Introduce focal robot
Books about real STEM users
Small group 1-2
Centers as desired

week 3

Phase 2
Continued robot explorations
Books about robots
Small Group 3-4
Centers as desired

week 6

Phase 2
Phase 2 Focal Experience
Small Groups 3-4
Centers as desired

PHASE 2

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CULTURAL RELEVANCE

Honor communities!

Spend time thinking with children about their community - the assets and the challenges. Consider where and how robots are a part of their everyday lives. Talk about how robots can solve specific community issues.

STEM is for everyone!

Discuss who can do STEM. Books in Phase 2 focus on real life STEM heroes who defied the odds of their time. Discuss how everyone (including children) can do STEM. Use the design process to support conversations about how STEM works.

Solving problems iteratively!

Remember that the design process does not have a specific starting and ending. As some cultures do not tell stories using the Western narrative structure (beginning, middle, ending), problem solving can also support iterative and cyclical ways of thinking. Problems can be worked on, the plans can be revised and re-envisioned, and new problems and questions can emerge.

THINGS TO CONSIDER

Note: These are tips and tricks to get the most out of the phase

- Use the design process to solve problems and address questions above and beyond specific robotic activities. You can use the design process to support a science experiment or building a block structure.
- Phase 2 builds on Phase 1. Continue implementing Phase 1 activities based on children's interests and needs. Suggestions include:
  - *Identifying sequences and algorithms in everyday experiences.*
  - *Continue programming self/teacher/peer using coding cards on velcro strips.*
  - *Program robots using coding cards, with a particular focus on directionality.*

ESSENTIAL QUESTIONS

Note: These are not questions to answer but thematic questions that underlie the phase

How do we break up a task into iterative steps to solve a problem?

What is a robot? What does it do? Where do we see robots in our lives?

Who is a computer scientist? How do they solve problems?

PHASE 2
WE CAN DO STEM

THE DESIGN PROCESS

The **design process** is a series of steps. Those steps help us solve complex problems in strategic and creative ways. All the steps are related to each other. Solving hard problems is messy! So the design process helps us stay organized. But we can repeat steps in the design process as many times as needed. It is normal to make mistakes when doing STEM. We can learn from those mistakes. We use the design process to keep trying.

START

Children have **big questions**! Help them identify related but smaller questions & problems that they can answer or solve.

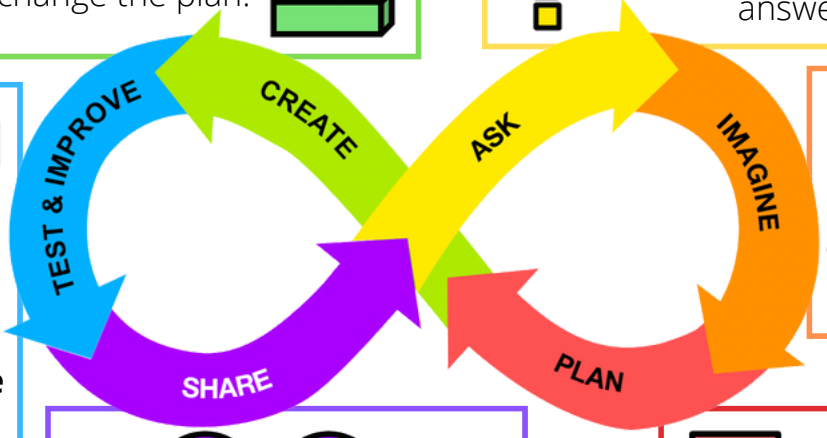
Support children to come up with **ideas** to answer question. **Be creative**!

Planning can be hard for children. Encourage them to use different tools, such as **talking** about their plans or **drawing** pictures.

Share with others. This can help you imagine different solutions or improvements.

Test out the prototype. Does it solve the problem or answer the question? If not, go back and **imagine** new solutions. If it works, can it be improved? If so, go back and plan improvements.

Children can **build** a *prototype* -- a test model -- based on the plan. Use items available around the house like toys or recyclables (paper towel tubes, recyclables (paper towel tubes, cereal boxes, etc.). If something goes wrong, go back and change the plan.



Design Process anchor chart, from DevTech Research Group's Coding as Another Language Curriculum.
Source: https://sites.tufts.edu/codingasanotherlanguage/curricula/pre-kindergarten-kibo/

PHASE 2

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PHASE 1 CENTERS

Center	Materials	Powerful Idea
Art	In art, we can be designers and makers • Design materials (rulers, protractors) • "Maker space" craft materials (pompoms, pipe cleaners) • Recycled materials and loose parts for prototype building	**Design Process**
Blocks	In blocks, we can continue exploring robots • Robot mice, directional cards, numbered velcro strips for directional cards; Botleys/Code-a-pillars • Tangram blocks and/or Magna Tiles • Various blocks and loose parts	**Design Process** **Hardware/ Software** **Debugging**
Books/ Library	In books, we can learn about robots and STEM leaders • Books on robots • Books on computer scientists and other STEM figures	**Hardware/ Software** **Debugging**
Dramatic Play	In dramatic play, we can act as computer scientists • Astronaut or scientist dress ups/props • Old (not operating) phones, tablets	**Representation** **Hardware/ Software**
Puzzles and Games	In puzzles/games, we can represent designs and solve problems • Pattern blocks and sheets	**Representation** **Debugging**
iPad/ Computer	In iPad/computer, we can build our own robots • ABCya Robot Builder (web)	**Hardware/ Software**
Writing	In writing, we can represent our ideas and plans • Clipboards • Graph paper	**Representation** **Design Process**

PHASE 2
WE CAN DO STEM

PHASE 2 SMALL GROUPS

Small Group #1 and #2

Please collect documentation/artifacts for each small group

Robot vs. Robot

hardware/software | **representation**

Students will discuss the nature and functions of different robots. What are robots and what can they do?

Standard: PK.PS1.01a. Describe and categorize objects based on their observable properties.

Materials Needed:
Robot Mouse and other robot (Botley or Code-a-Pillar)
Directional cards
Chart paper (anchor chart), paper, markers

Instructional Steps

I DO **Introduce the idea of a robot - what it is and what does it do? Introduce new robot and review its functions.**

WE DO **Explore Robot Mouse and record on their paper what it can do, use cards to help. Discuss and compare with new robot.**

YOU DO **Collaborate on an anchor chart showing the differences in robots. Students can represent their thoughts on the chart paper.**

Key Questions

How do we know these are robots? What makes them so? What are all the things that Robot Mouse can do? How can you represent those actions on your paper? What can the new robot do? How are they the same or different?

Success Criteria

M= Student contributes several (3-4) ideas defining robots' nature and functions; represents functions using drawing, writing, and/or dictation
IP= Student contributes a few (1-2) ideas to define robots' nature and functions; may or may not represent meaningfully
NM=Student follows along, imitates and observes.

Robot Prototype**

** - *Collect small group assessment data for all children*

design process | **representation**

Students will discuss robots - what they are and what they can do = and plan/design and build their own robot.

Standards: **PK.CA.2** Create artistic works with intent and purpose using varying tools, texture, color, and technique. **PK.AL.CT.10** Identify a problem and attempt multiple ways to solve it, with or without assistance.

Materials Needed:
Robot books or anchor chart (from SG #1)
Design Process poster
Loose parts and recycled materials (to consider *how* to build robot)

Instructional Steps

I DO **Review what a robot is and what it does (and how). Connect to books or previous small group anchor chart.**

WE DO **Discuss robot functions, characteristics, and designs; discuss how the design process might be used to build a robot.**

YOU DO **Generate ideas to build individual robots - what they will look like, how they will function - represent plan (draw/write).**

Key Questions

What can robots do? If you were going to design your own robot, what would you want it to do? How would you communicate to the robot? How would it function? How does your robot compare to Mouse (or other)?

Success Criteria

M= Student designs and plans own robot; can define its functions and how those will be enacted and can describe the robot.
IP= Student may design robot and provide some detail and description of its appearance and functions.
NM=Student follows along, imitates and observes.

PHASE 2

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PHASE 2 SMALL GROUPS

Small Group #3 and #4

Please collect documentation/artifacts for each small group

Problems We Can Solve

(ABC Tree)

design process | **debugging**

Students will collaborate on solving a problem and designing/constructing an ABC Tree (inspired by Chicka Chicka Boom Boom).

Standards: PK.RL.KID.2 With prompting and support, orally retell familiar stories including details.
PK.AL.CB.14 Demonstrate a willingness to collaborate with others to solve a problem.

abc

Materials Needed:
Chicka Chicka Boom Boom book or recording
Several types of building materials (e.g., wooden cubes and foam blocks) + magnet letters
Paper and writing utensils

Instructional Steps

I DO **Read part or watch segment of *Chicka Chicka Boom Boom.* Discuss the tree in the book and the issues (not enough room).**

WE DO **Using the design process, work together to develop a plan for constructing a tree. Represent plan in writing/drawing.**

YOU DO **Build tree and balance letters on tree top. Collaborate on ways to improve structure. Problem solve as needed.**

Key Questions
What is the challenge or problem in the book?
How can we represent our plan for building?
What do you think is the issue with your design?
What steps can we take to fix it?

Success Criteria

M= Student plans design, represents planning using drawing/writing/dictation, enacts plan, identifies problems and attempts to solve them. .
IP= Student does some of the following - plans, represents plan, enacts plan, problem solves.
NM=Student follows along, imitates and observes.

Welcome Home, Robot

design process| **hardware/software**

Students will design and draw homes for various robots (prototypes they created or class robots like Robot Mouse).

Standards: PK.AL.CO.11 Ask and respond to questions with peers and adults in individual and group activities.
PK.W.PDW.5 With guidance and support from adults, respond to questions and suggestions from others and add details to strengthen drawing, dictating and/or emergent writing as needed.

Materials Needed:
Robot prototypes (from SG #3)
Classroom robots (Robot Mouse)
Design materials

Instructional Steps

I DO **Walk through the design process steps. Model drawing a design for a robot house. Think out loud about what is needed.**

WE DO **Brainstorm together a robot's home. Discuss homes for different robots and why they might be constructed differently.**

YOU DO **Design and draw a home for a robot of choice. Share designs with their small group.**

Key Questions
How will the houses be the same/different?
How will the robot get in/out of the house?
What shapes will you use in your design?
What materials would you use?

Success Criteria

M= Student designs a home for the robot including the materials that will be used and share their design with a friend or friends.
IP= Student designs a home for the robot.
NM= Student make a random drawing.

PHASE 2

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FOCAL EXPERIENCE

Build a Community Robot

design process | **debugging** | **hardware/software** |

Objective: Children will use the design process to build a prototype for a class robot and work together to co-construct a community robot from loose parts.

Materials Needed

Robots, Robots Everywhere / Robot Pete book
Robot Prototype Designs (SG2); Materials
Chart Paper and Markers

Standards

PK.AL.CB.14 Demonstrate a willingness to collaborate with others to solve a problem.

PK.AL.CT.10 Identify a problem and attempt multiple ways to solve it, with or without assistance.

Key Vocabulary:

- design/ design process
- computer scientist
- prototype
- algorithm
- program(mer)

1. **Share robot designs/plans from SG #2. Discuss children's design choices, material selections, and robot functions.**
2. **With prompting and using the design process, collaborate to design a shared robot that will address problems.**
3. **Using previous designs and new ideas, collectively design robot including materials and functions.**

Engage

Connect to children's prior knowledge and introduce key concepts

"What features did you include in your prototype?"

"What makes a robot a robot? How do you know?"

"How do you think robots get built? What steps do they take?

"When you built/designed your robot prototype, what materials did you use/plan to use? What functions did your robot have? How did/would you build it?"

Connect

Link initial ideas to computer science ideas and prepare children for activity

"Robots can be used to solve community problems!"

"What problems have you noticed in our classroom, school, or community?"

"Let's discuss how robots might be helpful to address some of these problems. What functions might they need?"

Explore

Support children in participating in the activity. Ask questions and help make connections

"Let's design a shared robot to solve problems!"

"I want you to be engineers and think about what robot components we would need to address the problem?"

"What materials could we use to create these components?"

"Let's sketch what this will look like."

"Let's see if our design will solve the problems we noticed."

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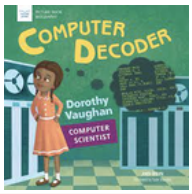
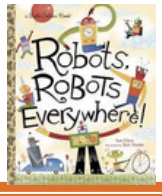
PHASE 2 TEXT CONNECTIONS

Text Title	Connection to Phase and Powerful Ideas	Possible Extensions	Questions (before, during, and after reading)
Computer Decoder 	This book is about Dorothy Vaughan, a groundbreaking African American computer scientist.Use this book to discuss who can do STEM and who uses the **design process.**	Discuss who computer scientists are and what they do - draw pictures of them in art center and discuss the problems they work to solve.	**Before**: What do you think it means to be a *computer decoder?* **During**: Can we see parts of the design process in her work? **After**: Who can help me remember the *sequence* of the story? What happened in Dorothy's life that led her to be a computer scientist?
The Astronaut with a Song for the Stars 	This book is about the first female Latina astronaut Dr. Ellen Ochoa and how she made her dreams come true. Use this book to talk further about people who use the **design process** and do STEM.	Talk to the children about what they want to be when they grow up and the steps that they need to get there.	**Before**: I see a woman in space on the cover with a flute. What do you think she is doing? Why? **During**: Why is it important for her not to give up? What steps did she take to realize her dreams? **After**: What is something you want to learn to do? Who will help you achieve your goal?
Robots, Robots, Everywhere 	The robots in this book are busy doing tasks that help humans. From milking cows to planting gardens, to helping vacuum around the chairs robots are everywhere! This book supports understanding of **hardware/software.**	Use design materials in the art center to draw and design robots. Connect to the book - what can our designed robots do to help us like the robots from the book?	**Before**: Is a phone/iPad a robot? How do we know if something is or isn't a robot? **During**: What do you see in this picture? How is the robot helping? **After**: What are some of things the robots did in this book? How is what they did the same/different from what other robots do (Robot Mouse, phones, etc.)?
Pete the Cat: Robot Pete 	Pete The Cat wants to play catch but all of his friends are busy doing other things. In an effort to solve his problem Pete builds a robot so he won't have to play alone.Use this book to talk about **design process** and **debugging**.	In small group, do a picture walk and discuss the **sequence** of Pete's robot creation. Talk about the materials used and how they support the robot working, and how Pete communicates with his robot. Make connections to **the design process.**	**Before**: What do you think this part of the robot does? How do you think that the robot moves? What makes it turn on and off? **During**: What does Pete program Robot Pete to do? **After**: How did Pete Debug Robo Pete when he wouldn't play the music quieter?

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OTHER POSSIBILITIES

This list contains other possibilities and extensions, small groups and centers, and large group opportunities that were not developed as a part of the CRRAFT program but could be used in this phase.

LARGE GROUP IDEAS

- Read focal texts about robots and computer science. Look at pictures of robots. Discuss and chart characteristics of robots. Use robot puppet to support discussions about robots.
- Read *Robots, Robots Everywhere*. Use the electronic KWL chart visual for students.
- Define robot. Use focal texts, prior experiences with robots, and classroom robots to create a shared definition of what a robot is. Emphasize that robots have both hardware and software that help them to do different things.

SMALL GROUPS AND CENTER IDEAS

- Draw a computer scientist. Draw an engineer. Read books about computer scientists and engineers and ask children to draw their own pictures of computer scientists or engineers at work.
- Design and draw robots. Brainstorm the process of designing a robot and the materials needed to draw one (or build one with clay, blocks, etc.).
- Continue robot center and small group activities with varying levels of teacher support. For example, use Robot Mouse board game, STEM-based loose parts (e.g., pipe cleaners, cardboard, tape), Code-a-pillar, Robot Mouse, blocks, LEGOs, etc.

EXTENSIONS

- Use the **design process** throughout the day. Brainstorm and test solutions to problems with students, for example. Discuss classroom/school/community problems that robots could solve.
- Discuss robot functions for those in the classroom and not (e.g., phones, computers, vacuums, etc.) to emphasize **hardware/software**
- Provide opportunities to see **debugging** in play - help children identify problems (e.g., a falling block structure) and determine approaches for solving.

OTHER TEXTS