

PaperBot Series

Pull-Up Man Activity

Subject: Science & Technology

Grade Level: 3 - 5

Topic: Build a paper pull-up man using a cam mechanism.

Activity Time: 45 minutes

Goals	Students will be able to: <ol style="list-style-type: none">1. Define what an assembly is.2. Understand how to build an assembly.3. Understand what a cam is.
Objectives	Create a paper man that can do pull-ups by moving a crank that will activate a cam.
Materials	Cardstock, scissors, and brass fasteners
Introduction	Introduction topics: <ol style="list-style-type: none">1. Assemblies and assembly instructions2. Cams
Procedure	<ol style="list-style-type: none">1. Create perforated shapes using cutter.2. Introduce activity and required information topics3. Split students into teams of two and distribute materials and assembly instructions.4. Have students follow instructions to build a pull-up man.5. Wrap-up activity with discussion about methodologies used and lessons learned.
Wrap-up	Suggested discussion points: <ol style="list-style-type: none">1. What is an assembly?2. What common products are assemblies?3. How do assembly instructions help in your design and building process?4. What is a cam?5. Why would we want to use a cam?6. What are common examples of cams?

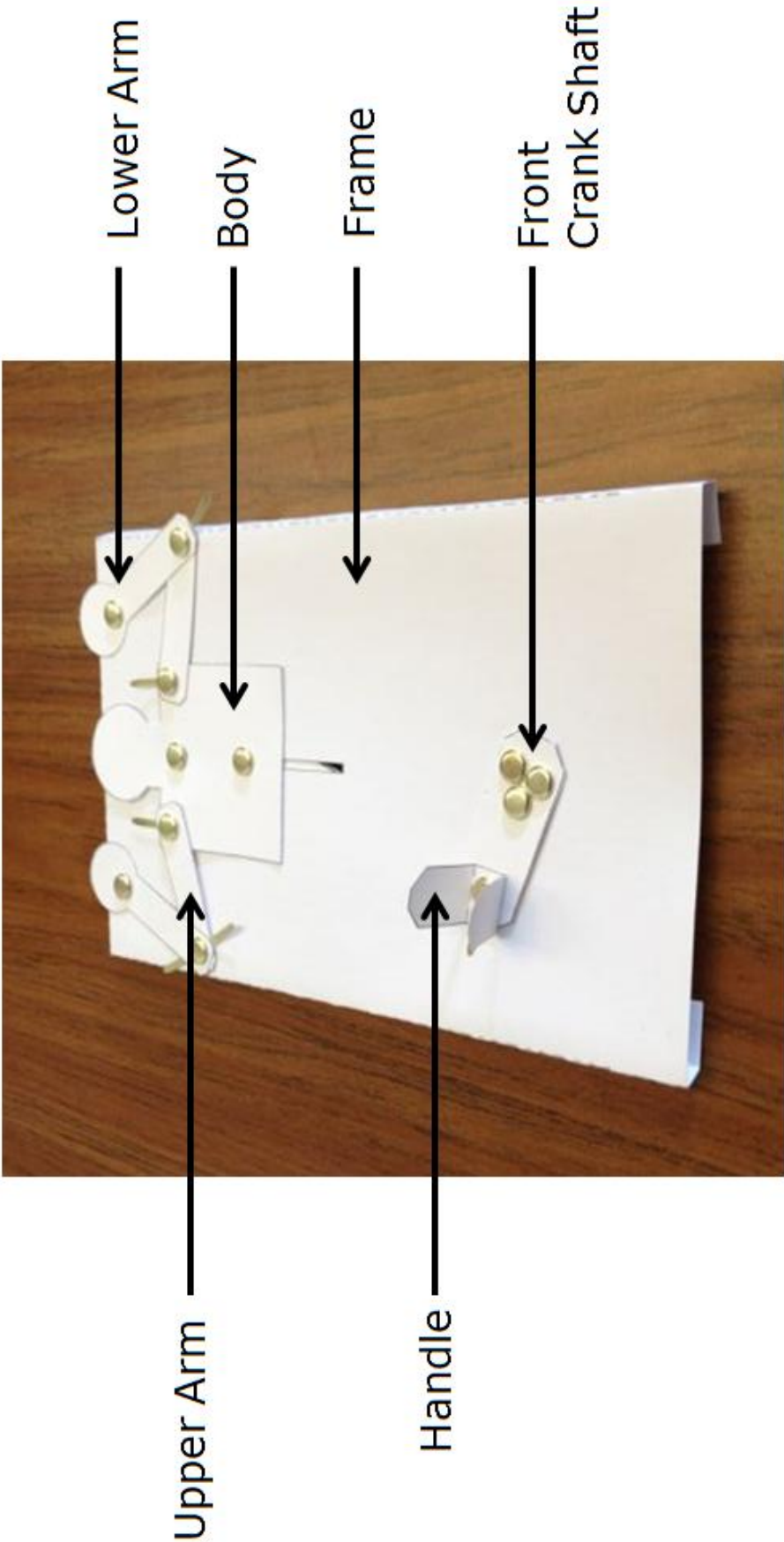
Educational Standards:

Massachusetts State Standards for Educational Framework – Science – Grade 3 to 5

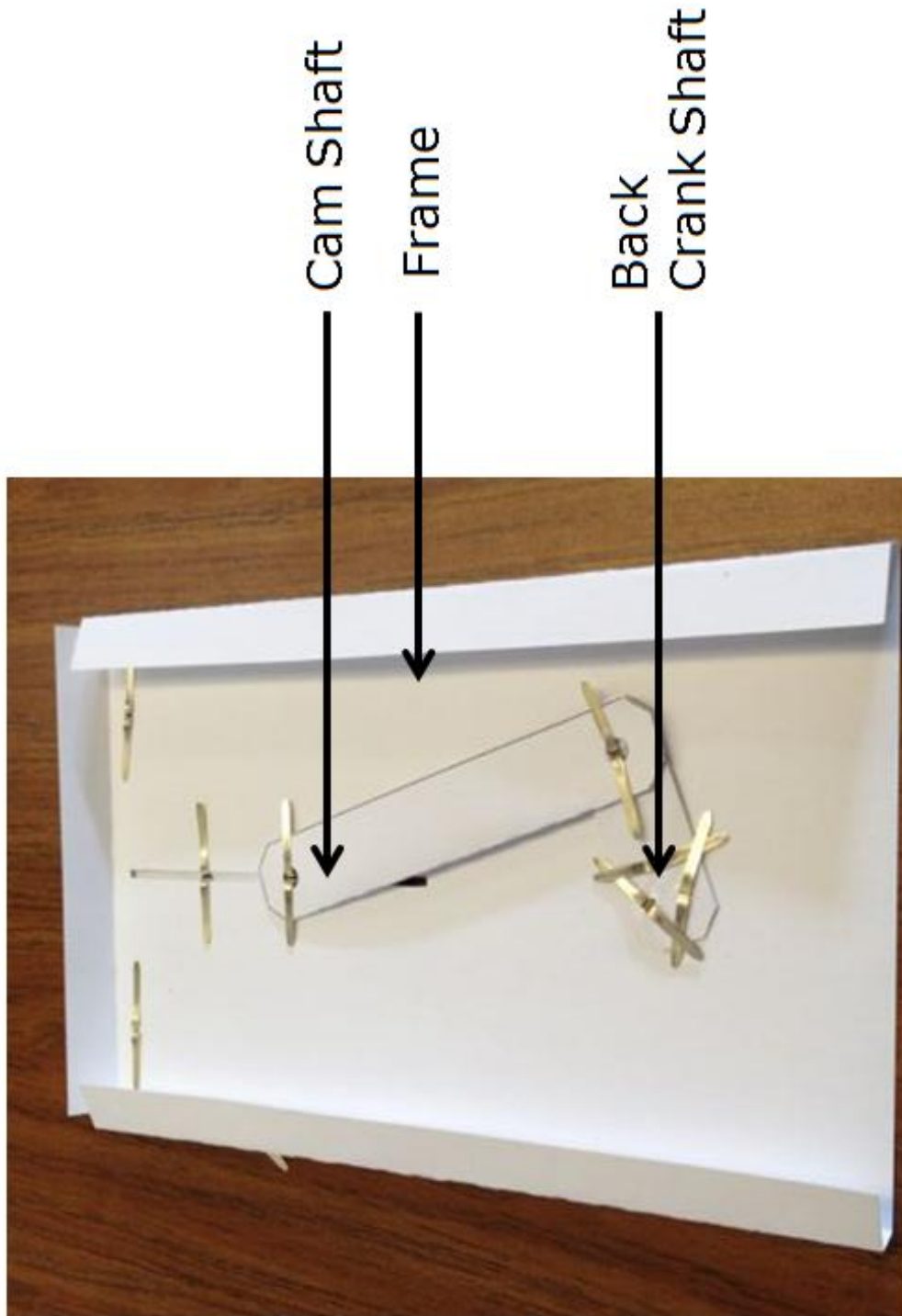
- MA.T/E.1.1 → Identify materials used to accomplish a design task based on a specific property, i.e., weight, strength, hardness, and flexibility.
- MA.T/E.1.2 → Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.
- MA.T/E.1.3 → Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge gear, and lever.
- MA.T/E.2.4 → Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird's wings as compared to an airplane's wings.

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PaperB
Pull-Up M:

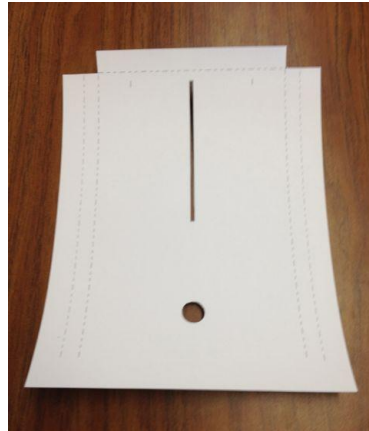


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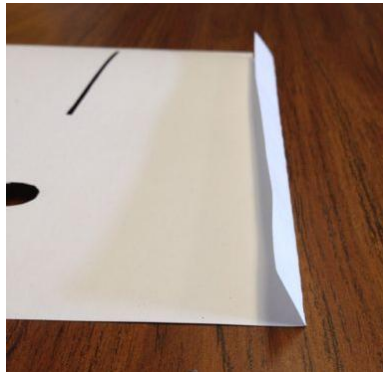
Pull-Up Man Activity

Assembly Instructions

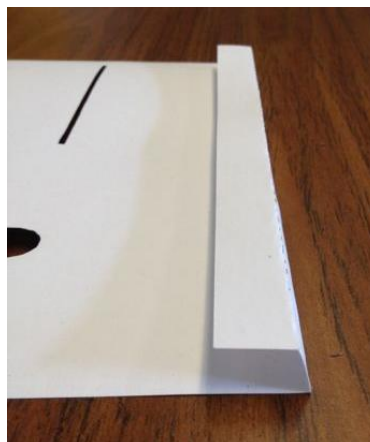
1. Punch all parts from sheets, then place to the side of your desk.
2. Start with the frame dashed line side up. Make sure the rectangle and hole in the middle of the sheet are removed.



3. Flip the frame over and create a 90° fold along the outside dashed line on the longer side of the sheet. The dashed line should be on the outside of the fold.



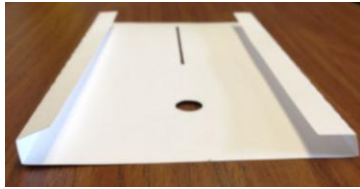
4. Create a 90° fold along the second dashed line on the longer side of the sheet. The dashed line should be on the outside of the fold.



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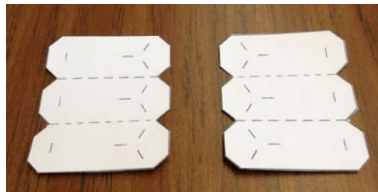
5. Fold the other two dashed lines on the other long side of the sheet in the same way.



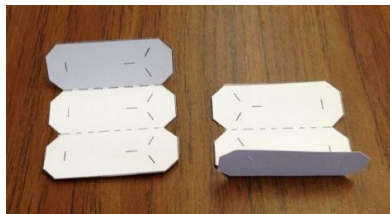
6. Fold the remaining dashed line on the top of the sheet to a 90° angle with the dashed line on the outside of the angle.



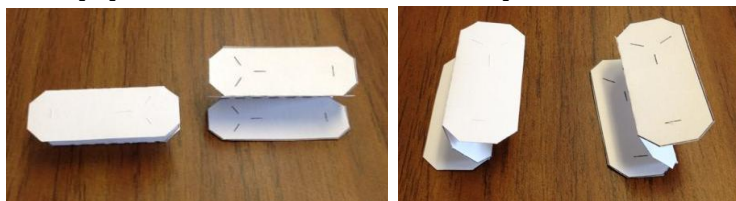
7. Place the frame to the side and take out the two crank pieces.



8. Fold the outer face of the crank punch-out toward the middle face along the dashed line. The dashed markings should be on the inside of the fold.



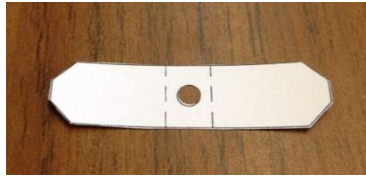
9. Fold the other outside face along the dashed line so that the dashed markings are on the outside of the fold. The paper should be folded in a 'Z' shape.



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10. Place the two crank shafts to the side and take out the handle.



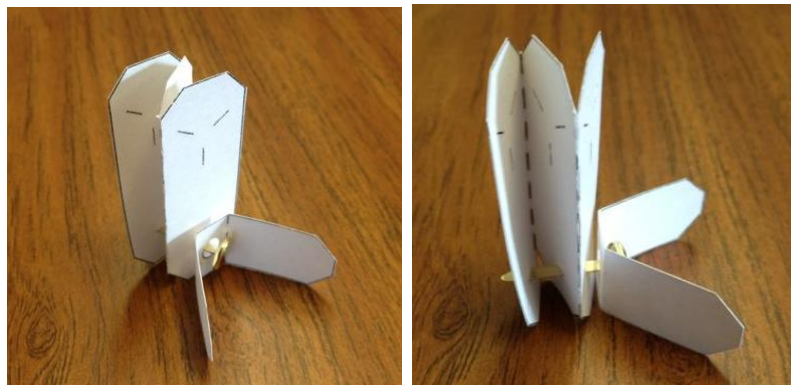
11. Fold both sides along the dashed lines. The dashed lines should be on the inside of the folds.



12. Take out one crank shaft and one brass fastener.



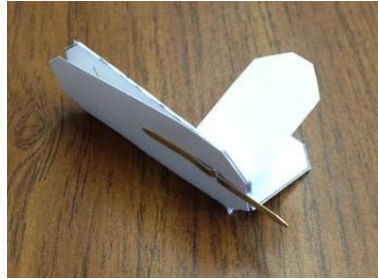
13. Insert the tail of the brass fastener through the hole in the handle and through the horizontal slit towards the bottom of the crank.



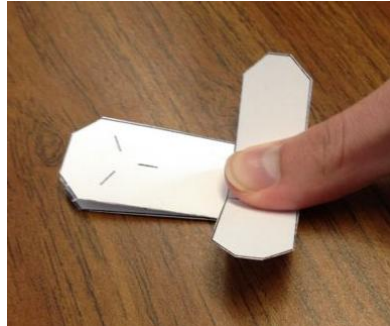
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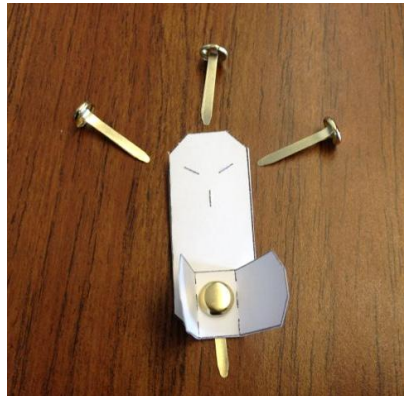
14. Fold the two tails of the brass fastener so they lay flat against the side of the crank.



15. Press your thumb against the head of the fastener to further secure the two tails.



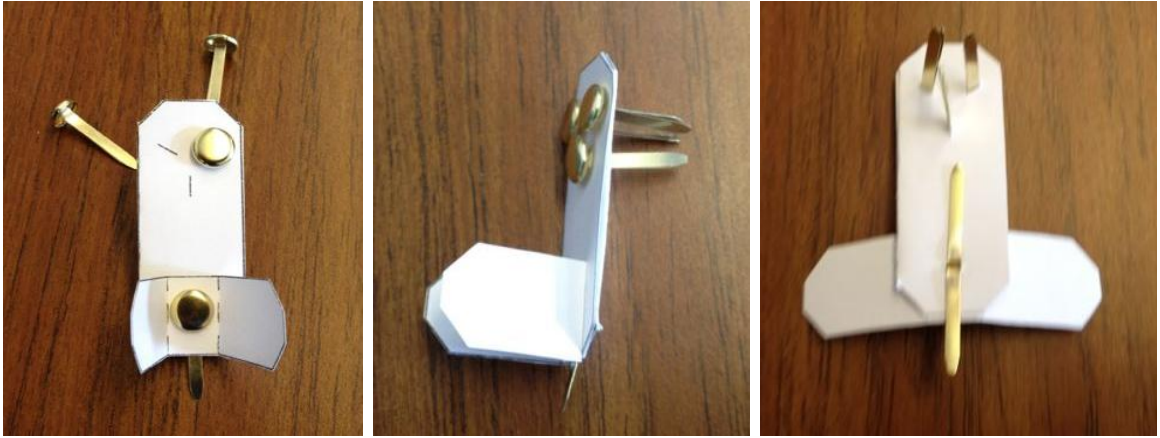
16. Take out three more brass fasteners and the existing crank assembly.



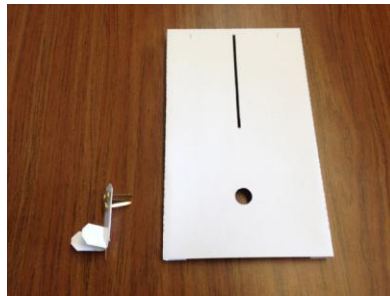
17. Insert one brass fastener at a time through each of the three slits at the top of the crank shaft.
If you have trouble inserting the fasteners, ask your teacher for help.

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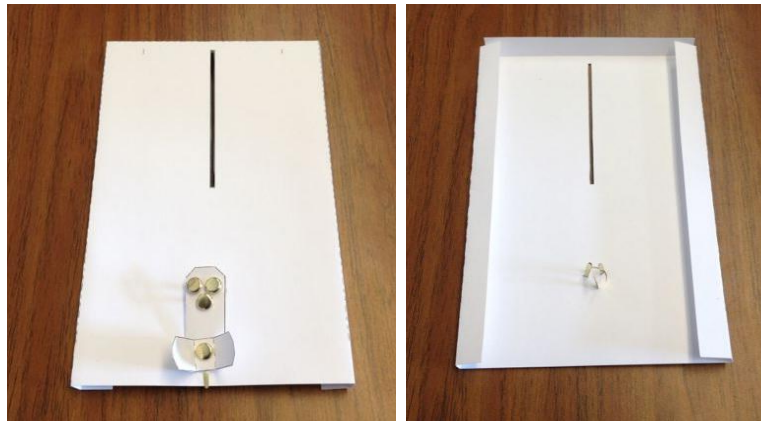
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18. Take out the frame and the current crank assembly.



19. Place the backside of the crank assembly (with fastener tails) through the hole in the frame.



20. Place the assembly to the side and take out the cam shaft.

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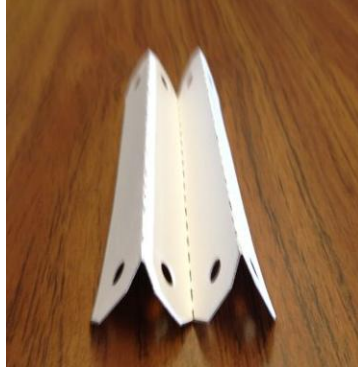
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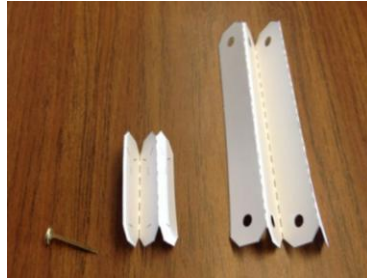
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21. Fold along the dashed lines of the cam shaft to make an 'M' shape. The middle dashed line should fall on the inside of the fold. The two outside dashed line should be on the outside of the folds. (Note: the 'M' shape strengthens the cam shaft more than having four pieces of stacked paper.)



22. Take out the cam shaft, the remaining crank shaft, and another brass fastener.



23. Insert the brass fastener tail through the single slit at the bottom of the crank shaft.



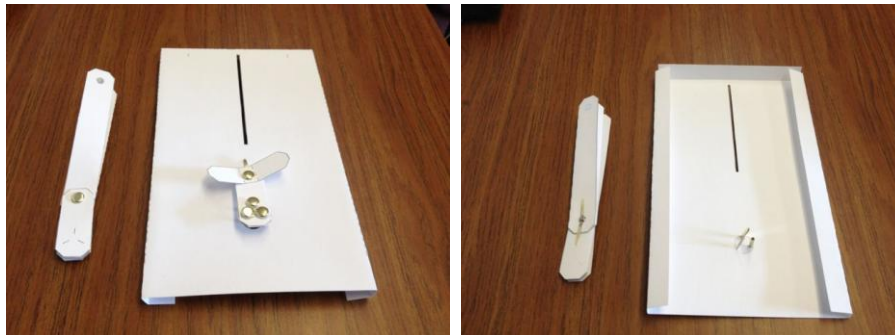
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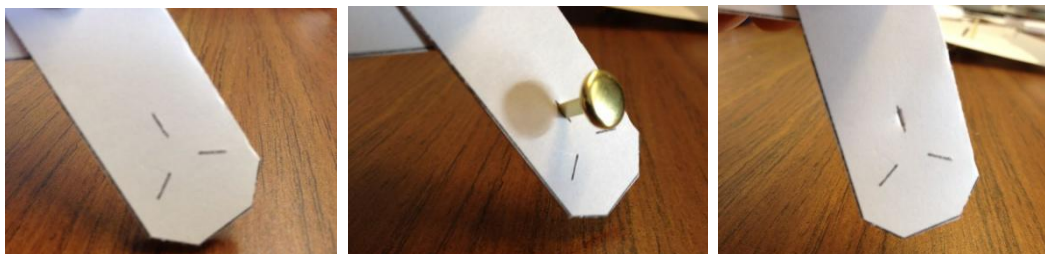
24. Insert the brass fastener tail through the bottom hole of the cam shaft. Then flatten the two portions of the fastener tail to secure the crank and cam connection.



25. Take out the frame assembly and the cam assembly.



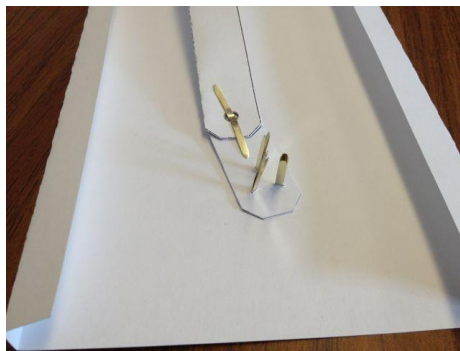
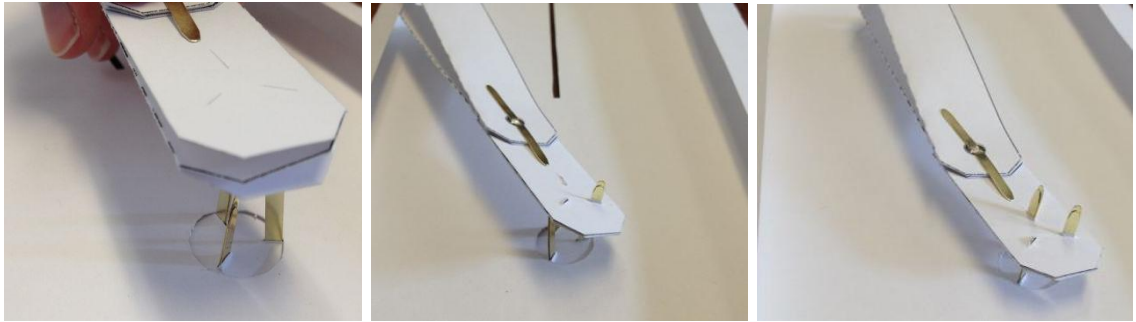
26. Use an extra fastener to punch through the three slots at the bottom of the crank that is attached to the cam shaft. Pre-punching the slots will allow for easier assembly with the frame/crank assembly.



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27. With the front of the frame facing the table, insert the tails of the three fasteners in the crank assembly through the crank portion of the cam assembly. (Note: This is easiest if you try to insert the tail of one fastener at a time.)



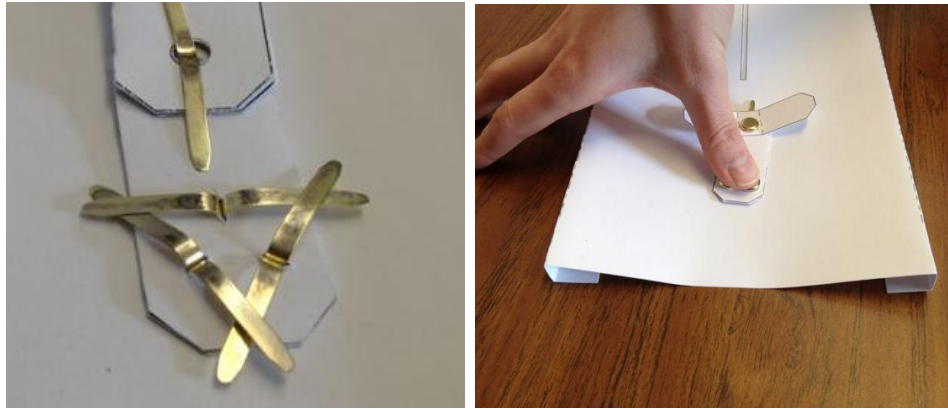
28. Split the sections of each fastener tail. Bend the two sections of each tail so that they overlap with the tails of the other two fasteners.



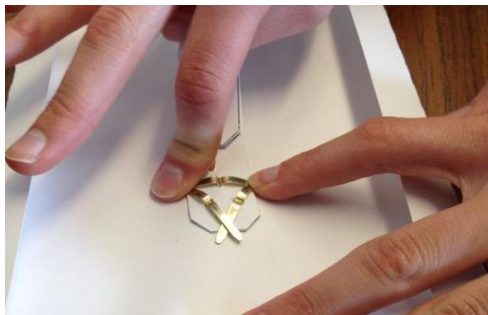
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29. Fold tails securely. Flip the frame assembly over so the back of the frame is against your desk. Use your thumb to apply pressure against the heads of the three fasteners.



30. Flip the frame assembly over once again so that the front of the frame is rested on your desk. Ensure that the sections of each fastener tail are tightly secured.



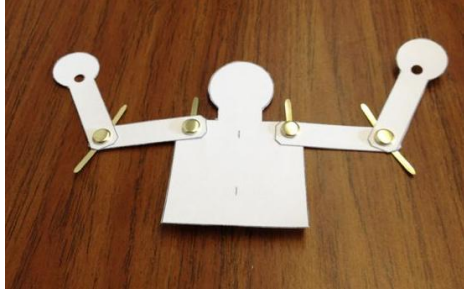
31. Put the frame assembly to the side. Take out the following parts: 1 body, 2 upper arms, 2 lower arms, and 4 brass fasteners.



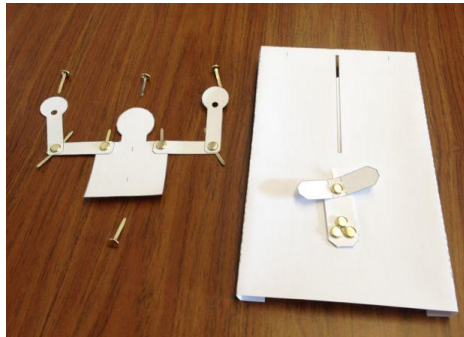
32. Insert and secure fasteners so the body is assembled in the manner shown below:

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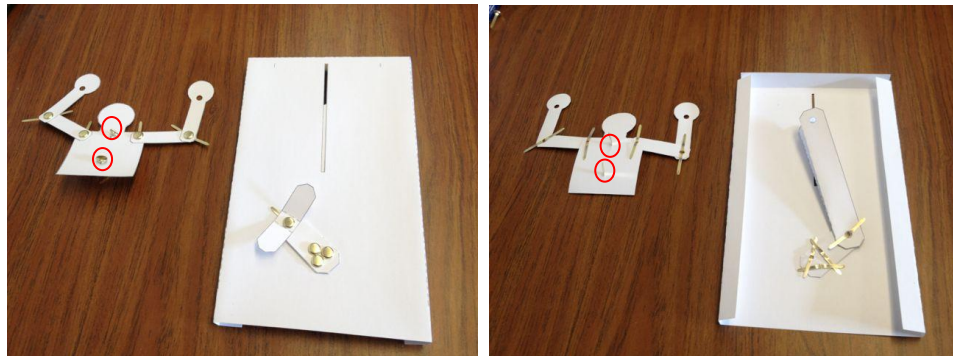
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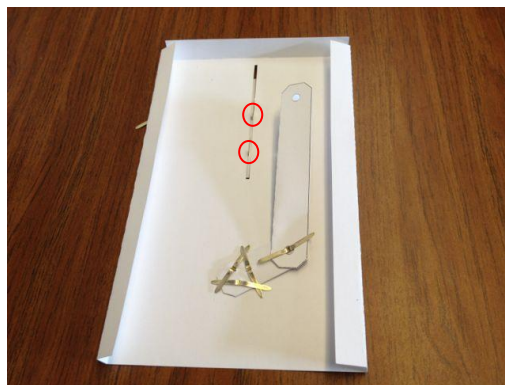
33. Take out the frame assembly with the pull-up man and four brass fasteners.



34. Insert a fastener in each of the two center slots in the center of the body.



35. Move the cam away from the slot and insert the two fastener tails into vertical slot of the frame.



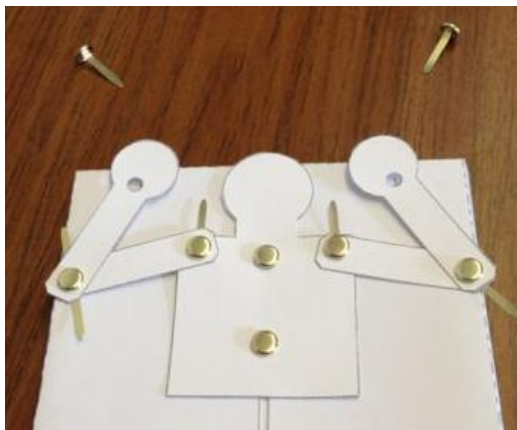
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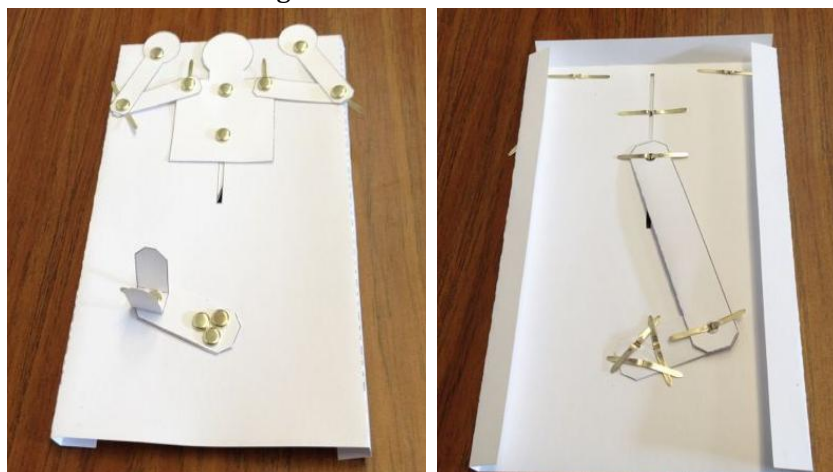
- 36.** Secure the top fastener once it is through the slot. The tail of the bottom fastener should go through the hole in the top of the cam strut. Secure the bottom fastener.



- 37.** Take out two additional fasteners.



- 38.** Insert a fastener through the hole in each hand and through the slits in the top corners of the frame. Secure fasteners once through the hands and frame.



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39. Test the pull-up man by rotating the crank. If there is any resistance in motion then fix snags between fasteners and paper by adjusting the fastener tails.

40. Decorate your pull-up man.