International Council of Associations for Science Education

PROFILES TYPE INQUIRY LEARNING MODULES

PROF.DR. BULENT CAVAS

PROFESSIONAL REFLECTION ORIENTED FOCUS ON INQUIRY-BASED LEARNING and EDUCATION THROUGH SCIENCE

PROFILES TYPE INQUIRY LEARNING MODULES
Dr. Bulent CAVAS
December 2018
Published in Cork, Ireland
http://www.profiles-project.eu
Publisher: International Council for Associations for Science Education (ICASE)

ISSN:

International Council of Associations
for Science Education

PROFILES project is made possible by a grant from the European Commission's 7th Framework program and coordinated by Freie University from Germany with 21 Partners including DEU and ICASE.

INTRODUCTION

PROFILES is a network project scattered across Europe and even beyond Europe. This project is carried out with the participation of 22 partner institutions including Dokuz Eylül University from 20 countries. The focus of the PROFILES project is professional reflection-oriented instruction. The focus is on increasing the scientific, pedagogical and educational competencies of the teachers, especially those related to inquiry-based science education (IBSE) and the teaching methods that support this education.

The innovative aspect of PROFILES is to support teachers by effectively using existing science teaching materials and by organizing long-term pre-service and in-service professional development programs. PROFILES professional development programs are prepared by taking the opinions of the individuals and institutions involved in the training and taking into account their needs.

The purpose of this book is to present the knowledge of science teachers by developing various learning modules related to the 3 Stage model used in the PROFILES project.

Prof. Dr. Bulent CAVAS

CONTENTS

PROFILES TYPE INQUIRY LERNING MODULES

WHAT IS PROFILES PROJECT?

PROFILES is a Science Education project supported by the European Union 7th Framework Program. 21 institutions from 19 different countries cooperated for the PROFILES project.

PROFILES Countries

PROFILES conducts inquiry-based science teaching by increasing the self-confidence of teachers by adopting more effective teaching methods, and by the support of researchers and institutions related to education. In this way, PROFILES contributes to a better understanding of the changing objectives of science teaching in schools.

The innovative aspect of PROFILES is to support teachers by effectively using existing science teaching materials and by organizing long-term pre-service and in-service professional development programs. PROFILES professional development programs are prepared by taking the opinions of the individuals and institutions concerned with the education and taking into account the needs of the students.

PROFILES Researchers in Berlin Meeting

The project is based on teacher cooperation. The aim of this cooperation is to use teaching materials in science courses, which are targeted in collaboration with teachers, which include science subjects, which adopt inquiry-based science teaching and can be used as examples for other science subjects. Long-term professional development programs designed to reflect the challenges experienced by participating teachers will increase teachers' creative thinking, scientific problem solving and socio-scientific learning environments. In these learning environments, the students will develop their personal competences such as their internal motivations for learning science and their ability to make decisions and conduct scientific inquiry.

Klagenfurt Meeting

The project carries out the sharing of methods and approaches with leading teachers. These teachers play an important role in the training of other teachers in the pre-service and in-service level and in organizing workshops for other people and institutions related to education at the national level. The PROFILES project focuses on the secondary education level, in which open inquiry-based approach is one of the objectives of science teaching. In this context, PROFILES attaches great importance to the motivation of students to be internally (to be relevant to the student, to make the learning meaningful to the students) and to the environment (teacher's support and encouragement).

PROFILES PHILOSOPHY: 3 STAGE MODEL

The three-stage model is based on socio-scientific subjects and the general characteristics are as follows:

• Start an interesting situation (as a social or student-familiar situation) for students (as a group),

• Discover the science behind the scenario in the context of the scenario that is introduced within the class discourse,

• Developing science learning through research-based learning method. - Various forms of research are initiated by the scientific question (s) in the script.

• Reinforcing science education by applying the concept of science attained as a result of the scenario,

• Completion of the scenario again in the context of socio-scientific or other decision-making processes, taking into account the interest of the students and completing the science education within the framework of social or daily life.

In this 3-stage continuous flow model where the steps lead each other respectively:

1. Stage

The social scenario (for example, a social problem with a scientific element) is introduced and discussed. Then, students are guided to realize that there is a gap in their scientific understanding and then to express them in the form of appropriate scientific questions or questions for their research.

2. Stage

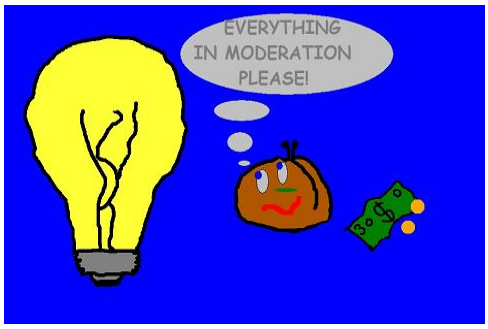
It leads to the solution of the scientific problem based on research. This stage is an important stage in terms of both teaching time and the situation or content-based program. At this stage, intensive scientific process skills are used.

3. Stage

At this stage, the students use the results obtained in the second stage to solve the initial problem condition. They demonstrate the extent to which their results are suitable for the solution of the problem and realize the decision-making mechanisms.

MODULES

HOW HAPPY ARE YOU AND YOUR FAMILY WITH THE ELECTRICITY BILL? *



8th Grade science and technology module on determining energy consumption at home

Abstract

This module leads to a decision making activity, designed to consolidate learning about consuming energy, and energy saving, taking examples from everyday life and to introduce the electrical energy and power. It involves the reading of an electricity bill and checking that the calculation of the bill is correct. It introduces students to the (kilo) watt as a unit of power and the kilowatt hour as the unit used in the home for energy consumption.

Sections included		
1.	Student activities (for students)	Describes the scenario in more detail and the tasks the students should perform
2.	Teaching guide	Suggests a teaching approach
3.	Assessment	Gives suggested formative assessment strategies
4.	Teacher notes	Gives expectations of calculations to be carried out by students

Acknowledgement
This module has been adapted from that developed under the PARSEL project **(www.parsel.eu)** as part of an EC FP6 funded project (SAS6-CT-2006-042922-PARSEL) on Popularity and Relevance of Science Education for scientific Literacy

Overall Objectives/Competencies:

The students are expected to:

1. concerning the use of electrical energy and electrical power
   1.1. Realize that the amount of energy that devices working with electrical energy consume per time differs
   1.2. Define the electrical energy that devices working with electrical energy consume per time as the power of that device.
   1.3. Express that electrical power units are named as watt and kilowatt
   1.4. Realize that the amount of electrical energy consumed by devices working with electical energy changes by power of devices and time in which devices run.
   1.5. Express that the amount of energy consumed is named as "watt*second and kilowatt*hour"
   1.6. Express the measures that should be taken for the consciously use of electrical energy

Curriculum content: power as (kilo)watts, energy as kilowatt hour,

Kind of activity: Designing a questionnaire, calculations involving (kilo) watts aad kilowatt hours, decision making discussion on realistic ways to reduce the electricity bill.

Anticipated time: 4 lessons

This unique teaching-learning material is intended to guide the teacher towards promoting students' scientific literacy by recognising learning in 4 domains – intellectual development, the process and nature of science, personal development and social development.

Its uniqueness extends to an approach to science lessons which is designed to follow a 3 stage model. For this the approach is intentionally from society to science and attempts to specifically meet student learning needs.
This uniqueness is specifically exhibited by:

1. a motivational, society-related and issue-based title (supported in the student guide by a motivational, socio-scientific, real life scenario);
2. forming a bridge from the scenario to the scientific learning to be undertaken;
3. student-centred emphasis on scientific problem solving, encompassing the learning of a range of educational and scientific goals;
4. utilising the new science by including in socio-scientific decision making to relate the science acquired to societal needs for responsible citizenship

How Happy are You and Your Family with the Electricity Bill?

Student Activities

The Scenario

Today, thanks to technological achievements, more and more equipment needs electric power to operate. Think what would happen if there was a black-out right now! What would be out of action? Unfortunately, as a result of the heavy use of electrical devices, the household electricity bill has become an important part of the family budget. But are you happy with this? Would you be interested in influencing the members of your family to see how it might be possible to reduce this bill? What devices are large users of electricity? Are they essential?

Below is an example of an Electricity Bill:

	GÜNDÜZ	PUANT	GECE
Son Endeks	4811.000	2633.000	3064.000
İlk Endeks	4667.000	2560.000	2990.000
(+/-) Kwh			
Trafo Kaybı			
Tüketim	144.000	73.000	74.000
Birim Fiyat	0.162684		
Tüketim Tutarı	47.34		
	Per.Sat.Hiz.Bd.	İlet. Sis.Kul.Bd.	Dağıtım Bedeli
Birim Fiyat	0.001703	0.004596	0.025908
Tutar	0.50	1.34	7.54
Sözleşme Gücü	5.64	DEMAND	
Demand (kW)		Çarpan	
Güç Aşımı		Gösterge	
Güç Tutarı		Güç Birim Fiyat	
Güç Aşımı Tutarı		G.Aşımı Birim Fiyat	
E.Amade K.Bed.		Gerilim Trafo Oranı	
Enerji Tutarı	56.72	Akım Trafo Oranı	
Enerji Fonu	0.47	Günlük Ort.Tüketim	5.596
TRT Payı	0.95	İlk Okuma	03.06.2009
Bel.Tük. Ver.	2.37	Son Okuma	24.07.2009
(+/-) Tutar		Okuma Saati	11:08.04
K.D.V.	10.89	Tebliğ Tarihi	24.07.2009
Teşvik İndirimi		Ekip	
Kira Bakım		Sonraki Okuma Dön.	
Güç Bedeli		Yuvarlama	+0.00
FATURA TUTARI	71,40 TL		

Your Task

Within the whole Class:

1. Discuss/compare different electricity bills and find out which parameters/factors contribute to the total amount paid. Mention which of them are "internal" (from the family) and which are "external" (from the state).
2. Discuss the questions that will be included to create a questionnaire for the proposed research to find out which appliances are used I the home and for how often.

In Groups:

1. Each group is required to put forward 5 questions in a short time.
2. Discuss the questions and from the sources create a common questionnaire.
3. Each member of the group takes the responsibility to give the questionnaire to her/his family, plus one more family and bring responses to the next class.
4. Decide the selection of different electrical equipment for each group to study power, energy transformation and energy consumption in a period of time.
5. Design and carry out an experimental investigation to determine the consumption of each equipment selected.

In Groups:

1. Look over a part of the completed questionnaire (2 – 3 questions per group) and present the outcomes in bar diagrams or tables.
2. Prepare a presentation of the experimental results (measurements, calculations, etc).
3. Discussion and presentation of the conclusions of the equipment studied.

In Groups:

1. Fill in the table given in this worksheet
2. Answer the question given under the table
3. Please note that this task will be completed at the second lesson, because students needs to investigate at their homes.

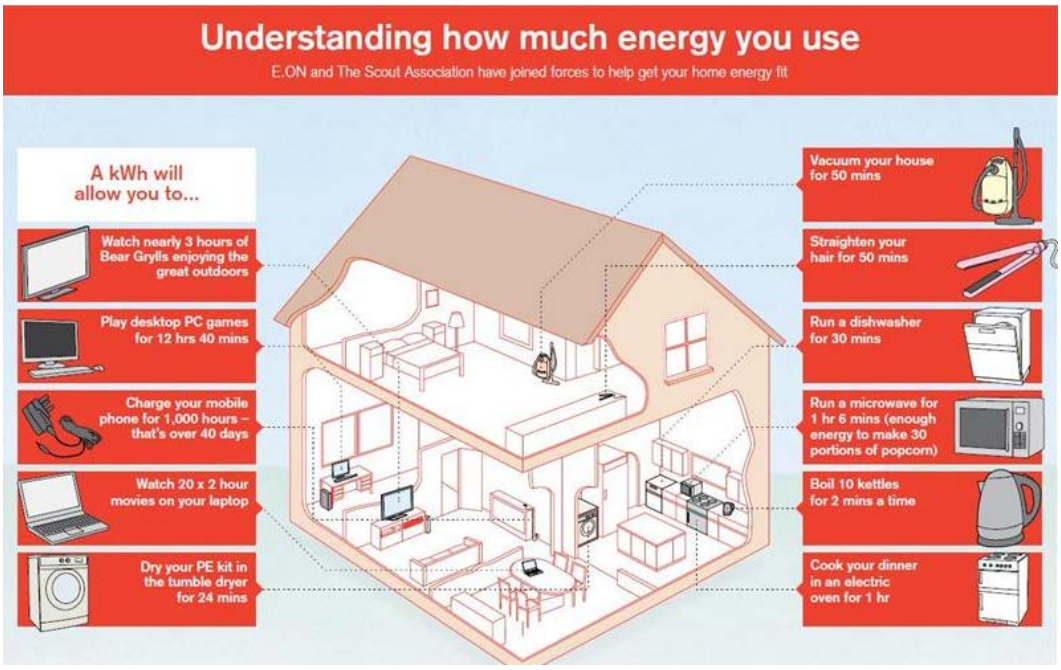
As a Class:

1. Presentation, discussion and comparison of each group's outcomes.
2. Reach final conclusions on:
   How it might be possible to reduce the electricity Bill.
   What is meant by power and how important is it to be aware of this in determining items to reduce on the electricity bill?
   Protecting the environment (power stations, fuels needed)
   Effect on the State budget (fuels imported)
3. Discuss whether people are generally happy with their electricity bills or whether they would welcome guidance on how to reduce the bills (bearing in mind the percentage reduction you might be able to put forward) and determine certain ideas as proposals in order to change habits on consuming electric energy.

Fill in the table using 5 different equipments. One example is given in the table.

The name of the equipment	power as Watts	Energy as kilowatt hour
Iron	2400 W	2.4 KW-hour

1. According to the table, which equipment use most electrical energy?
2. Look at the picture below and search time for each equipments



How Happy are You and Your Family with the Electricity Bill?

Teaching guide

The activity relates to:

- Reinforcing an appreciation of the electric energy demands in every day life
- Being familiar with electrical energy consumption in a house
- Educating energy – conscious citizens
- Introducing the concept of power

Lesson Learning Outcomes

Lesson 1

At the end of this lesson, students are expected to be able to:

- Look at an electricity bill
- Devise a questionnaire

Lesson 2

At the end of this lesson, students are expected to be able to:

- Analyse the questionnaire
- Determine appliances using most electricity
- Determine appliances used the most
- Read the electricity meter
- Fill in the table given in the students worksheet

Lesson 3

At the end of this lesson, students are expected to be able to:

- Understand the meaning of power and its units
- Understand the meaning of energy and its units
- Determining appliances that use much power

Lesson 4

At the end of this lesson, students are expected to be able to:
Reach a justified decision whether the household is happy with its electricity bill

Suggested Teaching Strategy

1. The lesson starts from the scenario and by brainstorming ideas by students
2. Students are divided into groups to plan the development of their project
3. While discussing the questionnaire design, students are guided to include questions such as the following, in order to cover all the mentioned objectives:
   - How many and who are the members of the family (adults / children)
   - Time spent at home

- Use of electric boiler, air-conditioner, etc Are they operating when no-one is at home?
- Coffee machine: how many hours is it on during the day?
- When you are on vacation do you turn off the T.V. completely?
- Do you forget the lights are on and leave them on even when there is no-one in the room?
- How often do you make use of the washing machine and the electrical iron?
- What do you think: saving electric energy at home plays a role in the protection of the environment ?

4. During the selection of the equipment by each group, students are guided to make sure there are different ones by considering the power ratings of the equipment. The teacher introduces the units of power and allows the students to undertake a series of exercises to ensure they understand the meaning of pwer and the units used.
    a. Every group plans its own project according to the given Students' Guide 6. Discuss as a class about questions so as to develop the final form of the questionnaire
5. The teacher arranged for the completed questionnaires to be distributed, then discussed in groups and the findings are analysed and presented
6. Each group presents the investigation results and calculations to the class
7. The teacher guides the discussion of the outcomes from each group; as a class the students conclude, propose and finally decide about:
    - reducing electric energy consumption in a family and at state level (giving special attention to power ratings)
    - informing the members of their family about these matters
    - highlighting the environmental protection

Achieving the competencies

Competency	***To be achieved by***
1 Decide, with justification, how to have a balanced electricity bill	Discussing within the group and recording the decision so as to present to the rest of the class
2 Designing a questionnaire (as a research process) to obtain data on the major costs on electricity bills	Students create the questionnaire as a group and administer it to families
3. Communicating by presenting the results in a tabular form / diagrams	Students draw their own diagrams, take part in the oral discussions and record justifications for decisions
4 Cooperating as member of a group carrying out an investigation project	Students cooperate in the group in carry out the project and in making the decisions
5 Explaining the meaning of power when used for electrical appliances, rather than mechanical machines, and the units used to measure power	Students undertake to complete a written record to explain the meaning of power
6 Determining the relationship between power and energy and be able to calculate energy consumption knowing the power of an appliance	Undertaking calculations of the electricity consumed by various appliances in the home
7. Filling the table in the students worksheet	To get help from family members to clarify electrical equipments and their power value.

How Happy are You and Your Family with the Electricity Bill?

Suggested Assessment

This guide to assessment strategies is put forward from different perspectives. In part A the assessment is based on the skill to be developed in the student. Part B is based on the assessment strategies to use in each lesson, whereas part C illustrates the assessment by the 3 different approaches which a teacher may use for formative assessment – observation, by oral communication, or by marking of written work. Summative assessment strategies are not shown, but these could relate to viva type oral communication and/or to the marking of written tests/examination questions.

PART A ASSESSMENT BASED ON SKILLS ATTAINED

Able to award a social values grade (objective 1).

Teachers listens to the discussions within the groups and the presentations to the class

x Not able to contribute to the discussion in a meaningful way

√ Participates in the discussion and is able to record the decision and the justification for this

√√ Not only participates in the discussion and puts forward a point of view but is able to do this with persuasion and can offer counter-arguments to points made by others.

Able to award a science method grade (objective 2).

The teacher marks the student questionnaires before the students to collect data for the community

x Not able to suggest appropriate items for the questionnaire.

√ Able to suggest items for the questionnaire and to put these into a useful sequence. Able to use the questionnaire to collect relevant data.

√√ Able to suggest key items for the questionnaire which are suitable and relevant for the community and is able to put forward a sampling plan that reflects the need for sampling of the community for a fair result.

Able to award a personal skills grade (objectives 3 and 4).

Teacher observes the students during the group work

x Does not cooperate with others during the group discussions and activities.

√ Participates in group work meaningfully, in the discussions and in the devising of questionnaires and recording of work in written form.

√√ Not only participates in the group work and in the discussions and written work, but takes on a leadership role helping others to participate.

Able to award a science concept grade (objectives 5, and 6).

x Not able to explain the meaning of power, the relationship between power and energy and the mechanism for calculating electricity used in the home

√ Able to explain the meaning of power and the relationship between power and energy with the help of the teacher. Able to read an electricity bill and determine the energy used.

√√ Able to fully understand and record in a meaningful way, the meaning of power and its links to energy. Able to read the electricity bill. Can deduce appliances that have been in great use.

PART B ASSESSED BY LESSON

Lesson 1

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Creates a questionnaire	Puts forward appropriate questions for a questionnaire to find out what appliances are used in the home and how much electricity is used per month.	
		Creates an appropriate questionnaire to the level of detail required by the teacher.	
		Develops an appropriate procedure to collect data using their questionnaire	
2	Interpret an electricity bill	Looks at an electricity bill and able to understand the data given in the various columns	
		Draws appropriate conclusions related to the electricity used	

Lesson 2

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Interpret or calculate from data collected and making conclusions	Interprets data collected in a justifiable manner including the use of appropriate graphs, tables and symbols.	
		Draws appropriate conclusions related to appliances using the most electricity.	
		Draws appropriate conclusions related to the appliances used most frequently.	
2	Answers questions	Provides correct written answers to questions asked by the teacher on their manner of interpretation and drawing conclusions.	
3	Draws charts/tables.	Able to present findings in an appropriate graphical representation.	
		Able to present graphical representations in suitable detail.	
		Able to provide full and appropriate headings for charts, tables.	

Lesson 3

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Explanations	Able to explain the meaning of power and the units used.	
		Able to explain the meaning of energy and the units used.	
2	Interpret from data collected and drawing conclusions.	Interprets from the data collected those appliances which use much power compared with other appliances.	
		Draws appropriate conclusions related to the use of such appliances.	

Lesson 4

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Scientific or socio-scientific reasoning	Able to work cooperative with others in the group and consider the data obtained and other factors.	
		Gives a justified socio-scientific decision based on efficiency and other factors whether families should be happy with their electricity bill.	

PART C ASSESSMENT BASED ON TEACHER STRATEGY

Assessment Tool based on the Teacher's Marking of Written Material

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Writes a plan or report of an investigation	Puts forward an appropriate research/ scientific question and/or knows the purpose of the investigation/ experiment	
		Creates an appropriate investigation or experimental plan to the level of detail required by the teacher	
		Puts forward an appropriate prediction/hypotheses	
		Develops an appropriate procedure (including apparatus/chemicals required and safety procedures required) and indicates variables to control	
2	Record experimental data collected	Makes and Records observations/data collected appropriately (in terms of numbers of observations deemed acceptable/accuracy recorded/errors given)	
3	Interpret or calculate from data collected and making conclusions	Interprets data collected in a justifiable manner including the use of appropriate graphs, tables and symbols	
		Draws appropriate conclusions related to the research/scientific question	
4	Answers questions	Provides correct written answers to questions given orally or in written format	
		Provides answers in sufficient detail especially when called upon to give an opinion or decision	
5	Draws charts/ diagrams/tables / models/symbolic representations.	Able to provide graphical representation as required	
		Able to present graphical representations of a suitable size and in suitable detail	
		Able to provide full and appropriate headings for diagrams, figures, tables	
6	Scientific or socio-scientific reasoning	Illustrates creative thinking/procedures in solving problems	
		Gives a justified socio-scientific decision to an issue or concern, correctly highlighting the scientific component	

Assessment Tool based on the Teacher's Observations

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Functioning in the group during experimentation or discussion	Contributes to the group discussion during the inquiry phases (raising questions, planning investigation/experiment, putting forward hypotheses/predictions, analyzing data, drawing conclusions, making justified decisions).	
		Cooperates with others in a group and fully participates in the work of the group.	
		Illustrates leadership skills – guiding the group by thinking creatively and helping those needing assistance (cognitive or psychomotor); summarising outcomes.	
		Shows tolerance with, and gives encouragement to, the group members.	
2	Performing the investigation or experiment	Understands the objectives of the investigation/experimental work and knows which tests and measurements to perform.	
		Performs the investigation/experiment according to the instructions/plan created.	
		Uses lab tools and the measurement equipment in a safe and appropriate manner.	
		Behaves in a safe manner with respect to him/herself and to others.	
		Maintains an orderly and clean work table.	
3	Presenting the investigation or experiment orally	Presents the activity in a clear and practical manner with justified decisions.	
		Presents by illustrating knowledge and understanding of the subject.	
		Uses precise and appropriate scientific terms and language.	
		Presents with clarity and confidence using an audible voice.	

Assessment Tool based on the Teacher's Oral Questioning

	Dimension	**Criteria for evaluation** **The student:**	**Mark/grade given (x,√,√√)**
1	Questions to individuals in a Whole Class setting	Answers questions at an appropriate cognitive level using appropriate scientific language	
		Shows interest and a willingness to answer	
		Willing and able to challenge/support answers by others, as appropriate	
2	Questions to the group	Able to explain the work of the group and the actions undertaken by each member	
		Understands and can explain the science involved using appropriate language	
		Willing to support other members in the group in giving answers when required	
		Thinks in a creative manner, exhibits vision and can make justified decisions	
3	Questions to individuals in the group	Able to explain the work of the group and actions taken by each member	
		Understands the purpose of the work and shows knowledge and understanding of the subject using appropriate scientific language	
		Can exhibit non-verbal activity (demonstrate) in response to the teacher's questions, as appropriate	

How Happy are You and Your Family with the Electricity Bill?

Teacher Notes

- It is useful to collect electricity bills (at least 4) from households of one and four persons, with at least one for the winter period and another for a summer period.
- It is useful to have on display different equipment that need electric power to function. (e.g. T.V., iron, electric boiler, computer, electric oven, lights) (Alternatively students can check these apparatus at home, when parents can guide them to find the labelling indicate power consumption).
- Access to an electricity meter (this could be by means of a video/CD)

Student Handout

The following steps /questions are to help you to complete your project successfully:

1. Which criteria will you choose for selecting the house equipment ?
2. Are you sure that you are measuring the consumption of only one piece of equipment at a time? How do you determine this?
3. Measure, for a time duration of 5 minutes, the energy consumption of each equipment on the house electric meter.
4. Notice the units which are used to measure energy.
5. Calculate the energy consumption using the theoretic type (find it in your textbook), for the same equipment and the same period of time. Use the prospectus of the equipment for the power, etc. NOTICE: This step is omitted in the first grades.
6. Calculate the amount of money needed to be paid the consumption for each equipment
7. Which of the equipment consume more and which the less?
8. What is the energy transformation for each piece of equipment?
9. Is there a connection between the energy transformation taking place and the consumption?

Student Handout 2

Exercise to Aid the Understanding of the Concept of Power

Answer the following:

1. On which of the following does the electricity we consume depends ? (there may be more than one correct response)
   (a) the voltage of the appliance;

(b) the size of the appliance;
(c) the type of plug used;
(d) the current supplied to the appliance;
(e) how long the appliance is in use;
(f) the age of the appliance.

2. For each of those selected in question 1, give the name of the units in which it is measured, both as (a) the base unit and (b) when multiplied by 1000.
3. Look at the information supplied on an electrical appliance. Which of the units given in question 2 are observed ?
4. As the manufacturer of the appliance does not know when, where or how long the appliance will be used, it can only indicate the power of the appliance. What units (by deduction or otherwise) represent the power of the appliance ?
5. Link the units of power to the other units indicated in question 2.
6. If an appliance is plugged into the usual mains supply and had a rating of 0.25 amps, what power rating would you see written on the appliance ?
7. If the power rating was given as 10 watts, what was the current drawn when the appliance was plugged into the mains supply ?
8. The electricity meter needs to record the power of the appliance and the time for which it is used. What units does it use to do this ? What are the units of electricity consumed which are written on the electricity bill ?

Watt

The watt (symbol: W) is the SI derived unit of power, equal to one joule of energy per second.
A human climbing a flight of stairs is doing work at the rate of about 200 watts. A first class athlete can work at 375 watts for 30 minutes before exhaustion. An automobile engine produces mechanical energy at a rate of 25,000 watts (approximately 30 horsepower) while cruising. A typical household incandescent light bulb uses electrical energy at a rate of 40 to 100 watts, while the energy-saving compact fluorescent lights which are replacing them use 8 to 20 watts to yield the same light output.

Definition
One watt is one joule (the SI unit of energy) per second, that is 1 newton metre per second. It may be visualized simply as the amount of energy expended by a single candle.

$$1\ \mathrm{W} = 1\ \frac{\mathrm{J}}{\mathrm{s}} = 1\ \frac{\mathrm{kg}\cdot\mathrm{m}^2}{\mathrm{s}^3} = 1\frac{\mathrm{N}\cdot\mathrm{m}}{\mathrm{s}}.$$

In electrical terms, it follows that:

$$1\mathrm{W} = 1\mathrm{V}\cdot 1\mathrm{A}.$$

That is, if 1 volt of potential difference is applied to a resistive load and a current of 1 ampere flows, then 1 watt of power is dissipated.[2]

Origin and adoption as an SI unit
The **watt** is named after James Watt for his contributions to the development of the steam engine, and was adopted by the Second Congress of the British Association for the Advancement of Science in 1889 and by the 11th General Conference on Weights and Measures in 1960 as the unit of power incorporated in the International System of Units (or "SI").

Confusion of watts and watt-hours
Power and energy are frequently confused in the general media, for instance when a device is said to be rated at "100 watts per hour", which does not make any sense since a watt is a rate of doing work or using energy of 1 joule of energy per second. As a rate itself, a watt does not need to be followed by a time designation, unless one is talking about a change in power over time, analogous to an acceleration or deceleration.
Because a joule as a quantity of energy does not have a readily-imagined size to the layperson, the non-SI unit watt-hour, or rather its multiple the kilowatt-hour, is frequently used as a unit of energy, especially by energy-supply companies (electricity and natural gas suppliers) which often quote charges by the kilowatt-hour. A kilowatt-hour is the amount of energy equivalent to a power of 1 kilowatt running for 1 hour (3.6 MJ).
The watt-hour (symbol W·h or Wh) is a unit of energy. It is most commonly used on household electricity meters in the form of the kilowatt-hour (kW·h or kWh), which is 1,000 watt-hours. It is not used in the International System of Units (SI), despite being based on the watt, as the hour is not an SI unit. The SI unit of energy is the joule (J), equal to one watt-second. It is, however, a commonly used unit, especially for measuring electric energy.

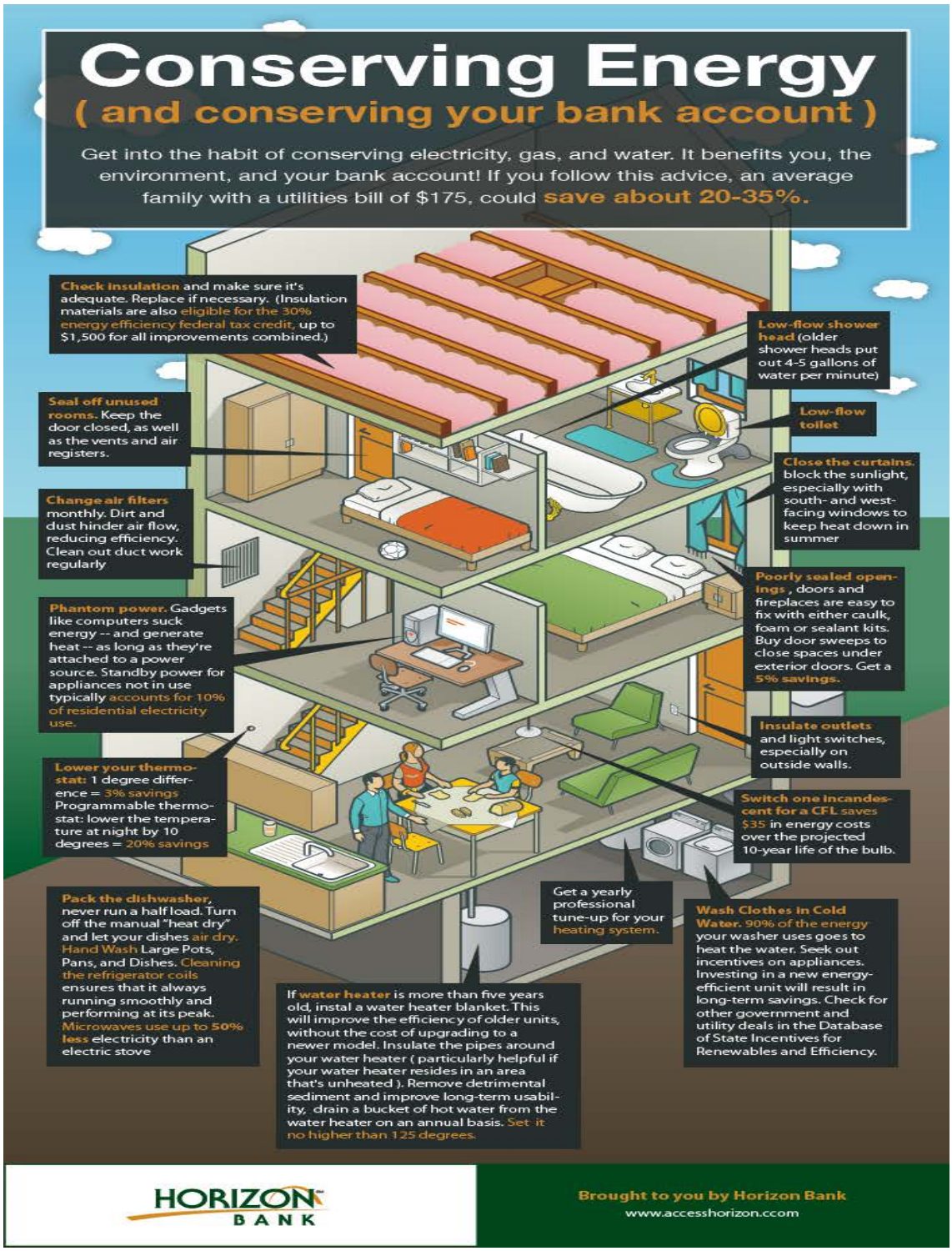
1 watt-hour is equivalent to 3,600 joules (1 W x 3600 s), the joule being the canonical SI unit of energy. Thus a kilowatt-hour is 3,600,000 joules or 3.6 megajoules.

Pricing for kilowatt-hours

Power companies sell energy in units of kilowatt-hours. In general, energy (E) is equivalent to power (P) multiplied by time (t). To determine E in kilowatt-hours, P must be expressed in kilowatts and t must be expressed in hours. Suppose a 1.5-kW electric heater runs for 3 h. Then P = 1.5 and t = 3, so the energy E in kilowatt-hours is: E = Pt = 1.5 x 3 = 4.5 kWh If P and t are not specified in kilowatts and hours respectively, then they must be converted to those units before determining E in kilowatt-hours. Consider a set-up with one 100 W light bulb (0.1 kW) left on for 10 hours per day. This will consume 1 kilowatt-hour per day (0.1 kW x 10 h). If a power company charges $0.10/kW·h, then this light bulb will cost $0.70 to operate over the course of a week (0.1 kW x 10 h x $0.10/kW·h x 7 days in a week) (see unit juggling for more information).

Conversions

from / to	Joule	Watt-hour	Electronvolt	Calorie
1 J = 1 kg m^2 s^{-2} =	1	0.278×10^{-3}	6.241×10^{18}	0.239
1 W·h =	3600	1	2.247×10^{22}	859.8
1 eV =	1.602×10^{-19}	4.45×10^{-23}	1	3.827×10^{-20}
1 cal =	4.1868	1.163×10^{-3}	2.613×10^{19}	1


Conserving Energy
(and conserving your bank account)
Get into the habit of conserving electricity, gas, and water. It benefits you, the environment, and your bank account! If you follow this advice, an average family with a utilities bill of $175, could save about 20-35%.
Check insulation and make sure it's adequate. Replace if necessary. (Insulation materials are also eligible for the 30% energy efficiency federal tax credit, up to $1,500 for all improvements combined.)
Low-flow shower head (older shower heads put out 4-5 gallons of water per minute)
Low-flow toilet
Seal off unused rooms. Keep the door closed, as well as the vents and air registers.
Close the curtains. block the sunlight, especially with south- and west-facing windows to keep heat down in summer
Change air filters monthly. Dirt and dust hinder air flow, reducing efficiency. Clean out duct work regularly
Poorly sealed openings , doors and fireplaces are easy to fix with either caulk, foam or sealant kits. Buy door sweeps to close spaces under exterior doors. Get a 5% savings.
Phantom power. Gadgets like computers suck energy -- and generate heat -- as long as they're attached to a power source. Standby power for appliances not in use typically accounts for 10% of residential electricity use.
Insulate outlets and light switches, especially on outside walls.
Lower your thermostat: 1 degree difference = 3% savings Programmable thermostat: lower the temperature at night by 10 degrees = 20% savings
Switch one incandescent for a CFL saves $35 in energy costs over the projected 10-year life of the bulb.
Pack the dishwasher, never run a half load. Turn off the manual "heat dry" and let your dishes air dry. Hand Wash Large Pots, Pans, and Dishes. Cleaning the refrigerator coils ensures that it always running smoothly and performing at its peak. Microwaves use up to 50% less electricity than an electric stove
Get a yearly professional tune-up for your heating system.
Wash Clothes in Cold Water. 90% of the energy your washer uses goes to heat the water. Seek out incentives on appliances. Investing in a new energy-efficient unit will result in long-term savings. Check for other government and utility deals in the Database of State Incentives for Renewables and Efficiency.
If water heater is more than five years old, instal a water heater blanket. This will improve the efficiency of older units, without the cost of upgrading to a newer model. Insulate the pipes around your water heater (particularly helpful if your water heater resides in an area that's unheated). Remove detrimental sediment and improve long-term usability, drain a bucket of hot water from the water heater on an annual basis. Set it no higher than 125 degrees.
HORIZON BANK
Brought to you by Horizon Bank
www.accesshorizon.ccom

CAN TRAFFIC ACCIDENTS BE ELIMINATED BY ROBOTS?

Elementary Science and Technology Grade 7
Teaching- learning Module for Unit Light and Sound

Abstract

This modules leads to a decision making activity related to ways to decrease traffic accidents. Robotics (in this activity, lego mindstorms NXT 2.0) is used where the main science background will be on the reflection of the light at the grade 6 and 7 level. The activity includes the construction of robots which are able to read different wavelengths of light using light sensor. Various sensors will add to constructed Robots (designed as a model car) and experiments are carried out to seek ways to prevent traffic accidents.

Sections Included		
1	Student Activities (for students)	Describes the scenario in more detail and tasks the students should perform
2	Teaching Guide	Suggests a teaching approach
3	Assessment	Gives suggested formative assessment strategies
4	Teacher Notes	Gives expectations of calculations to be carried out by students

Overall Competencies: The students are expected to:

- Construct a robo-car, controlled by, light sensors for decreasing/increasing the speed of the car according to different- coloured roads and how to present the results in a tabular form/ diagrams.
- Write suitable computer programs using NXT 2.1 programming to control the speed of the car.
- Collaborate as member of a group in designing and carrying out appropriate activities from writing the computer program to solving problems associated with the use of the robot.
- Explain transmitted, absorbed and reflected light, for both white and coloured light and the purity of reflection from different coloured roads.
- Explain wavelength of light in the context of the electromagnetic spectrum and the manner in which light sensors function.
- Decide with justification, whether robots can be viably used to reduce the number of road accidents.

Curriculum Content: Transmission and reflection of Light; Light as part of the electromagnetic spectrum.
Kinds of Activity: Constructing a robo-car using lego mindstorms NXT 2.0; controlling the speed of the robo-car using suitable computer software related to light sensors; undertake additional experiments to determine the effectiveness of speed control the robo-car related to different coloured/material surfaces; undertake a group discussion so as to make a justified group decision on whether realistic (acceptable, cost effective, reliable) ways can be possible using light sensors to decrease the number of traffic accidents.
Anticipated Time: 4 lessons

This unique teaching-learning material is intended to guide the teacher towards promoting students' scientific literacy by recognising learning in 4 domains – intellectual development, the process and nature of science, personal development and social development. Its uniqueness extends to an approach to science lessons which is designed to be popular and relevant. For this the approach is intentionally from society to science to specifically meet student learning needs.

This uniqueness is specifically exhibited by:

1. a motivational, society-related and issue-based title (supported in the student guide by a motivational, socio-scientific, real life scenario);
2. forming a bridge from the scenario to the scientific learning to be undertaken;
3. student-centred emphasis on scientific problem solving, encompassing the learning of a range of educational and scientific goals;
4. utilising the new science by including in socio-scientific decision making to relate the science acquired to societal needs for responsible citizenship

Can Traffic Accidents be eliminated by using Robots?

Name:

Surname:

Class:

STUDENT HANDOUT 1

The Scenario

Road accidents cause many deaths in Turkey. There are many reasons for it. The most important reason is the drivers' inattentiveness when they are driving, especially in the late hours. Most Turkish drivers do not follow the traffic signs related to speed limitation and with increased cars on the roads, many traffic accidents have occurred in the past 10 years. According to the Security Department of Turkey, 4236 people died in 2008; 4324 people in 2009 and 4045 people in 2010 as a direct result of traffic accidents. Are you happy with these results?

Would you be interested in exploring ideas about ways traffic accidents can be reduced (and maybe eliminated)? Let us build robot cars and explore how science and technology might be able to play a role using light sensors.

Your Tasks

Within the whole class:

1. Discuss the meaning of a light sensor and brainstorm ways a light sensor can decrease the number of traffic accidents.
2. Present information considered relevant from student group searches on the internet about the properties of light.

In groups:

1. Search the internet for information on the property of light, both white light and coloured light.
2. Construct a robo-car using lego mindstorms NXT 2.0 (following instructions?)
3. Integrate a light sensor to the robo-car (follow instructions or devise their own way?)
4. Use different coloured paperboard to make a road for testing the speed of the robo-car (straight or bending)?
5. Writing a computer program following a worksheet giving instructions (structured or guided or open guidance ?) for the light sensor using NXT 2.1 programming (which does what tasks – information given as structured/guided/open?) and upload it to the robo-car.
6. Test your cars' speed (open inquiry - no instructions? who decides the criteria for the numbers tests to be performed?) when it passes along different colored roads.
7. Check the reliability of outcomes on the different colour roads if road surface differs (smooth, rough, waxed, etc – who decides on the different possibilities?) or sloped (who decides on the actual slopes used?).
8. Discuss and test other factors that could influence the reliability of the light sensor to work. (Possibilities here could be (a) wavelengths too close (b) reflectivity too low)

As a class:

1. Presentation of each group's outcomes (how? – (a)from filming, (b)using power point slides, (c)oral report but data written on the blackboard accumulated across all groups), discussion and comparison of each group's outcomes (purpose of this ? –most effective program?)
2. Reach final conclusion on:
   How it might be possible to decrease/increase the speed of cars?
3. Discuss the feasibility of integrating the light sensors to all of the cars? Economically? Reliability in all conditions?
4. Discuss the feasibility of colouring the traffic roads to limit the speed of the cars? Road maintenance issues?

STUDENT HANDOUT 2

The following steps/ questions are to help you to complete your project successfully:

1. What is light?
2. How is light reflected?
3. What is a light sensor?
4. How does a light sensor work?
5. How does a light sensor detects objects of different colours?
6. How does a light sensor send detected data from different coloured objects?
7. Which coloured objects absorb the light best?

Your task is to prepare a presentation using web or sources provided by your teacher and present them in classroom.

STUDENT HANDOUT 3

1. Please try to understand the working principle of light sensors using NXT 2.0. You will find some technical details of light sensor presented in figure 1.

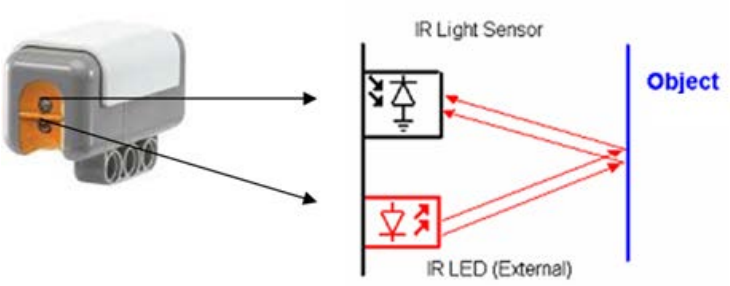


Figure 1. The technical details of a light sensor

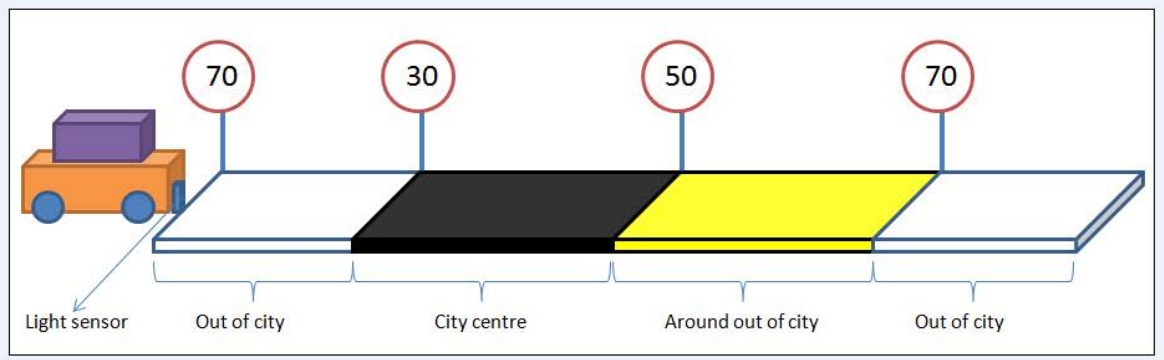
2. Please find the percentages of reflected light using light sensor and fill in the table below.

Colour of carton	Percentage of reflection
Red	
Yellow	
Blue	
Green	
White	
Black	

3. Please decide two colours which are absorbed by light sensors in most and in less.

STUDENT HANDOUT 4

1. Please make a robo-car using Lego Mindstorms NXT and blocks. Attached you can find an example to construct a robo-car.
2. When you complete your robo-car, please integrate the light sensor to the car.
3. Please upload the NXT program to your robo-car using USB cable.
4. Please test your robo-car on the roads which is coloured in two different colours.



(It is just an example, you can change the colours whatever you want)

Please note that your robo-car must decrease the speed when it passes the black road and increase the speed when it passes the yellow road. In order to do it, you have to change the power of two engines of the NXT.

You can find the construction steps for robotic-car: **Appendix 1**

5. Write an appropriate program using NXT 2.1 programming.

The Instruction Steps for Programming the robotic car: **Appendix 2**

STUDENT HANDOUT 5

Now it is time to::

1. Discuss the feasibility of colouring the traffic roads to limit the speed of the cars? Road maintenance issues?
2. Discuss the possibility of integrating the light sensors to all of the cars? Do you think that it is economic?

Can Traffic Accidents be eliminated by Robots?

TEACHING GUIDE

The activity relates to:

- Exploring the reflection of light on the different surfaces.
- Understanding the absorption of the light on the different surfaces.
- Understanding the function of light sensor.
- Introducing the concept of light.

Lesson Learning Outcomes

Lesson 1
At the end of this lesson, students are expected to be able to:

- Be familiar with NXT 2.0 programme
- Construct the robot kits for robo-car

Lesson 2
At the end of this lesson, students are expected to be able to:

- Understand the working principles of light sensor
- Integrate the light sensor to the robo-car
- Prepare different coloured paperboard to make a road for testing the robo-car

Lesson 3
At the end of this lesson, students are expected to be able to:

- Notice that light is absorbed by the object at the end of the interaction between object and light
- Know that why different coloured paperboards are used for testing the speed of robo-car
- Explore the light is absorbed more with dark colour

Lesson 4
At the end of this lesson, students are expected to be able to:

- Understand the reflection of light
- Understand the absorption of light
- Determine the colours which absorbed much light

Suggested Teaching Strategy

1. Lesson begins with the socio-scientific issue which occurs in the scenario.
2. Teacher explains the role of robotics and light sensor for solving the problem in the scenario and gives information about this.
3. Students who are divided into groups (maximum 5 students) construct a robotic car by using robotic kits and integrate light sensor to the robotic car.
4. Students write a suitable computer programme by using NXT 2.1. They upload them to the robotic car.
5. Results are discussed in the classroom by students.

ASSESSMENT

Can Traffic Accidents be eliminated by Robots?

This guide to assessment strategies is put forward from different perspectives. In part 1 the assessment is based on the skill to be developed in the student. Part 2 is based on the assessment strategies to use in each lesson and illustrates the assessment which a teacher may use for formative assessment like observation.

Part 1 Assessment based on Skills

Skills	Degrees				
	Low (1)	Acceptable (2)	Mean (3)	Good (4)	Perfect (5)
Social Values					
Able to distribute the tasks within the group					
Able to perform teamwork					
Able to contribute to the discussion in a meaningful way					
Personal Skills					
Willing to perform the project					
Able to think critical					
Able to be creative					
Able to present the subject in an interesting way					
Able to have self-confidence during the presentation					
Willing to present the subject to the class					
Able to indicate opinion when asked					
Using Science Method					
Able to apply different sources to gather information					
Able to make the observations carefully					
Able to determine the purpose of the project					
Able to make an appropriate working plan for the project					
Able to analyze data collected					
Able to make inferences					

Part 2 Assessment based on lesson

	Dimension	Criteria for evaluation	Mark/grade given
Lesson 1	Make Arrangements	Searches for answers to the questions given in Student Handout 1 and discuss with group members	
		Prepares to use Lego Mindstorms NXT 2.0	
Lesson 2	Construct robo-car	Presents the answers of questions given in Student Handout 1	
		Carries out simple experiments with NXT programme	
		Uses appropriate blocks for constructing a robo-car	
		Integrates the light sensor to the robo-car	
Lesson 3	Testing robo-car	Determines the percentage of reflected light for each colour given in Student Handout 2	
		Makes appropriate instructions and uploads them to the robo-car by using NXT programme	
		Tests the robo-car on different coloured 'roads'	
Lesson 4	Make conclusions	Draws appropriate conclusions related to the robo-car	
		Gives opinions about decreasing the number of traffic accidents by using robots	

TEACHER NOTES

Can Traffic Accidents be eliminated by Robots?

For the Lego Mindstorms NXT 2.0

- The students should have background information about Lego Mindstorms NXT 2.0 and its working principle to work with them.
- It will take one hour class time to teach your students about Lego Mindstorms if they do not have such background.
- The detailed information can be found on the Lego Mindstorms NXT 2.0 web page: www.mindstorms.lego.com

For the Science and Technology Curriculum

- It is useful to show different equipment which has a light sensor.
- It is also useful to show traffic accident videos and some statics about traffic accidents.
- It is useful to show some about light (especially reflection of light).

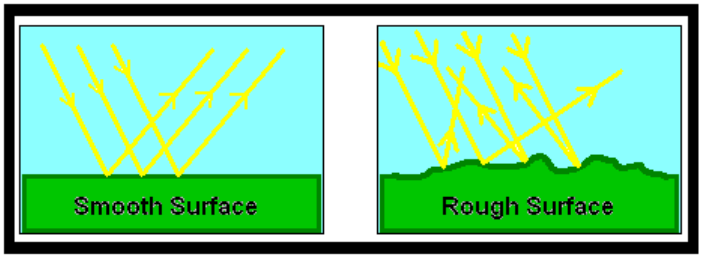
Light

Light is made of billions of tiny particles called photons. These photons travel from one place to another in waves. Visible light is the subset of photons that move at a wavelength that we can see. Among the different photons that are in visible light, the ones that have the longest wavelength look red to us, and the ones that have the shortest wavelength look blue to us. All colours come from different wavelengths of light.

Reflection of Light

Reflection occurs when light bounces off objects. How much reflection depends upon how even the surface is. If the surface is rough, the light scatters. If the surface is smooth and flat, the light will bounce off it at equal angles. That is why a flat mirror reflects a good likeness of the object being reflected.

Look at the diagrams below. Notice the angles at which the light (shown as rays) strikes the surfaces.



Light Sensor Block

This sensor detects ambient (surrounding) light. Using data wires, it can send out the current light value and a logic signal (true/false) based on whether the current light value falls above or below a trigger point.

A trigger point is the specific value in a range of numbers where a change in condition occurs. For example, you might program your robot to move forward only when the light level rises above 60%. The trigger point would be 60.

Specify the trigger point by using the slider or by typing a number into the input box. To specify the range (above or below the trigger point) that will generate the "true" signal, use the radio buttons or the pull-down menu. The "true" portion of the range will be in colour; the "false" portion will be gray.

The default setting for the light sensor block is for light levels above 50% to generate a "true" signal. The radio button to the right of the range is selected and the slider is set at 50. To switch the "true" portions of the range (setting values below 50% as "true"), you would select the left radio button.

The feedback box in the configuration panel shows the current light value. (To receive feedback, make sure that the light sensor is connected to the chosen port and that communication has been established with the NXT.)

You must drag at least one output data wire from this block's data hub to another block for any information to be sent. (See the Data Hub section below for more information.)

Tip: How do I set the Trigger Point for a Light Sensor?

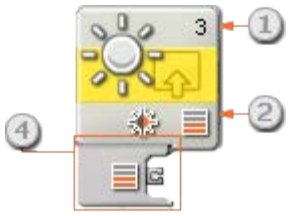
If you want a flashlight pointed at your robot to generate the "true" signal, try pointing a flashlight at your robot a few times and watching the light values displayed in the feedback box. If the flashlight generates light levels of around 80%, you might set the trigger value at 70. That way, bright light above 70% (like from the flashlight) will generate a "true" signal. Weaker light will be ignored.

The trigger point can also be set dynamically with an input data wire.

Detecting the Light Sensor's own Reflected Light

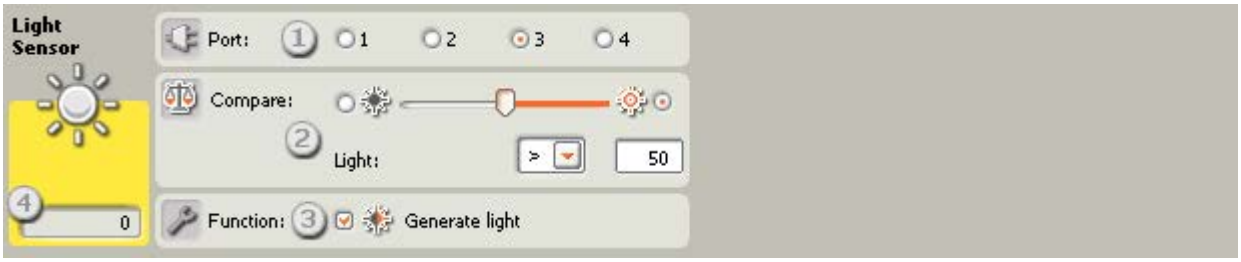
If you check the "Generate Light" checkbox, the light sensor will turn on its own small light source and detect this light if it is reflected back to it. This function is especially useful in difficult lighting conditions like very bright rooms. The function also allows the light sensor to serve as a short-distance range finder. With "Generate Light" turned on, a light sensor approaching a reflective object will detect higher reflected light levels. Therefore, it is possible to use the sensor to avoid running into obstacles.

Display Settings



1. The number shows which of your NXT's ports are connected to the light sensor. You can change this number in the configuration panel if you need to.
2. This icon indicates at what level the trigger point is set. The more coloured bars displayed, the higher the trigger point.
3. This icon is displayed if "Generate Light" is turned on.
4. The block's data hub will open automatically when the block is placed in the work area. At least one data wire must be dragged from the block's output plug to another block's data hub. (See the Data Hub section below for more information.)

Configuring the Light Sensor Block



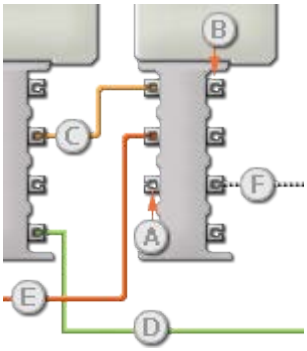
1. Choose the port where your light sensor is plugged in. By default, the block will be set to port 3 for a light sensor. You can change this selection if you need to.
2. Use the slider to set the trigger value or type a value directly into the input box. Select the radio button to the right of the slider if you want the block to be triggered by light levels higher than the trigger value; select the left radio button to trigger the block with light levels lower than the trigger value. You can also use the pull-down menu to set the "true" portion of the slider.
3. If you check the "Generate Light" checkbox, the light sensor will turn on its own small light source and detect this light if it is reflected back to it.
4. The feedback box displays the current light reading (0-100%). You can use it to try out different trigger values.

Configuring the Light Sensor block's Data Hub

You can control the Light Sensor block dynamically by connecting data wires (from other blocks' data hubs) to the Light Sensor block's data hub.

Open a block's data hub by clicking the tab at the lower left edge of the block after it has been placed on the work area.

Data wires carrying input information to a block are connected to the plugs on the left side of its data hub. Data wires carrying output information are connected to the plugs on the right side.



[A] Input plug
[B] Output plug
[C] Number data wire (yellow)
[D] Logic data wire (green)
[E] Text data wire (orange)
[F] Broken data wire (gray)

Passing data from the input plug to the output plug
If an input plug has a corresponding output plug (see A above), the input data will pass through from the input plug to the output plug without being changed. In this case, you can only use the output plug if the input plug is connected to an input data wire; connecting an output data wire to such an output plug without a connected input data wire will cause the output data wire to be "broken" (and coloured gray).

Data wires carry specific types of data
Each data wire carries a specific type of data between blocks. For example, if a data wire is dragged from a logic plug on a block's data hub, it can only be connected to a logic plug on another block's data hub. The chart below shows what kind of data each plug can accept or send out.

Data wire colours
Data wires are identified with specific colours: wires carrying number data are coloured yellow, wires carrying logic data are coloured green, and wires carrying text data are coloured orange.

"Broken" data wires
If you try to connect a data wire to a plug of the wrong data type, the data wire will be broken (and coloured gray). You will not be able to download your program if a data wire is broken.

If you click a broken wire you can read why it is broken in the small help window in the lower right corner of the work area.

Data must be within the possible range of the plug
If an input data wire transmits a value outside the possible range of the plug it is connected to, the block will either ignore the value or change it to a value within its range. For plugs that allow just a

few input values (example: just 0, 1, or 2), the plug will ignore the input if a value arrives outside its range.

For plugs that accept larger input ranges (example: 0 – 100), the plug will force any input outside its range to fit. For example, if a Move block's Power plug receives an input value of 150, the block will change the input value to 100 (i.e., a number within the Power plug's range).

This chart shows the different characteristics of the plugs on the Light Sensor block's data hub:

Plug	Data Type	Possible Range	What the Values Mean	This Plug is Ignored When...
 Port	Number	1 - 4	1 = Port 1, 2 = Port 2, 3 = Port 3, 4 = Port 4	
 Trigger Point	Number	0 - 100	Value to compare against	
 Greater / Less	Logic	True/False	Logic used in comparison. True = Greater, False = Less	
 Generate Light	Logic	True/False	Determines if the sensor's own LED is on or not	
 Yes / No	Logic	True/False	Result of comparison	
 Intensity	Number	0 - 100	Scaled value read from sensor.	
 Raw Value	Number	0 - 1024	Raw (unscaled) value read from sensor	

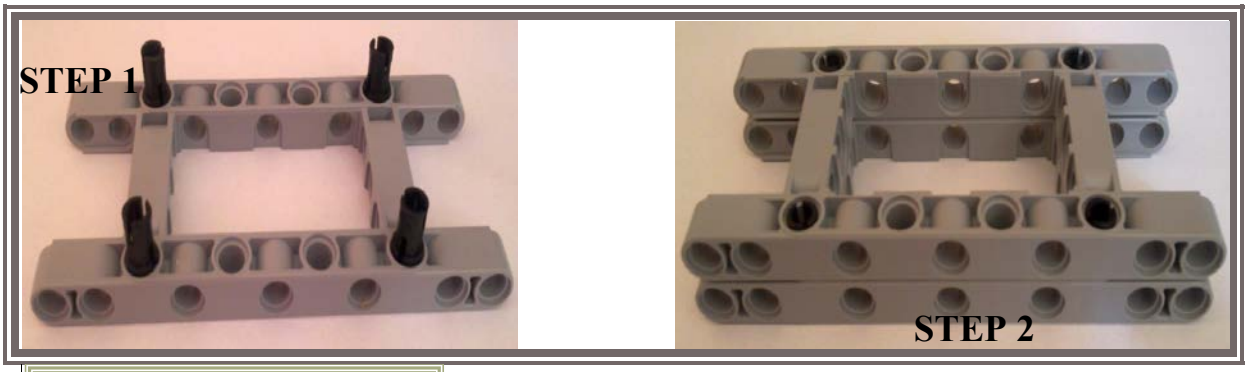
Colours and Light absorption
Dark colours do not exactly absorb more heat, but they do convert a higher percentage of light into heat. If you notice when heading out in the sun with a dark coloured shirt it gets hot, where a lighter coloured shirt would not get nearly as hot. This is due to the amount of light being absorbed by the colour. The lighter the colour, the smaller the range of visible light being absorbed and converted into heat.

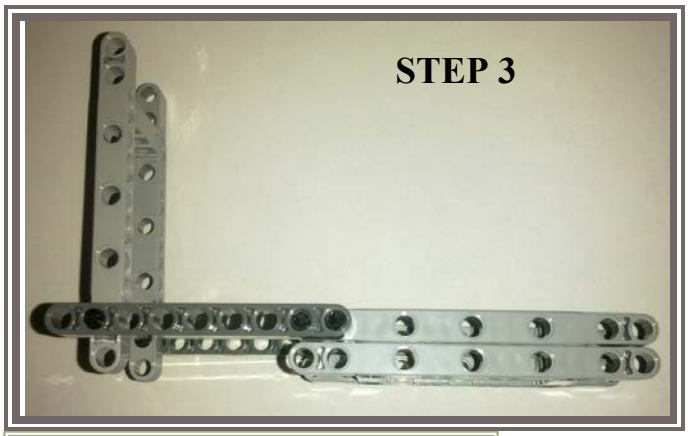
White objects reflect all visible light, where black objects absorb all visible light. This is also why we call both dark coloured objects and poorly lit objects dark.

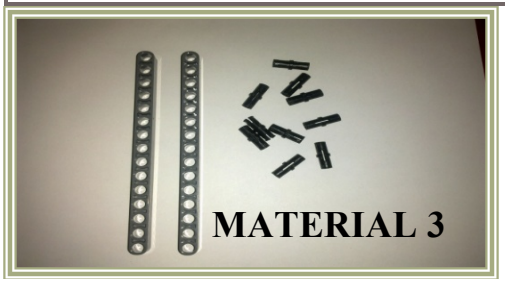
While colour is a factor of light absorption, it is not the only factor. You will find that some dark objects remain cooler in direct sunlight then other lighter objects. This is due to the fact that there are other factors at play, maybe one material is a poorer insulator; possibly there is a shine to darker object, leading more light to be reflected as a result. But if all but the colour is the same, you will find that darker colours do become hotter when exposed to light.

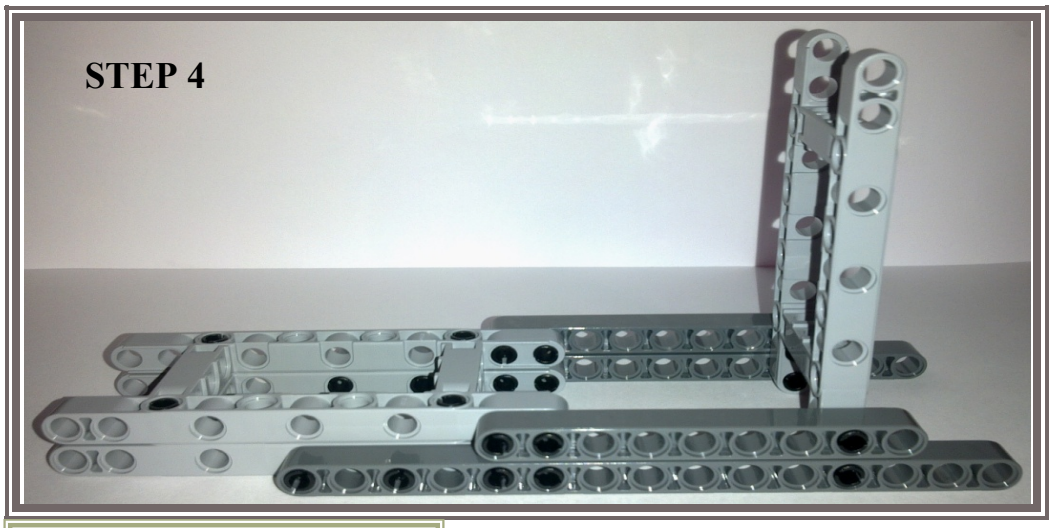
References
http://www.historyforkids.org/scienceforkids/physics/light/
http://wiki.answers.com/Q/Why_does_a_dark_colour_absorb_more_heat_than_white
http://users.sch.gr/gkevasi/nxt/light_sensor_block.htm
http://www.myschoolhouse.com/courses/O/1/36.asp

APPENDIX 1:
CONSTRUCTING A ROBOTIC-CAR WİTH COLOR SENSOR



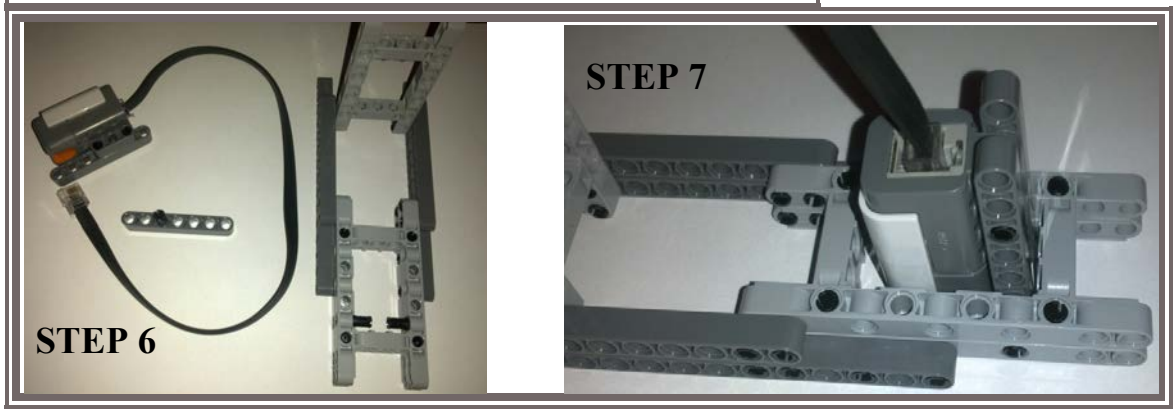




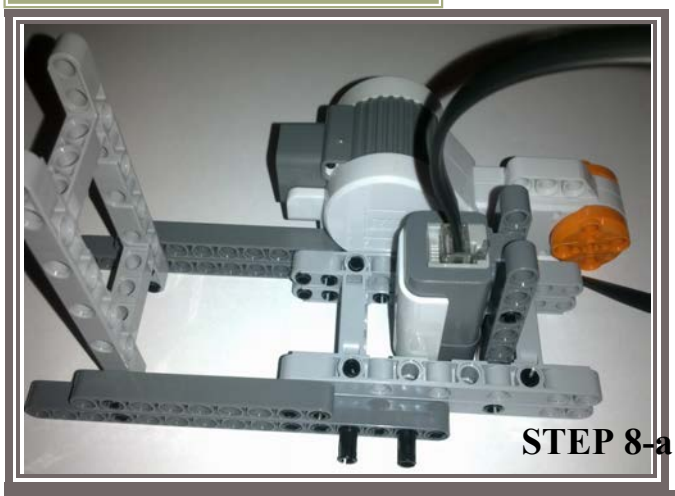

STEP 4


MATERIAL

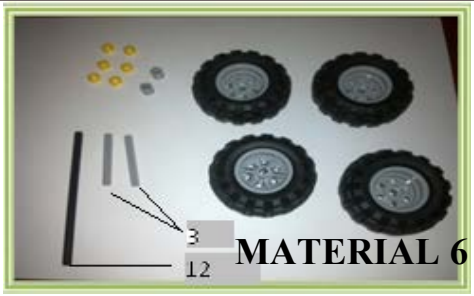

STEP 5

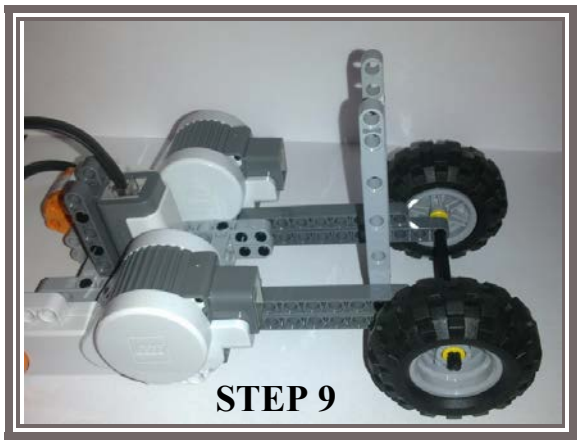

STEP 6
STEP 7


MATERIAL 5

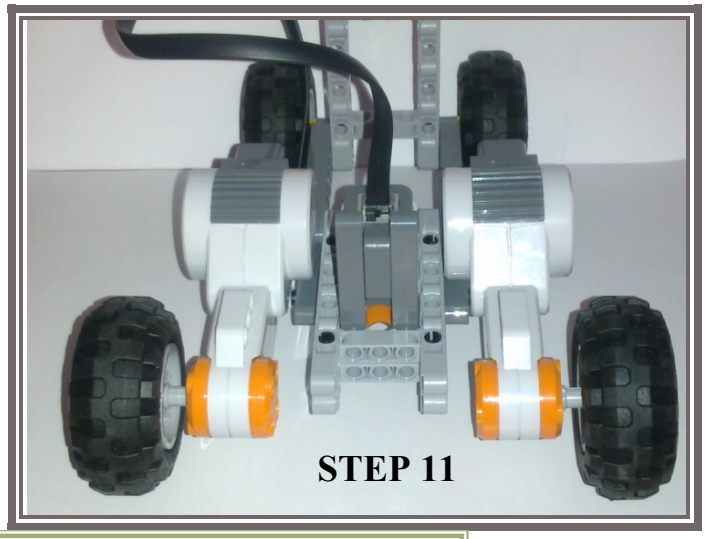

STEP 8-a

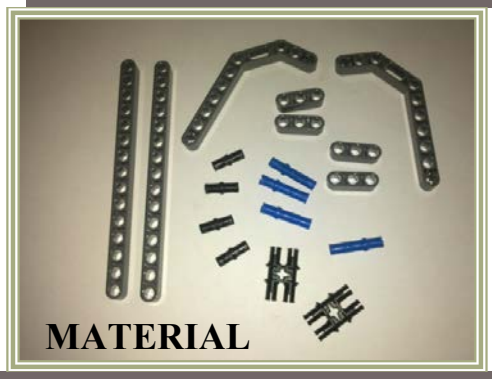

STEP 8-b

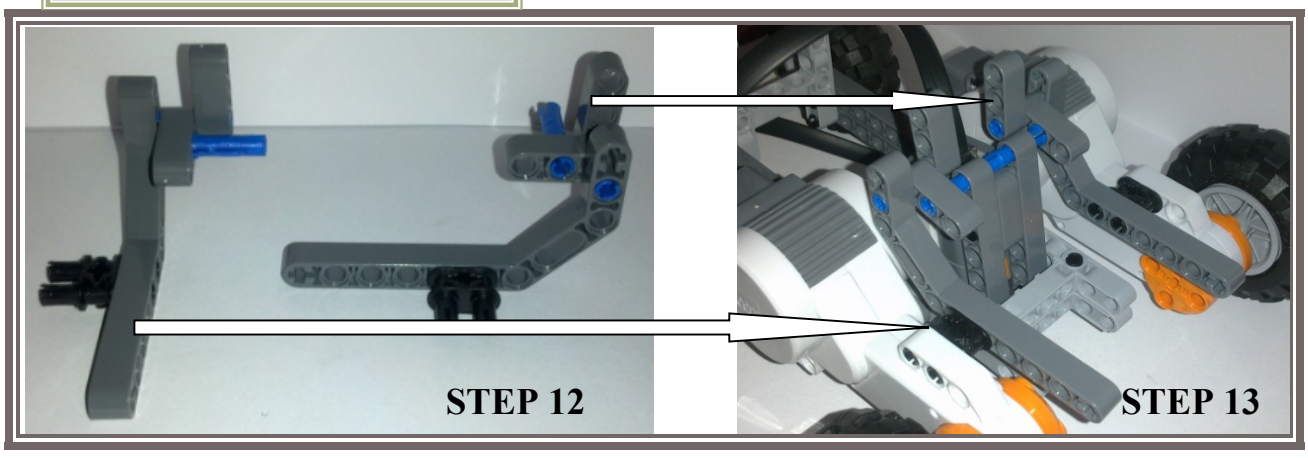

3
12
MATERIAL 6

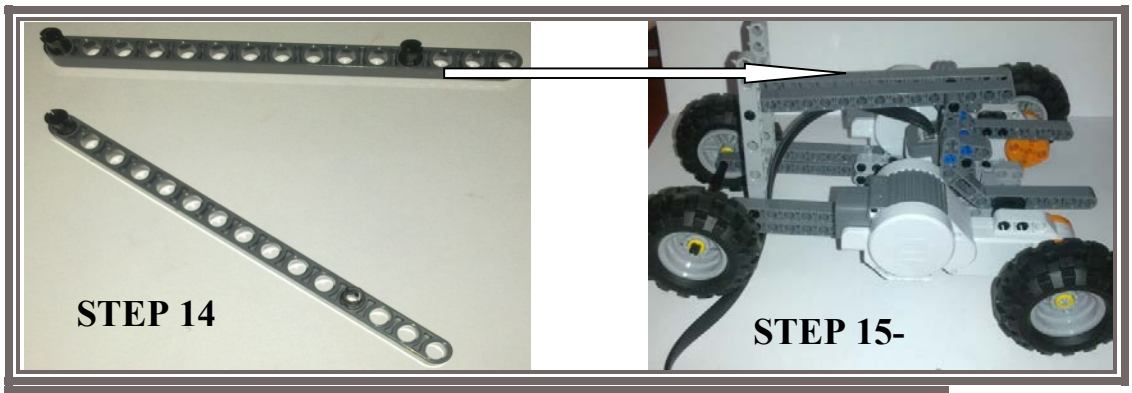

STEP 9

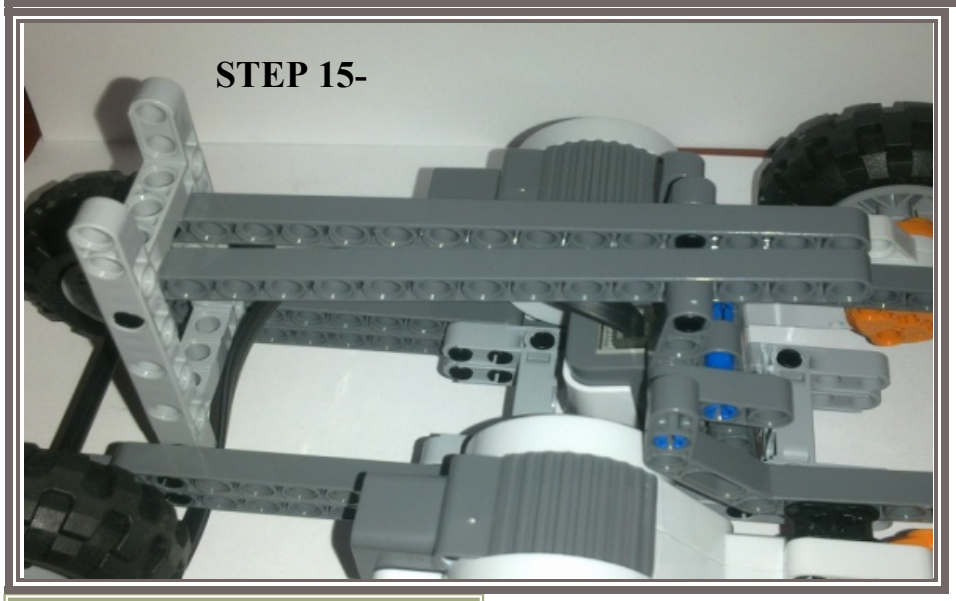

STEP 10


STEP 11

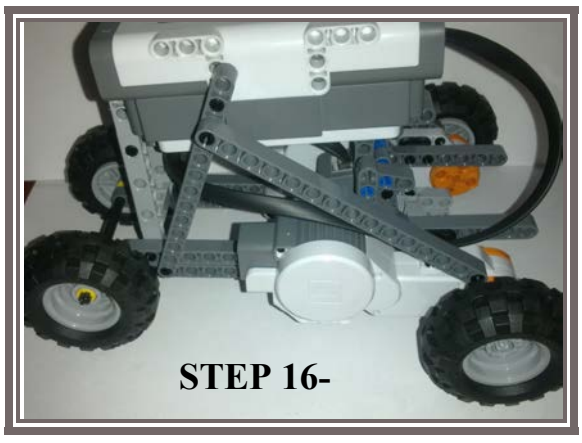

MATERIAL

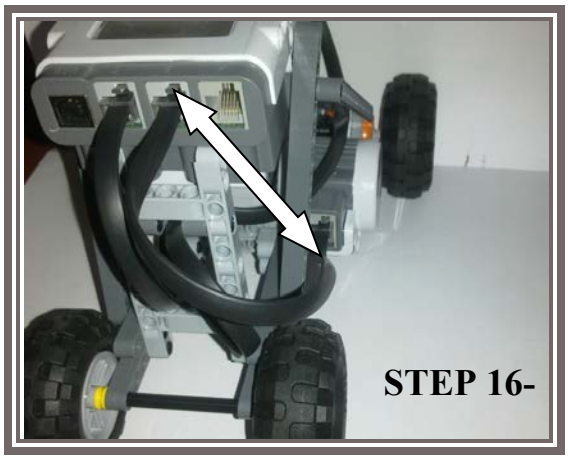

STEP 12
STEP 13

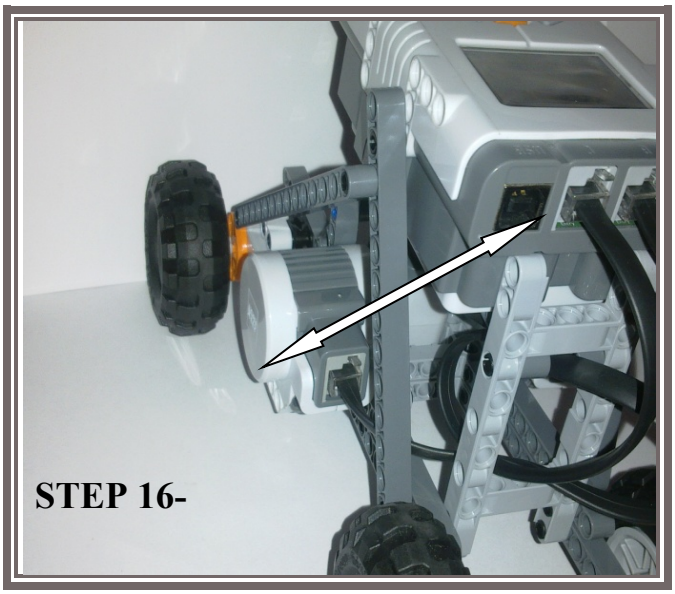

STEP 14
STEP 15-


STEP 15-


MATERIAL


STEP 16-


STEP 16-



APPENDIX 2: Programming Robotic car

Move: Allows robot's movement

Record/Play: Records sound and plays it

Sound: Allows robots make different sounds

Display: Allows to monitorize writing on robot's screen

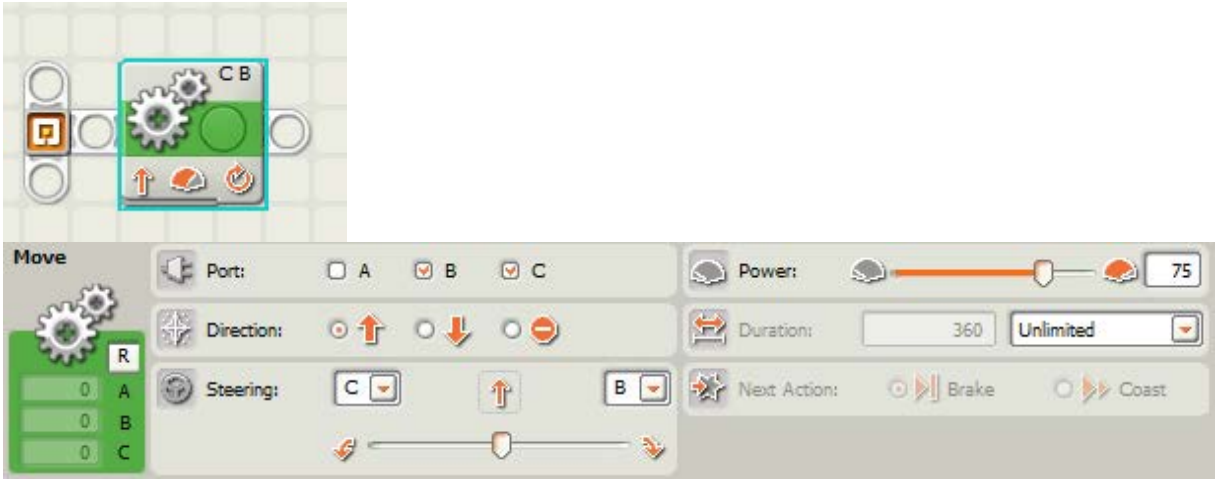
Wait: Allows robot stop for a while

Loop: Allows to replay action.

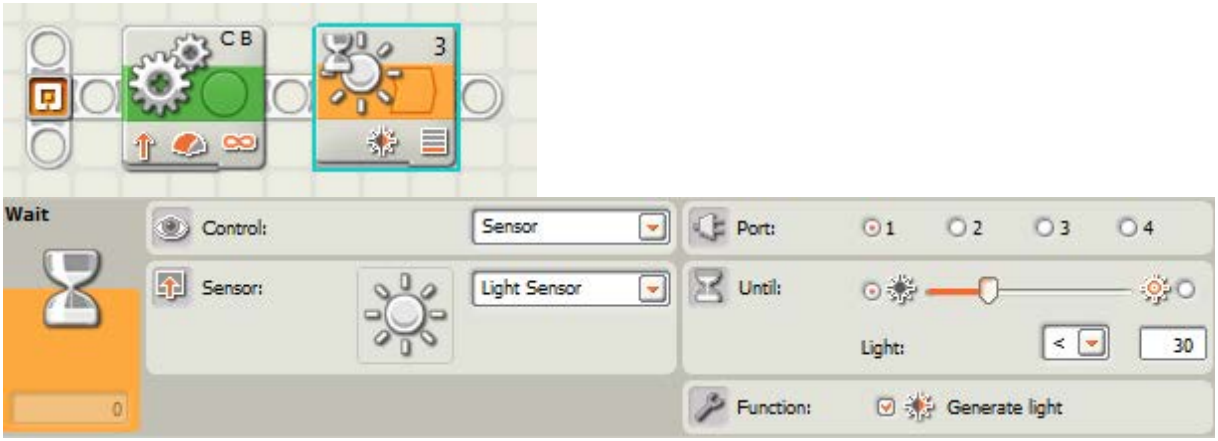
Switch: Allows robot to select one of two actions

Programming Steps

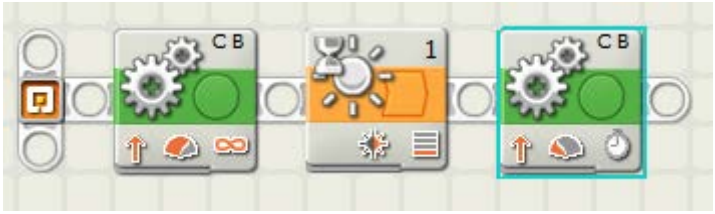
1. Click the “Move” button and add the icon on your programming table. Then following:
   - Choose B and C ports for engines
   - Choose “forward” in “directions” part
   - Set the engine power to 75 in “power” part
   - Change the selection as “unlimited” in duration part



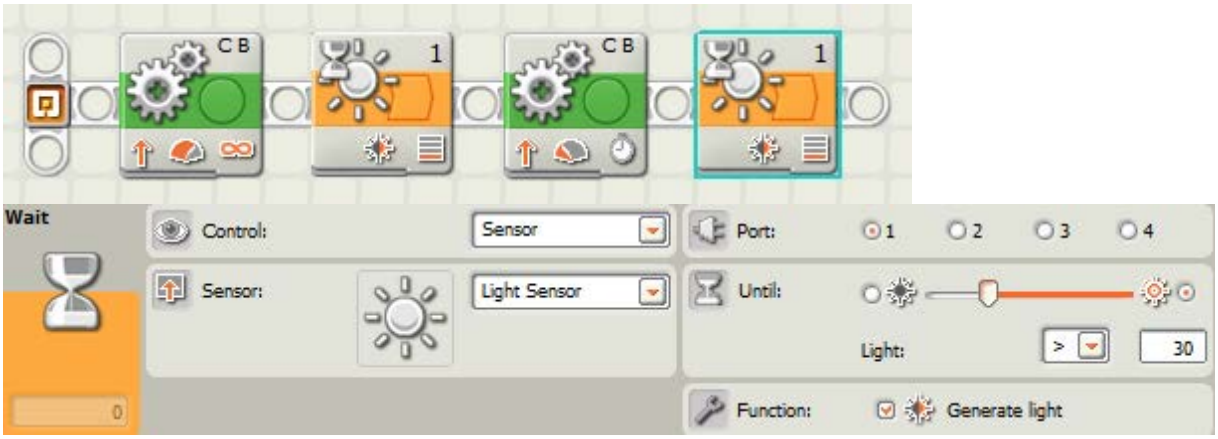
2. Choose light sensor in “wait” part of the left menu. Then the following:
   - Choose “sensor” in “control” part
   - Set the sensor as “light sensor” in “sensor” part
   - Choose “port 1” for light sensor
   - Set the light option as <30 in “until” part
   - Choose “generate light” in “function” part



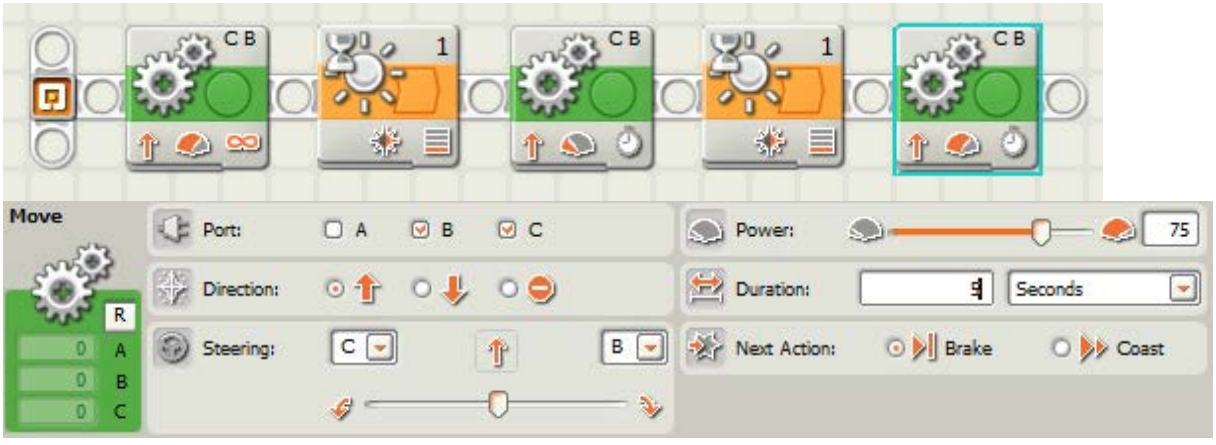
3. Click the “Move” button and add the icon on your programming table. Then following:
   - Choose B and C ports for engines
   - Choose “forward” in “directions” part
   - Set the engine power to 25 in “power” part
   - Change the selection as “5 seconds” in duration part
   - Choose “brake” in “next action” part



4. Choose light sensor in “wait” part of the left menu. Then the following:
   - Choose “sensor” in “control” part
   - Set the sensor as “light sensor” in “sensor” part
   - Choose “port 1” for light sensor
   - Set the light option as >30 in “until” part
   - Choose “generate light” in “function” part

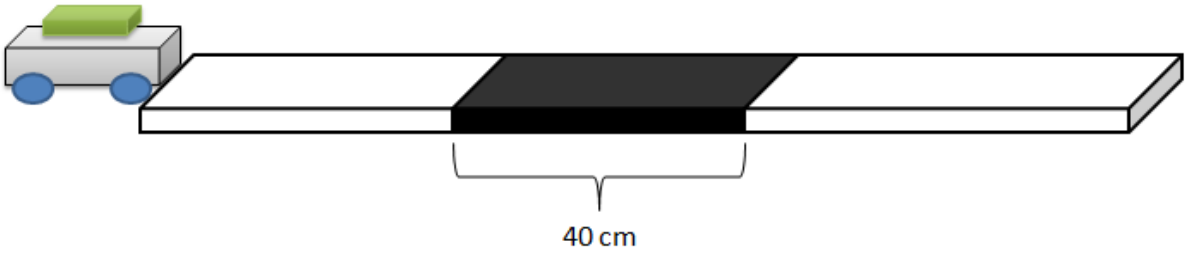


5. Click the “Move” button and add the icon on your programming table. Then following:
   - Choose B and C ports for engines
   - Choose “forward” in “directions” part
   - Set the engine power to 75 in “power” part
   - Change the selection as “10 seconds” in duration part
   - Choose “brake” in “next action” part



6. Then connect your NXT to computer and click “Download” button and program will be uploaded to your NXT.

7. Stick your white and black paperboards on the floor. The white ones can be as long as you want but black one should be 40 cm.



8. Put the robot on the road and push “Run” button on NXT.

HOW CAN WE CREATE AN ICE-CREAM CAR WHICH GOES ON THE BEACH USING WIND?

7th Grade science and technology module on
Forces, Friction and Renewable energy

Abstract

This module leads to a decision making activity, designed to consolidate learning about Design and technology; Using mechanisms – gearing down, Assembling components, Combining materials, Renewable energy, Measuring area, Measuring distance, Measuring time, Forces, Friction, Air resistance, Pressure, Scientific investigation, taking examples from everyday life and to introduce the friction, energy and power.

Sections included		
1.	Student activities (for students)	Describes the scenario in more detail and the tasks the students should perform
2.	Teaching guide	Suggests a teaching approach
3.	Assessment	Gives suggested formative assessment strategies
4.	Teacher notes	Gives expectations of calculations to be carried out by students

The module is designed and created by Bulent Cavas, Selin Nur Sayar and Duygu Seyman

Overall Objectives/Competencies:
The students are expected to:
7.2.4.2. explain the effects of friction on the kinetic energy
7.2.4.2. give examples connected to the air and water resistance.

Curriculum content: force and motion

Kind of activity:
Design and technology; • Using mechanisms – gearing down • Assembling components • Combining materials
Science • Renewable energy • Measuring area • Measuring distance • Measuring time • Forces • Friction • Air resistance • Pressure • Scientific investigation

Anticipated time: 4 lessons

This unique teaching-learning material is intended to guide the teacher towards promoting students' scientific literacy by recognising learning in 4 domains – intellectual development, the process and nature of science, personal development and social development.

Its uniqueness extends to an approach to science lessons which is designed to follow a 3 stage model. For this the approach is intentionally from society to science and attempts to specifically meet student learning needs.
This uniqueness is specifically exhibited by:

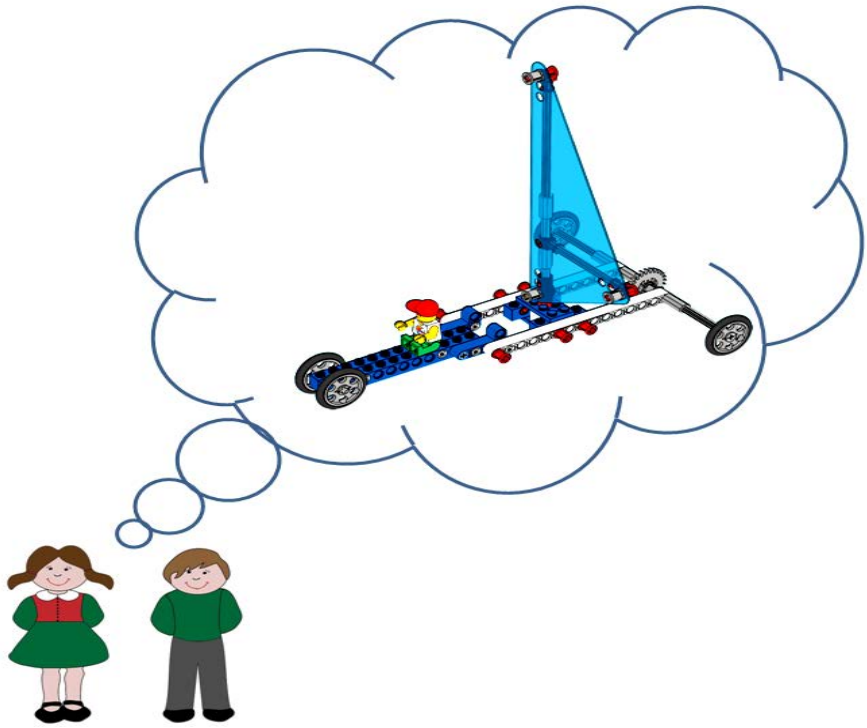
1. a motivational, society-related and issue-based title (supported in the student guide by a motivational, socio-scientific, real life scenario);
2. forming a bridge from the scenario to the scientific learning to be undertaken;
3. student-centred emphasis on scientific problem solving, encompassing the learning of a range of educational and scientific goals;
4. utilising the new science by including in socio-scientific decision making to relate the science acquired to societal needs for responsible citizenship

-

HOW CAN WE CREATE A CAR WHICH GOES ON THE BEACH USING AIR POWER?

Student Activities

The Scenario



Ege, Deniz and Efe are very closed friends and lives in Çeşme-Alaçatı* where is a windy place in Turkey. Unfortunately, one day they learned that Efe is very ill and he is getting worse day by day. Efe needs to go Istanbul in order to have some advanced medical tests. However, Efe's family is poor and they do not have enough money to send Efe to Istanbul and for advanced medical tests.

Ege and Deniz decide to sell ice-creams in Alaçatı-beach for supporting Efe to go Istanbul. In order to sell ice-creams in beaches, they need to build an ice-cream car that can move on the beach using air power. They know that they have enough wind in beaches and they want to use wind for moving their ice-cream car.

Would you like to help Ege and Deniz to build an ice-cream car using lego kits?

* Placed on the Cesme Peninsula, contrary to the Hellenic island Chios, Alacati is the perfect surf point in the Turkish Aegean Sea. Who does not dream of rushing over flat, Turquoise water with incessant wind? With Izmir just a 3 hour flight away, and the transferral to Alacati only 60 minutes, this perfect localisation is staggeringly approachable.

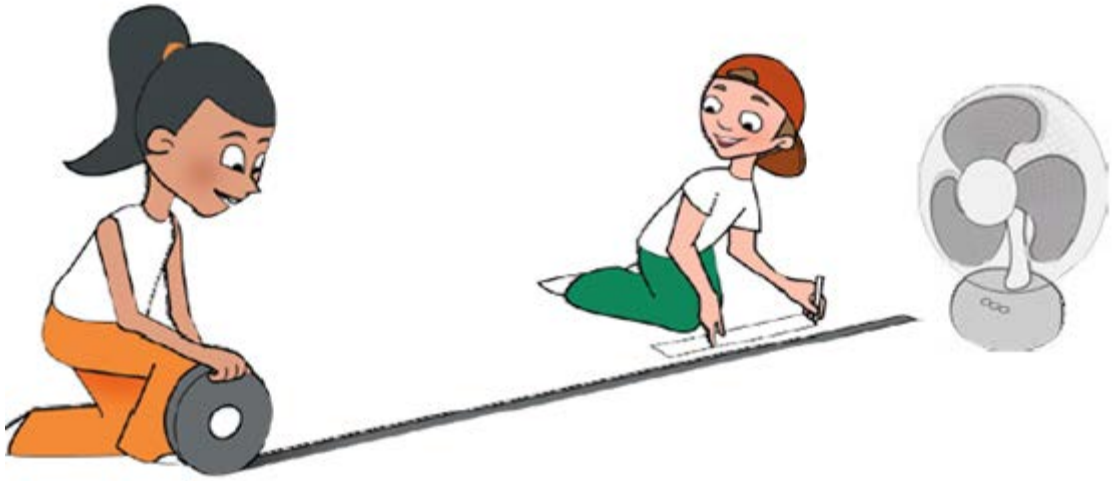
Construction

Warning!

Fans are potentially dangerous. Make sure that children handle them with great care!

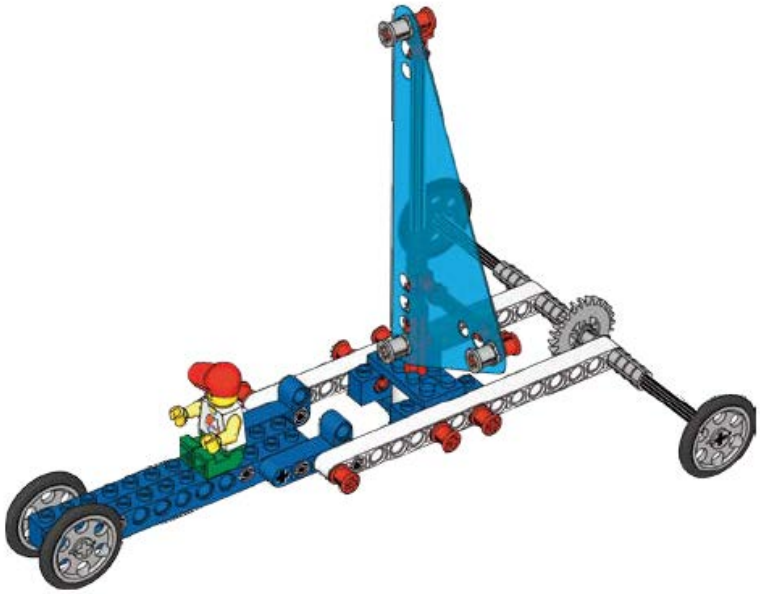
Make your test track

Stick a 1,5 metre strip of masking tape across a stretch of floor and mark it off every 10 cm from the fan. Now we are ready to build models!

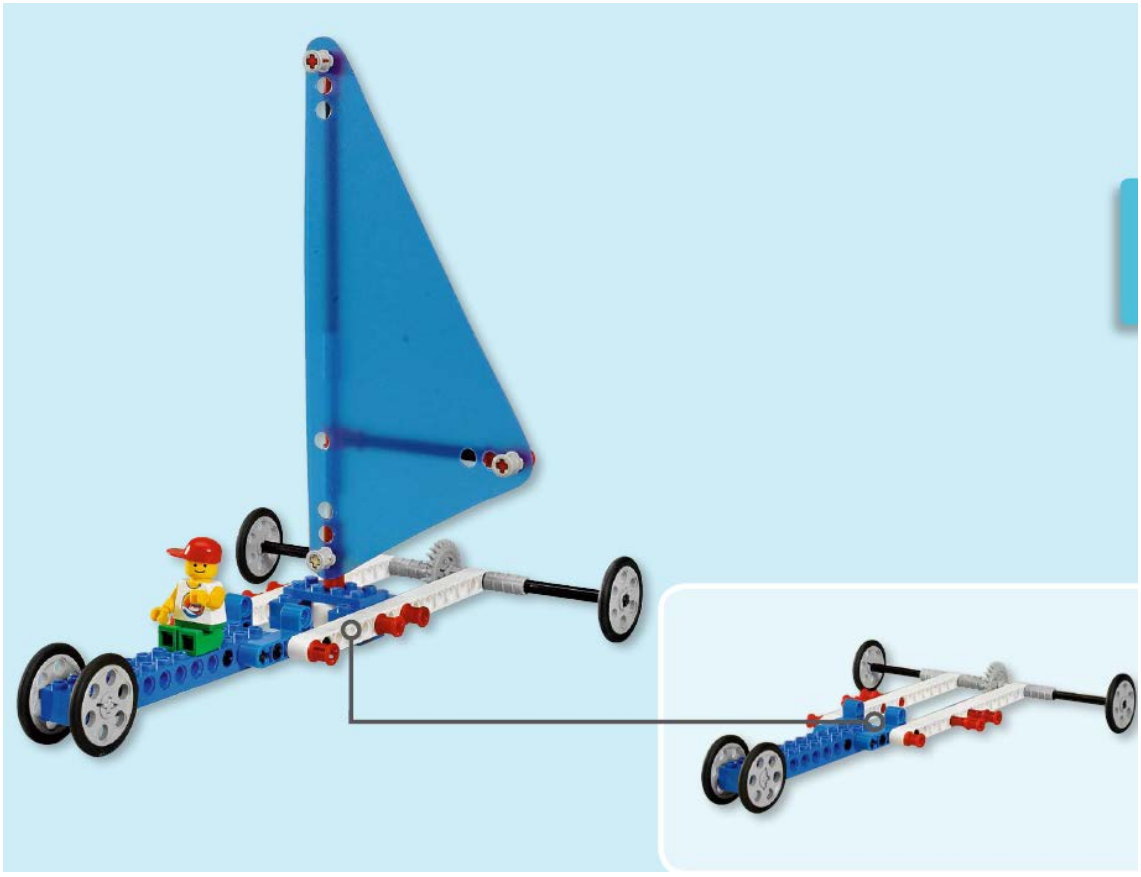


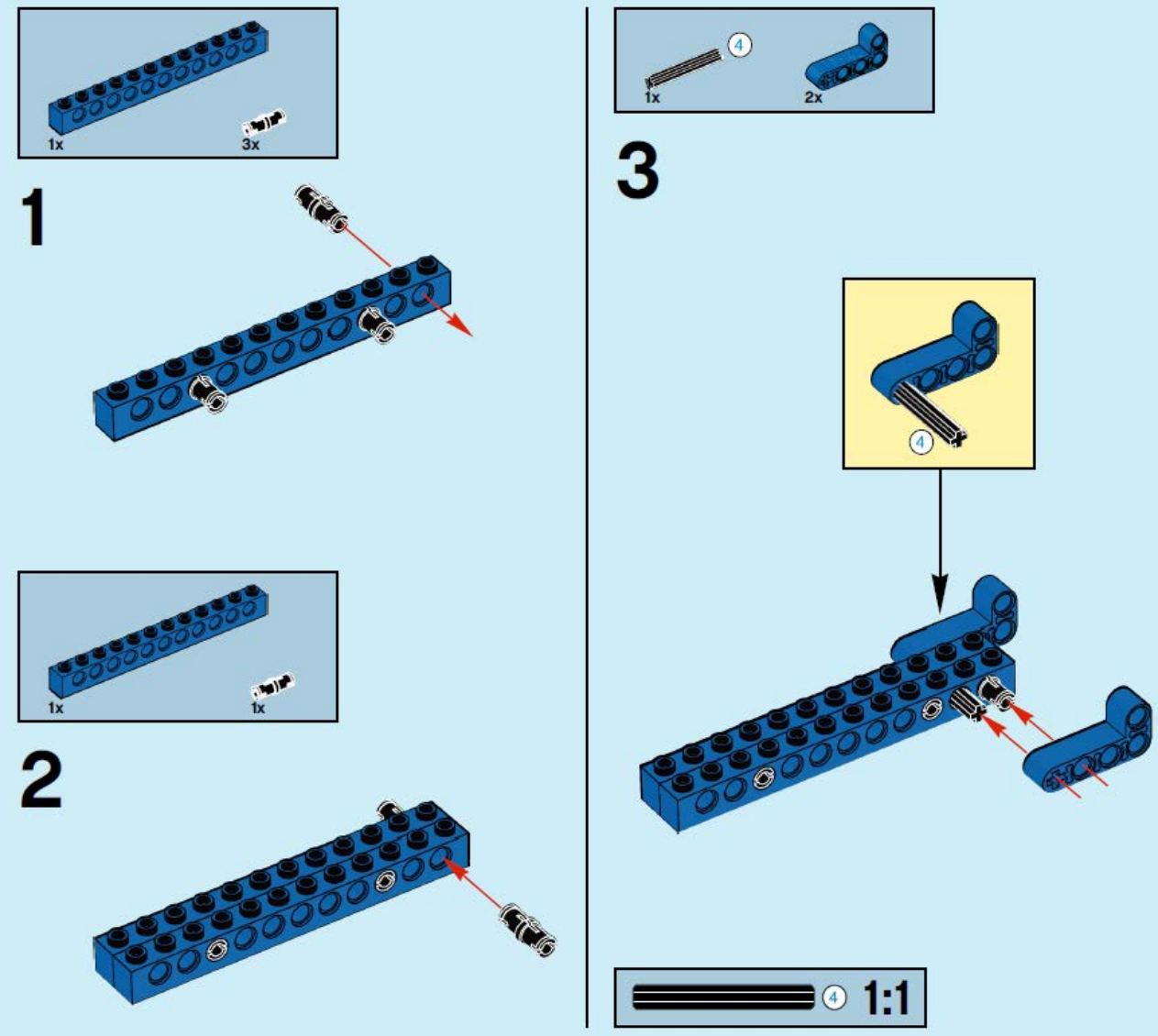
Build the ice-cream car

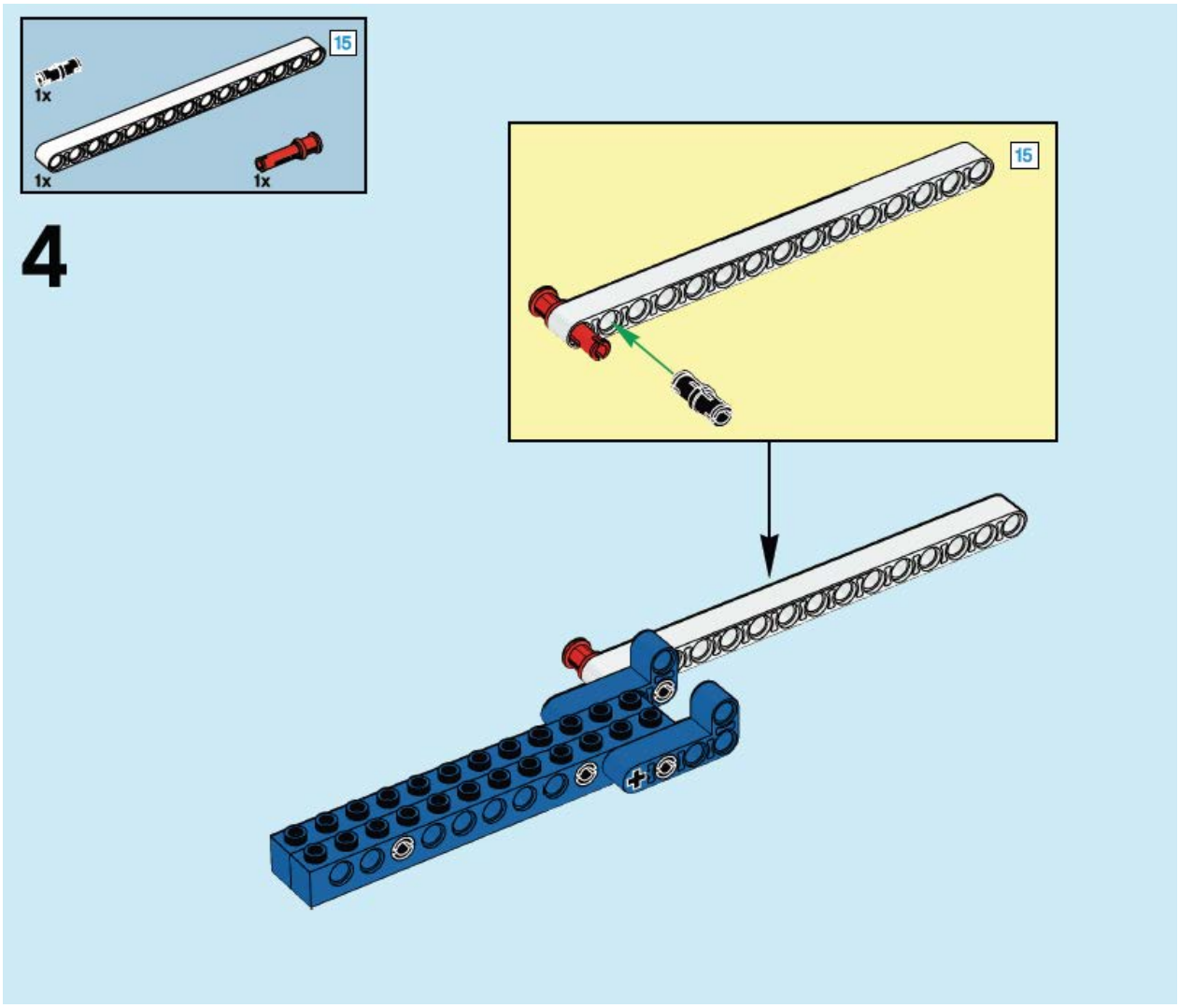
You can use following pages to build your car.

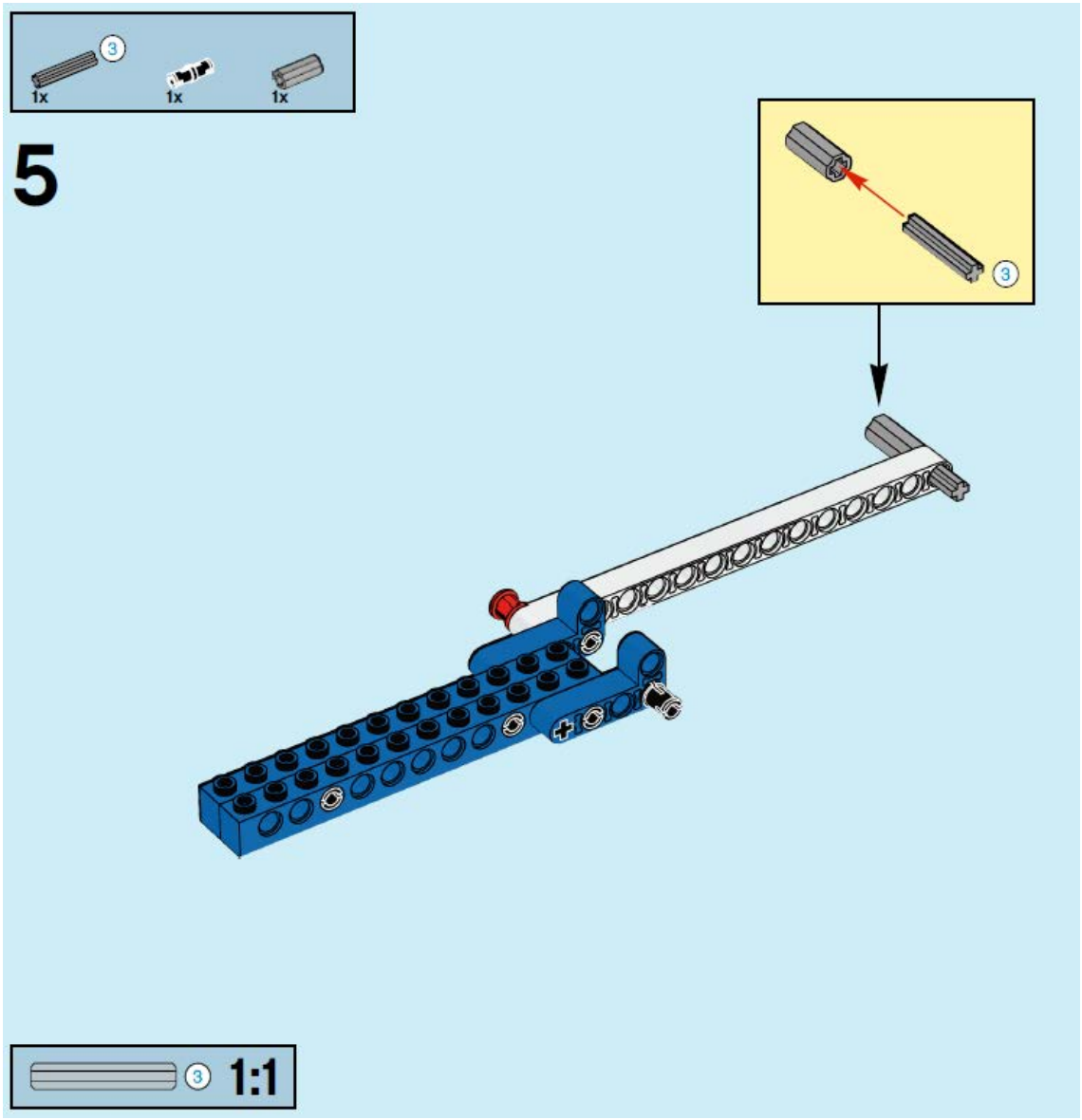


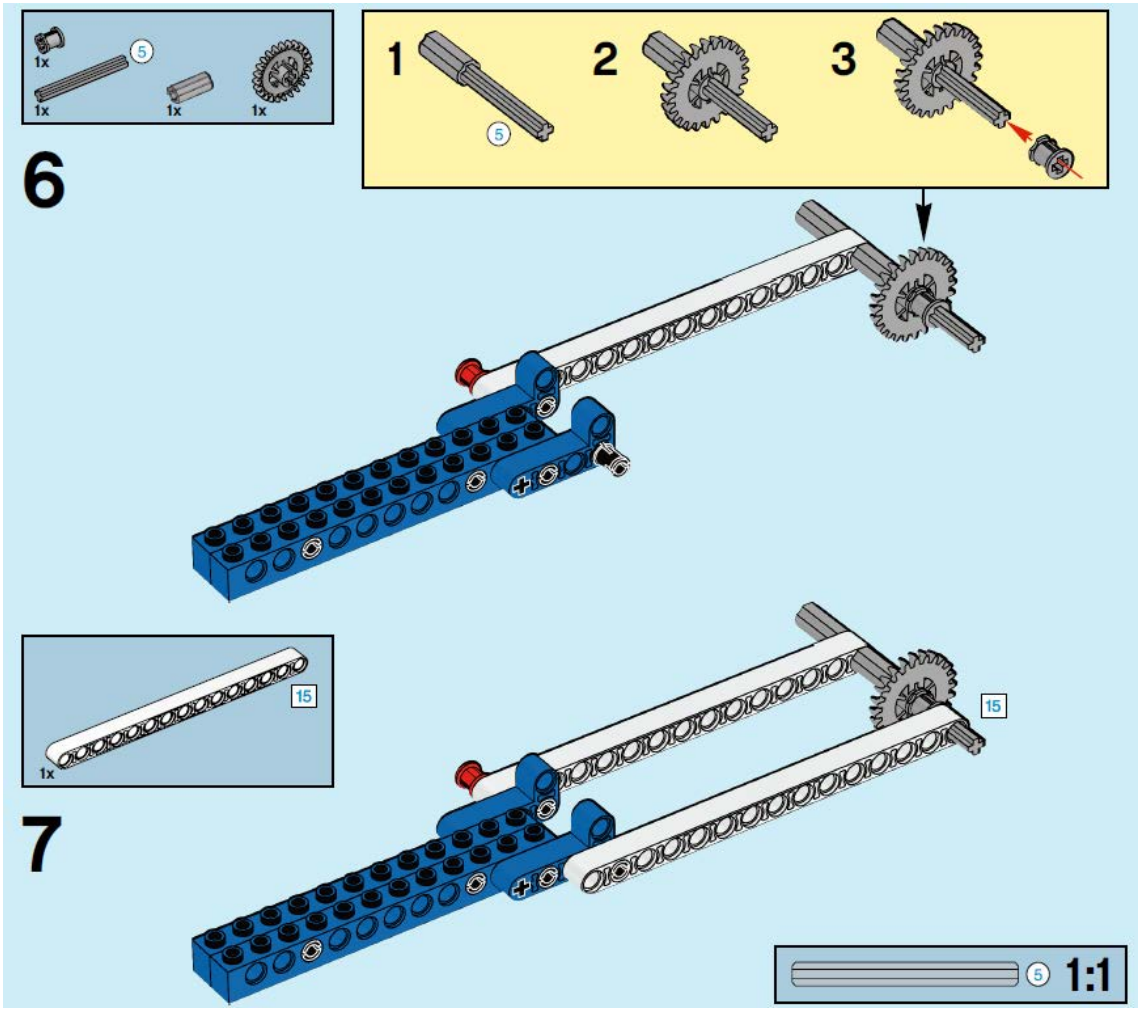
Building Instruction

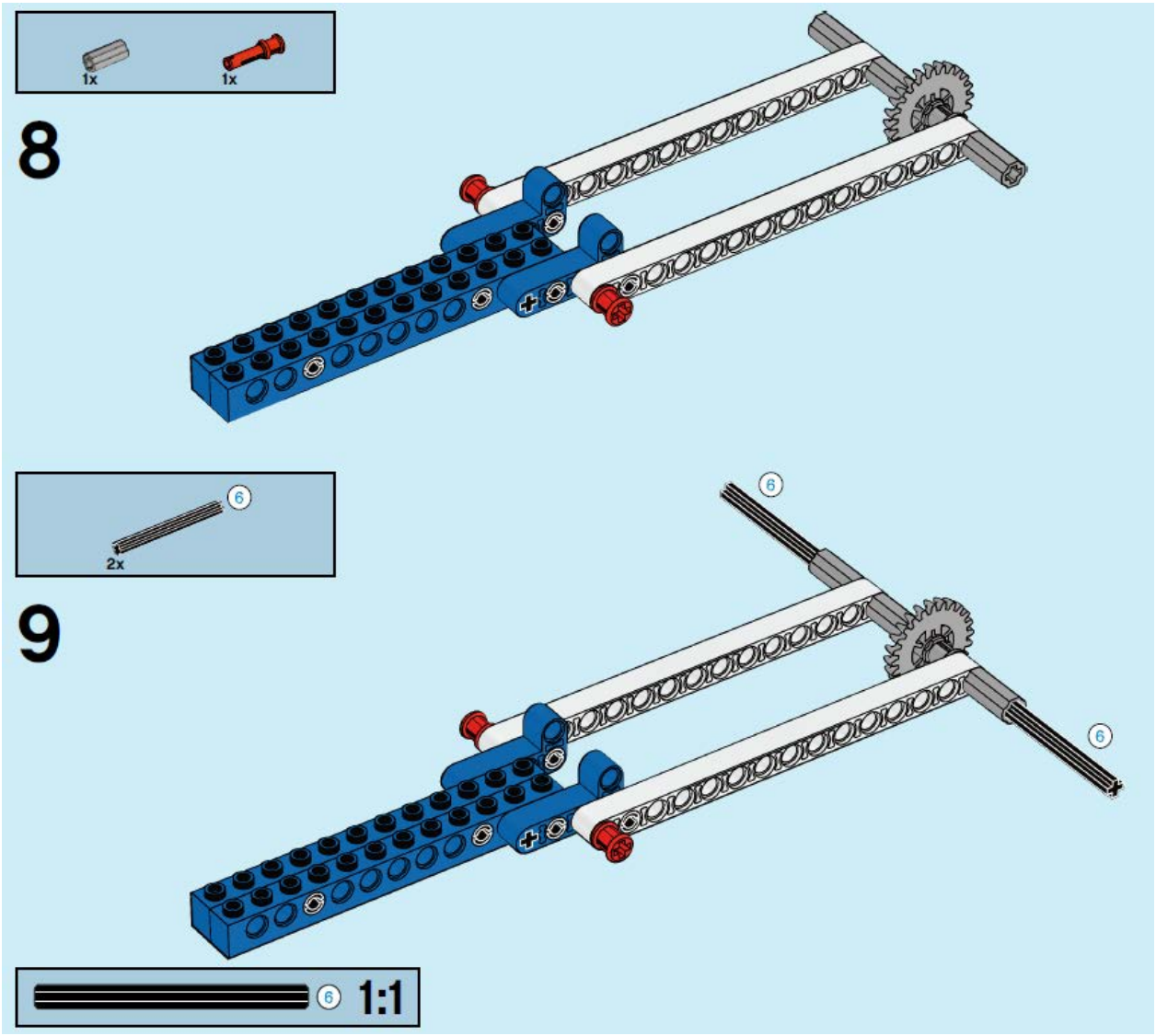


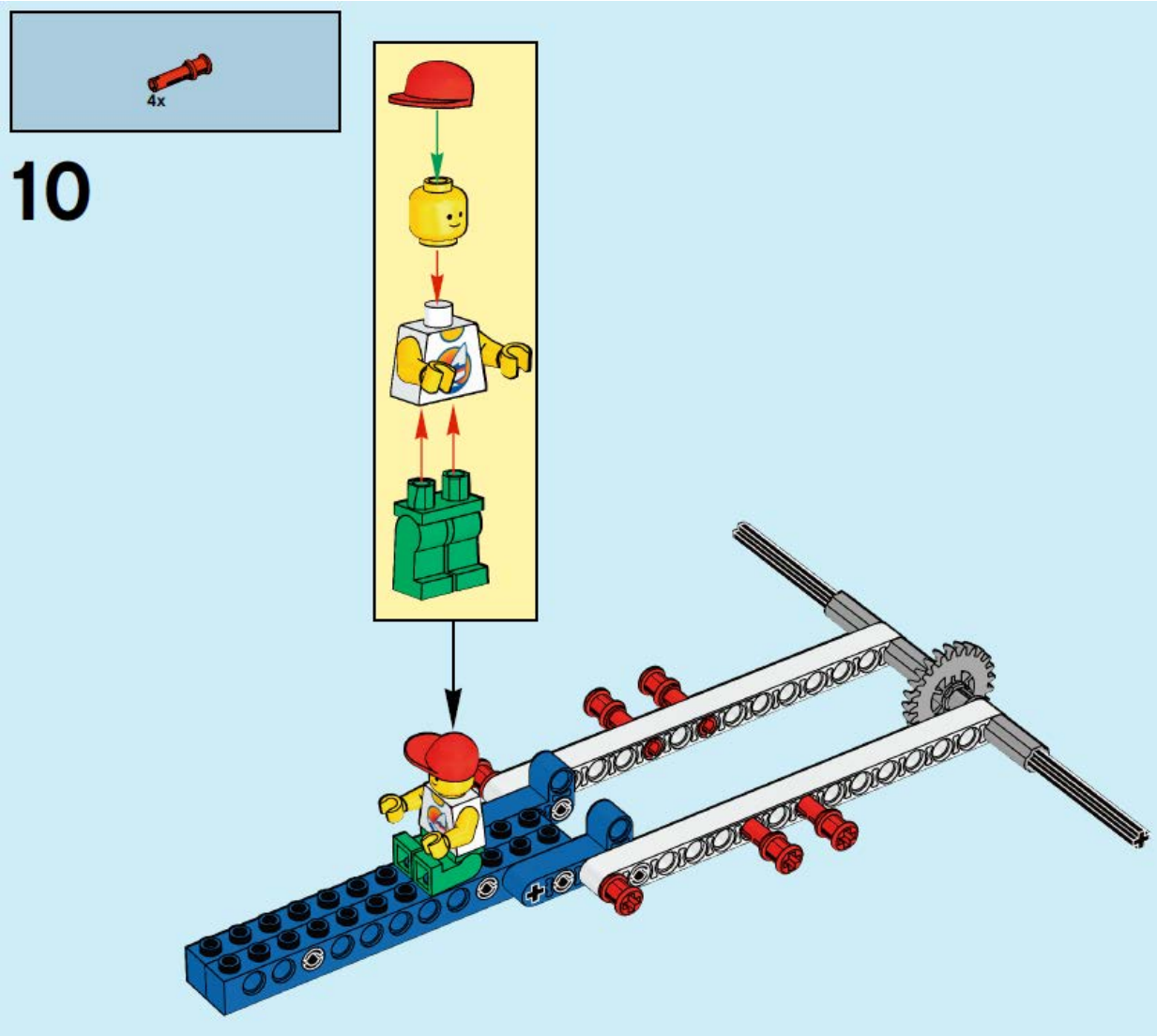

1x
3x
1
1x
1x
2
1x
2x
3
4
4
4
1:1

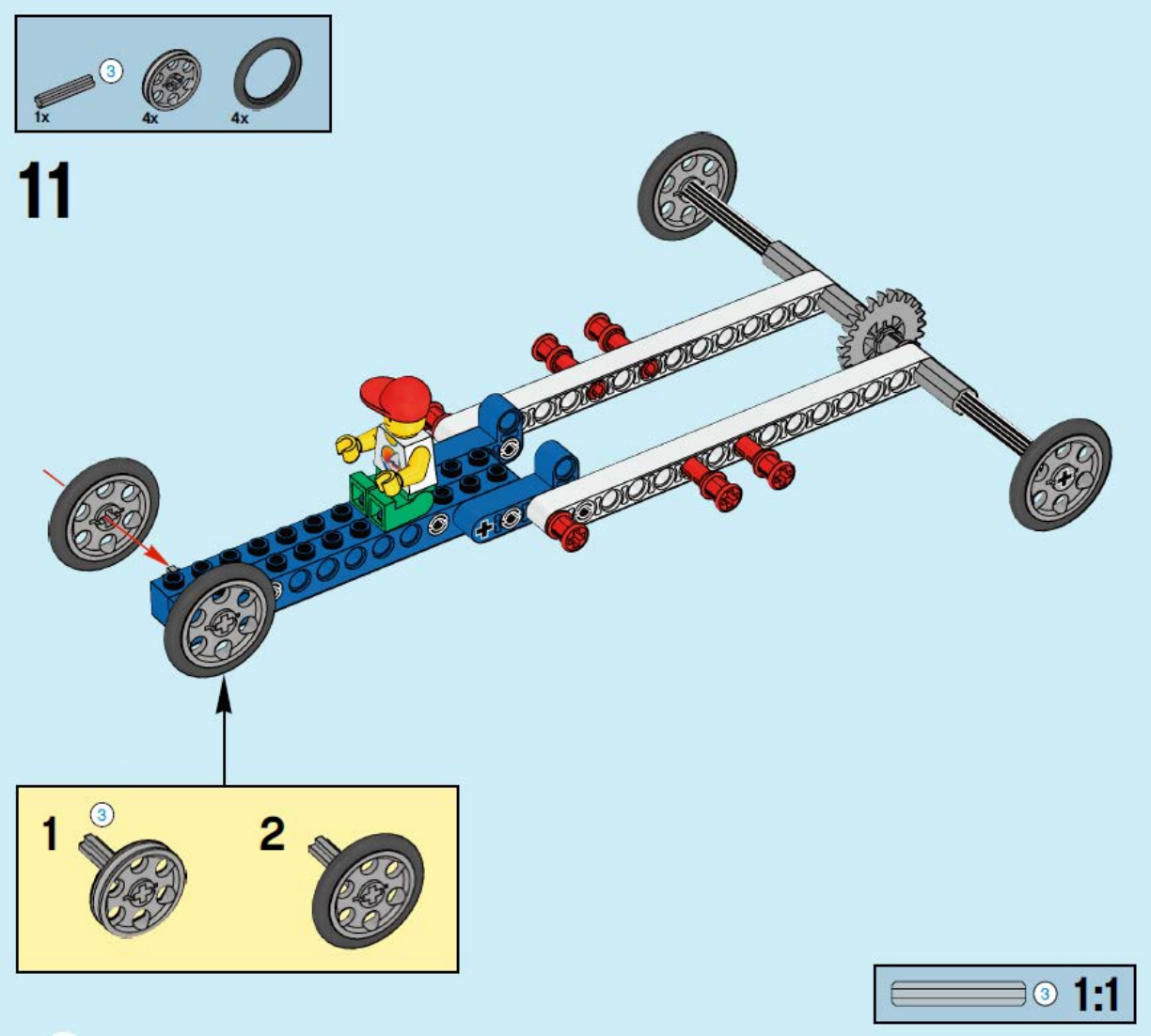

15
1x
1x
1x
4
15

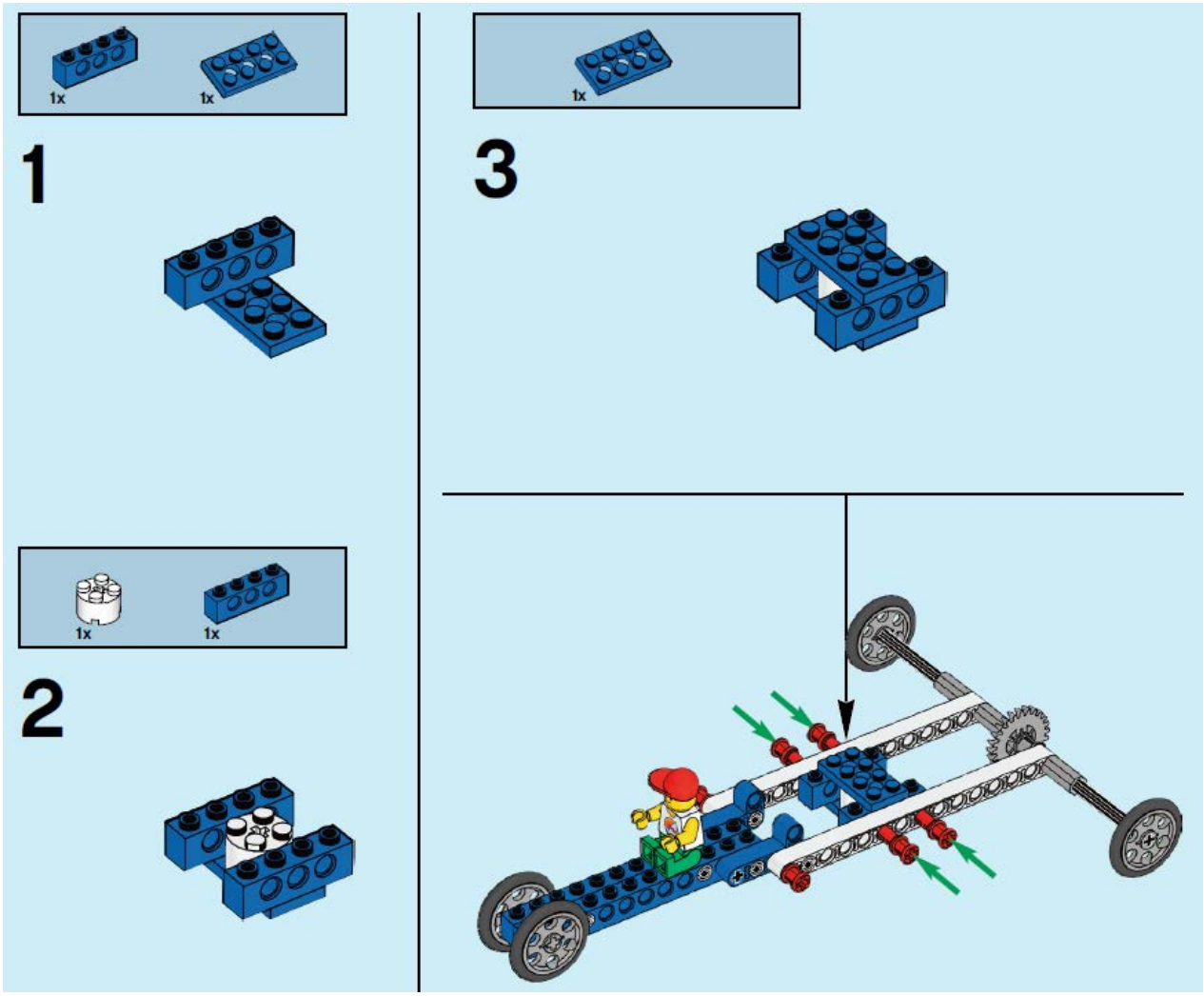

3
1x
1x
1x
5
3
3
1:1

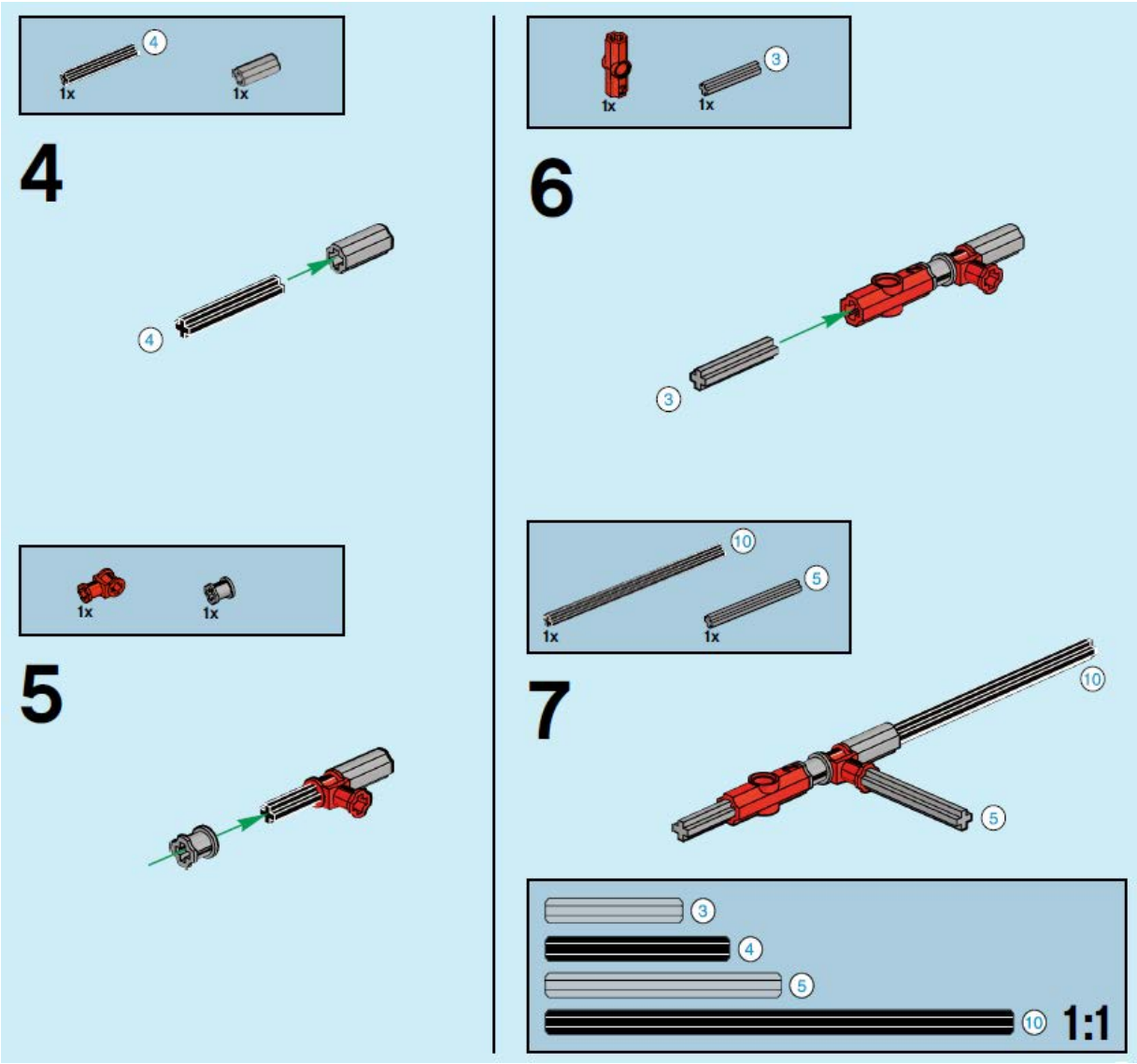

1x
5
1x
1x
1x
1
2
3
5
6
15
1x
7
15
5
1:1

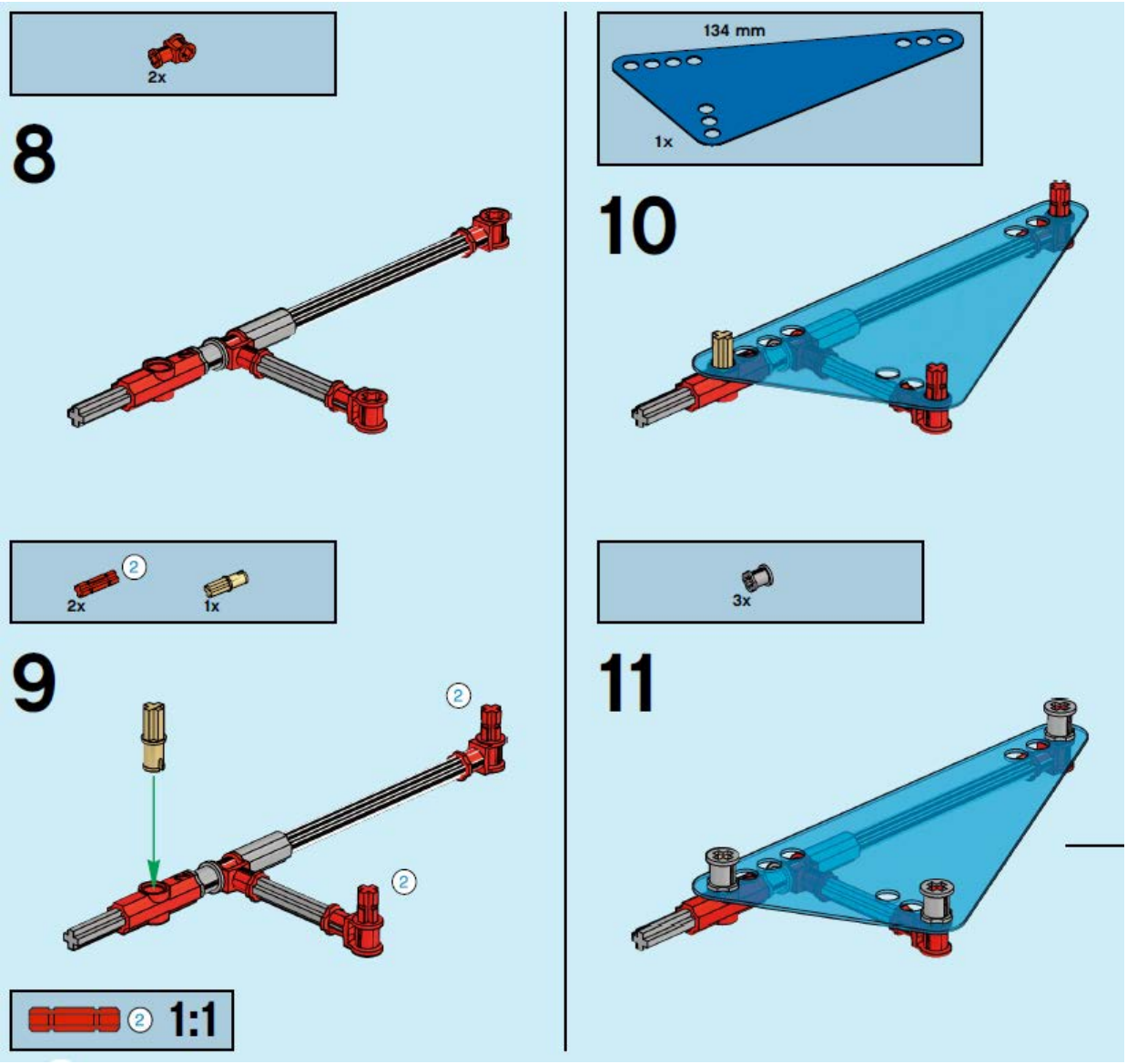

1x
1x
8
6
2x
9
6
6
6
1:1

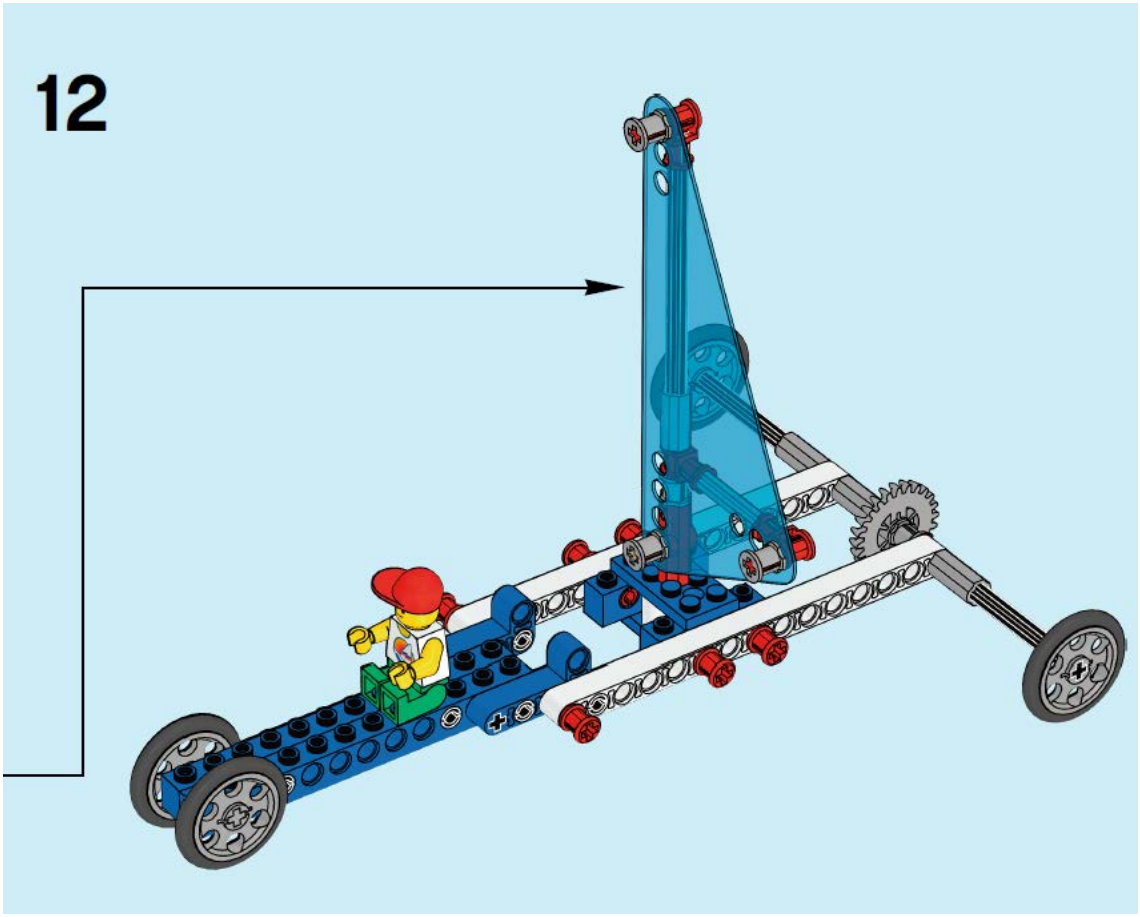

4x
10

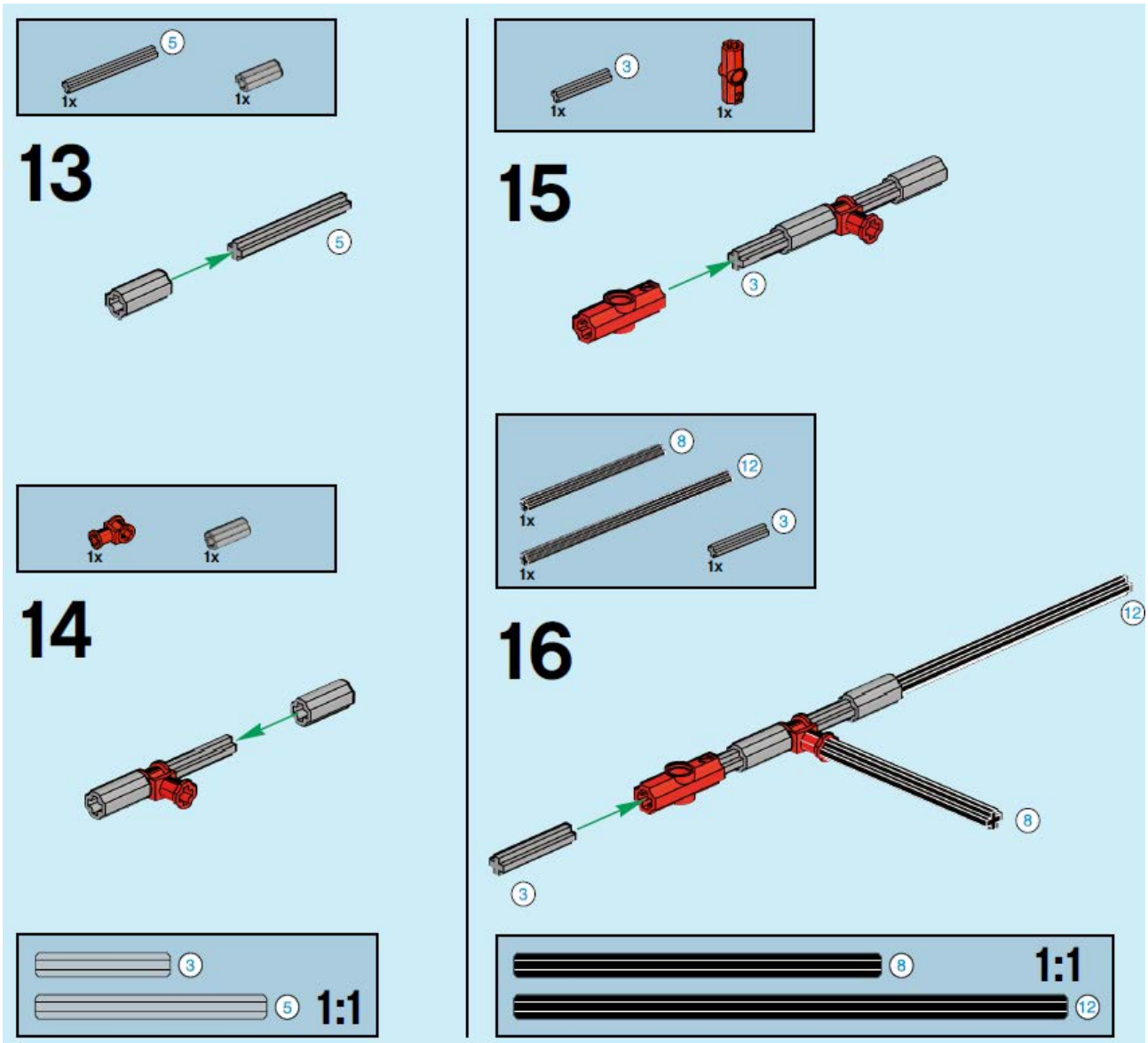

3
1x
4x
4x
11
1
3
2
3
1:1

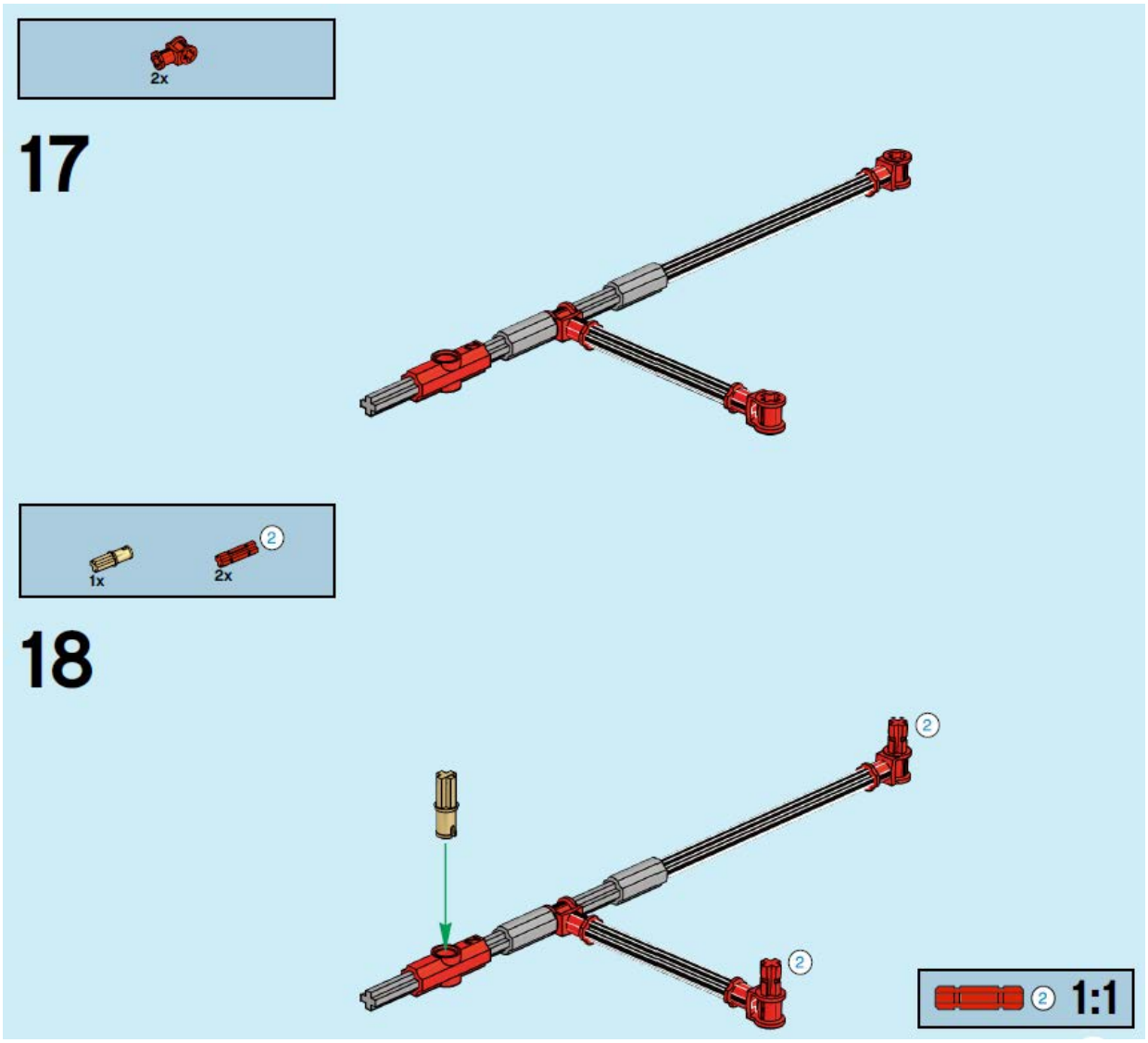

1x
1x
1
1x
3
1x
1x
2

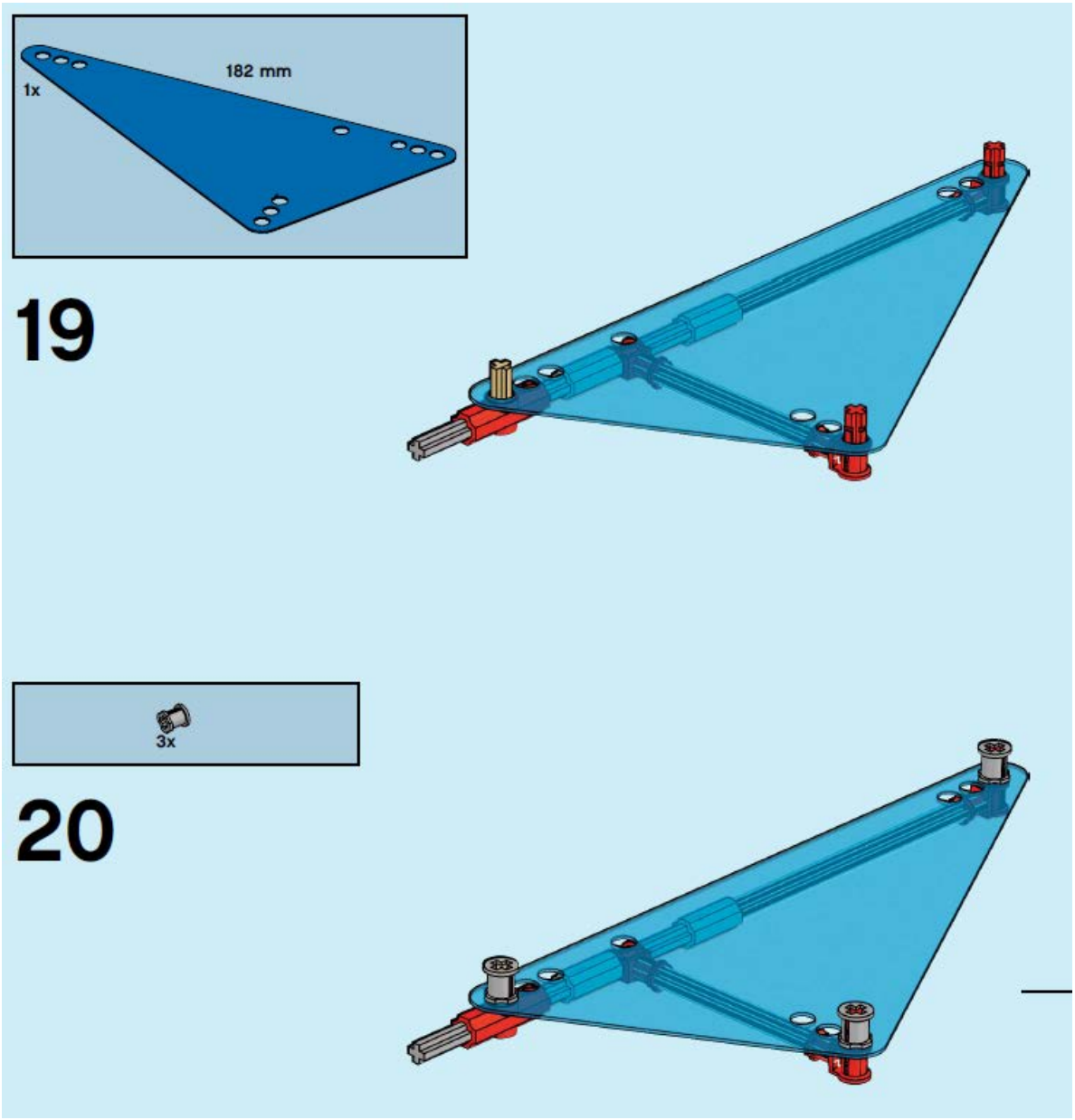

4
1x
1x
4
4
5
1x
1x
5
6
1x
1x
3
3
7
1x
1x
10
5
10
5
3
4
5
10
1:1

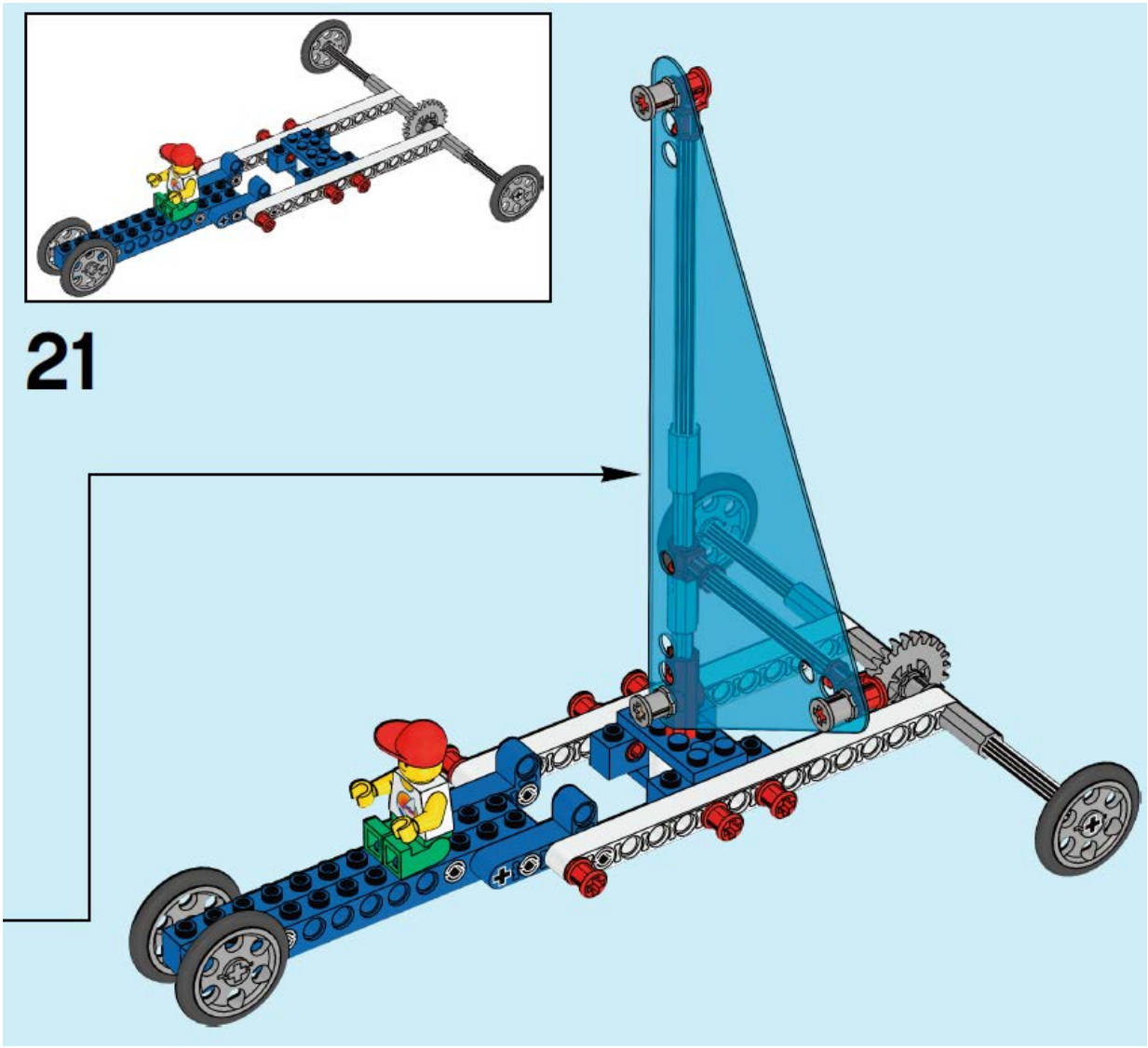

2x
8
134 mm
1x
10
2x
2
1x
3x
9
11
2
2
2
1:1

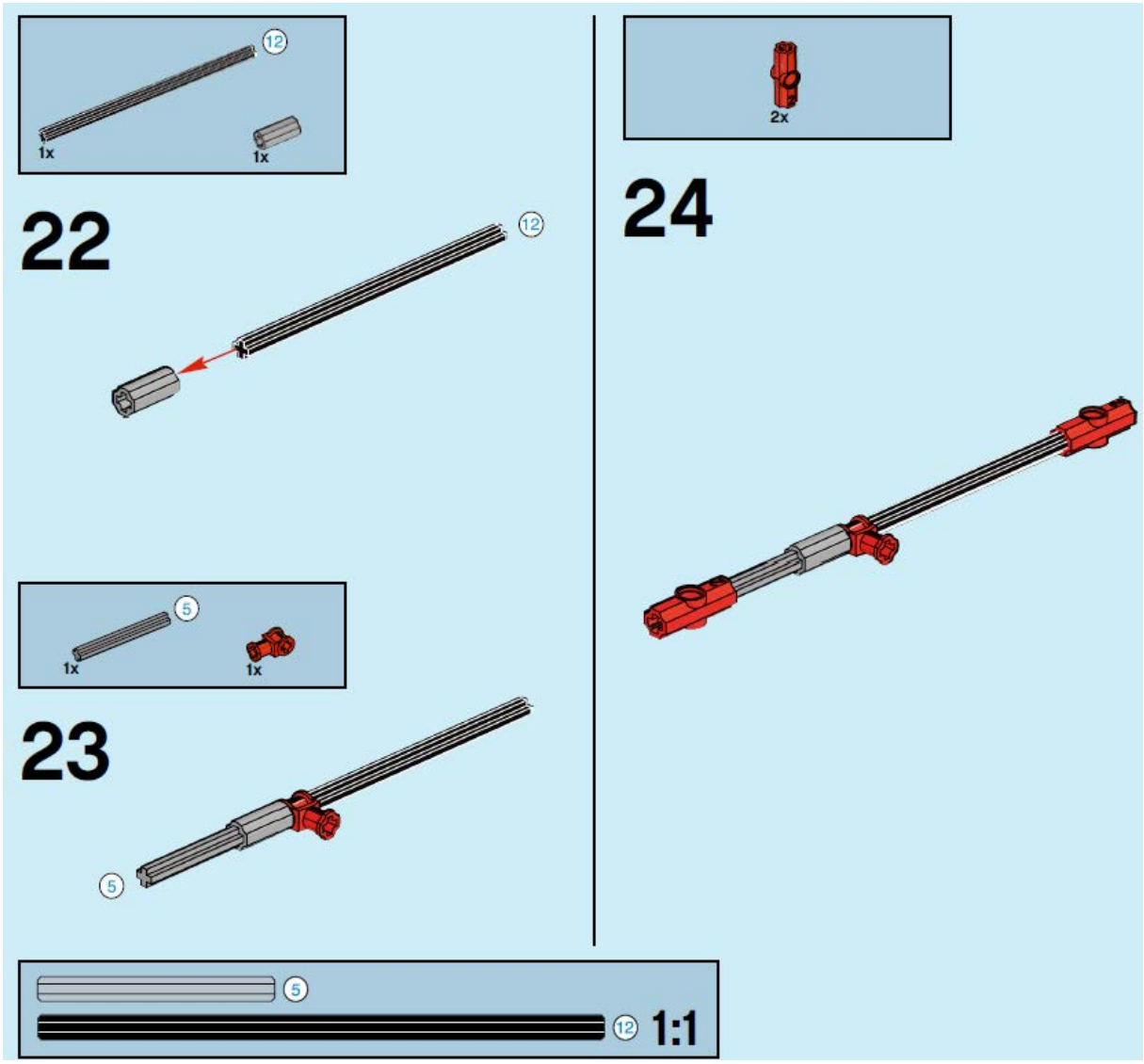

12

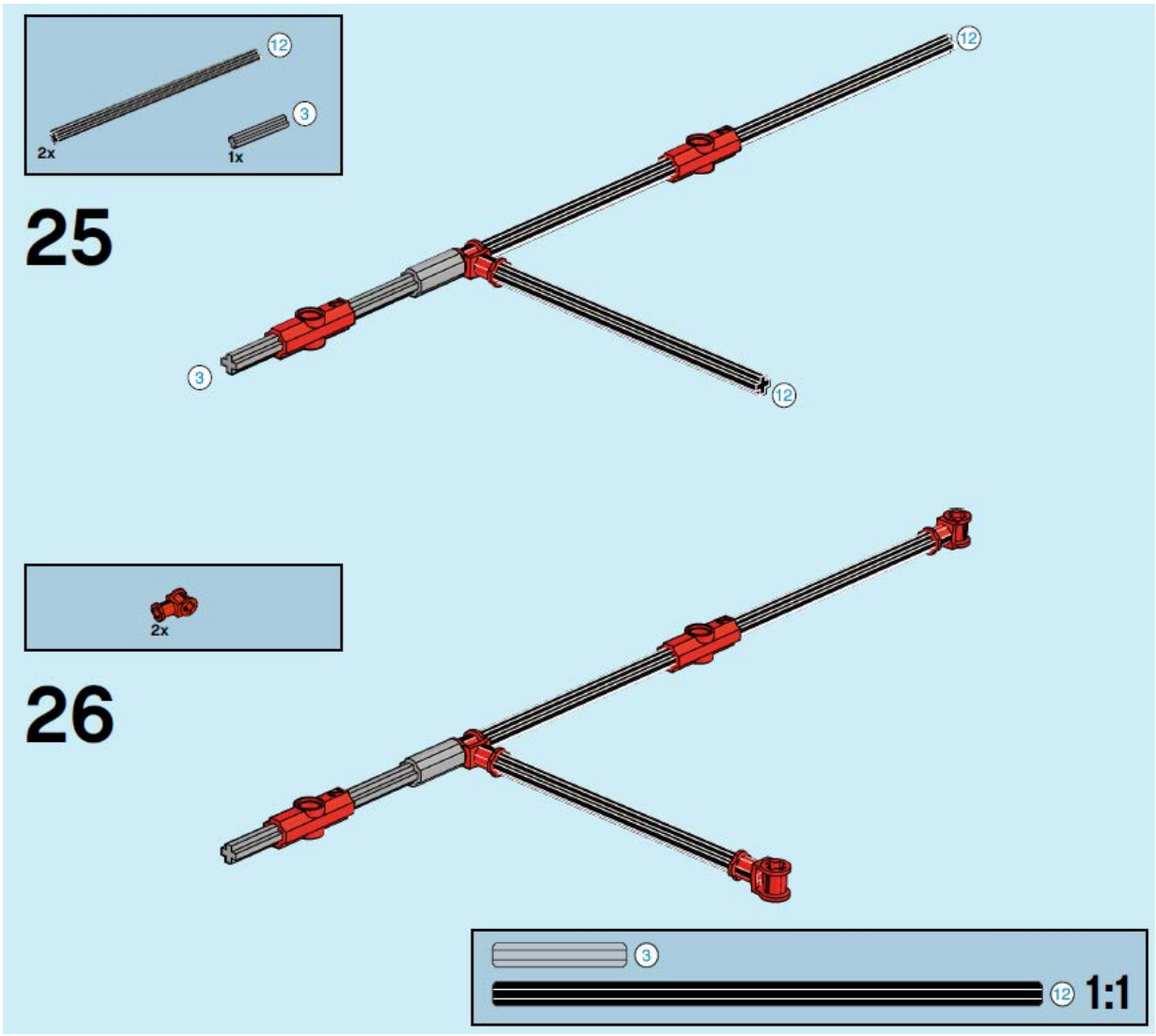

5
1x
1x
13
5
1x
1x
14
3
5
1:1
3
1x
1x
15
3
8
12
3
1x
1x
1x
16
12
8
3
8
1:1
12

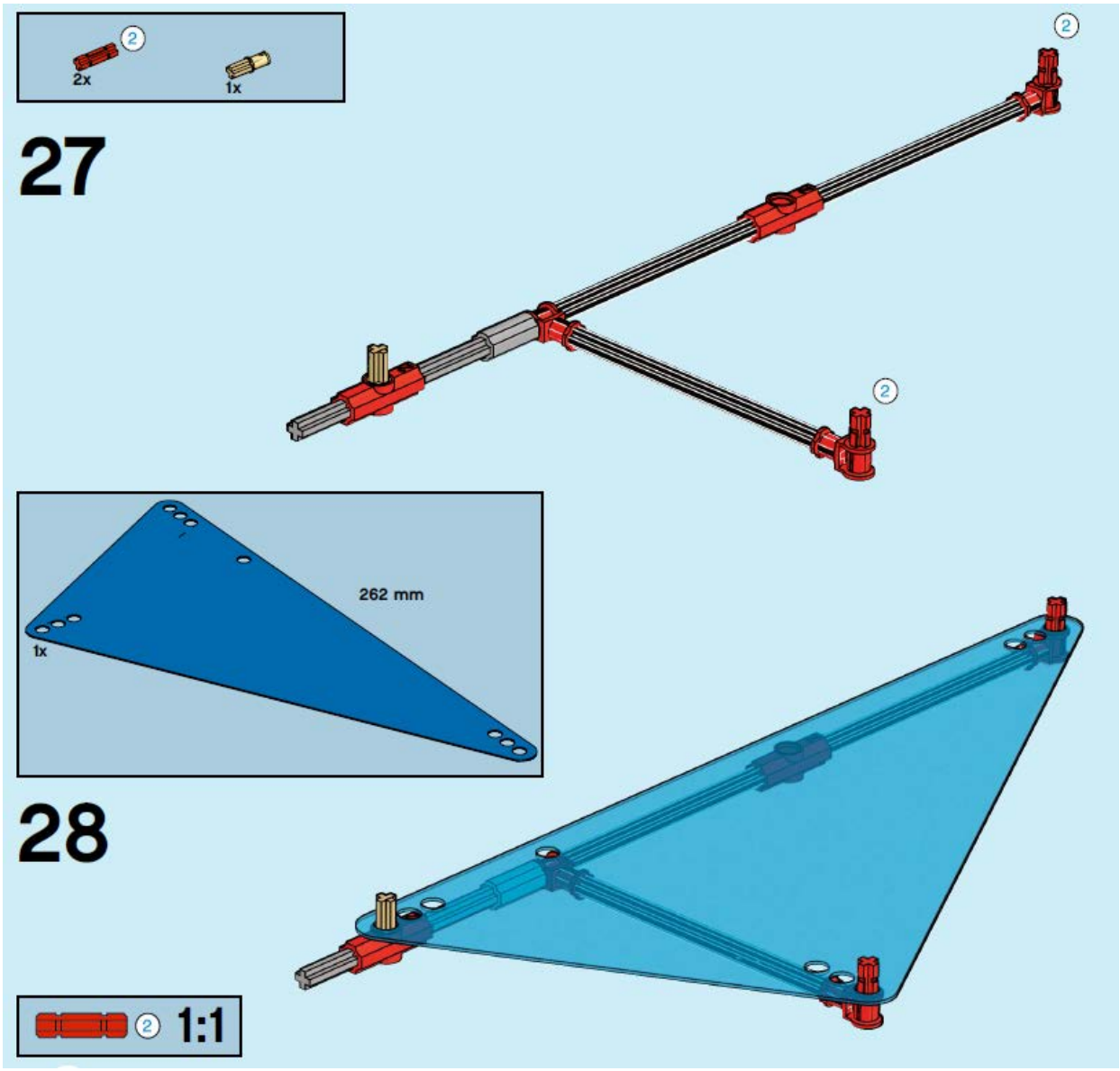

2x
17
1x
2
2x
18
2
2
2
1:1

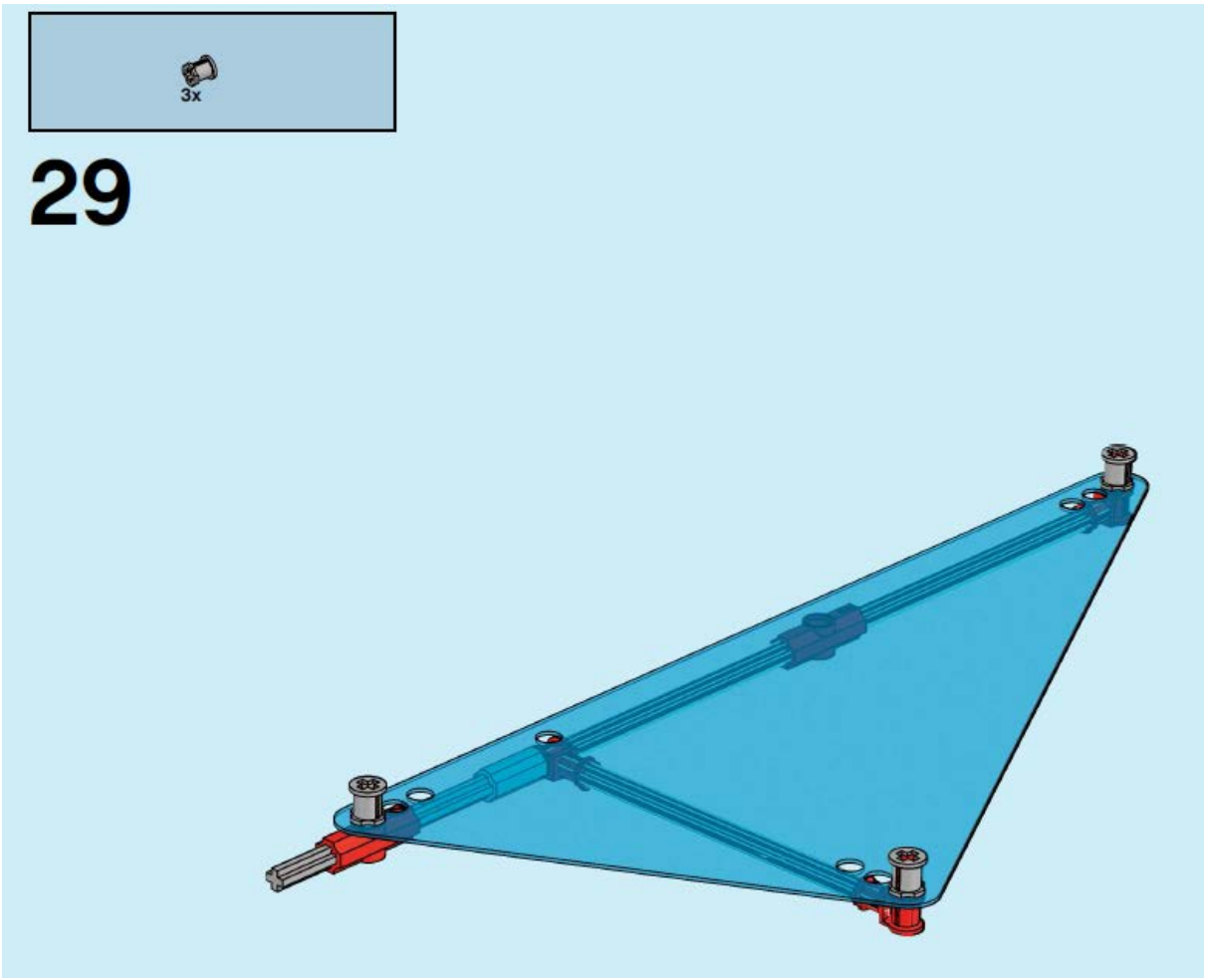

182 mm
1x
19
3x
20

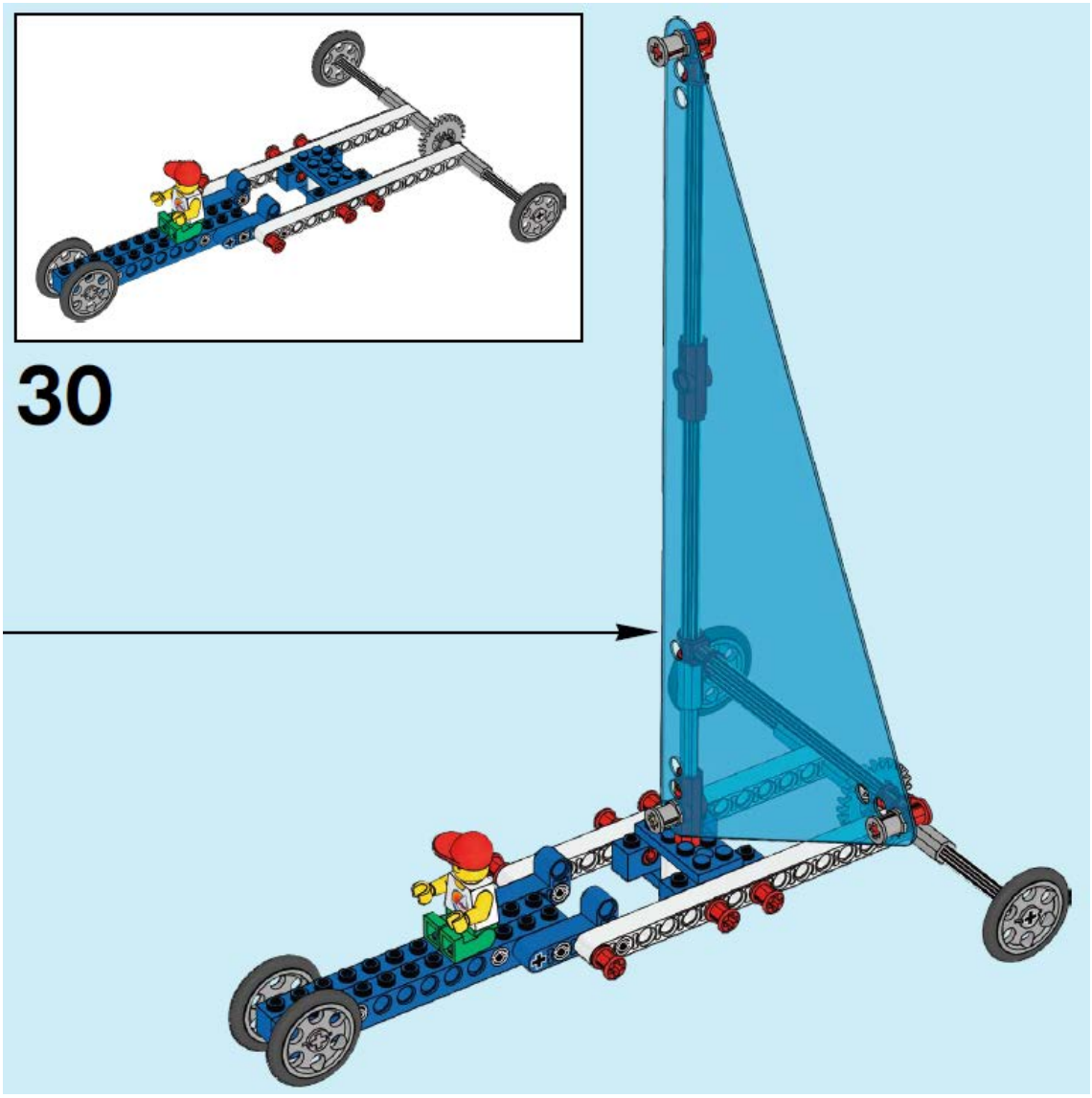

21


12
1x
1x
22
12
5
1x
1x
23
5
2x
24
5
12
1:1


12
3
2x
1x
25
12
3
12
2x
26
3
12
1:1

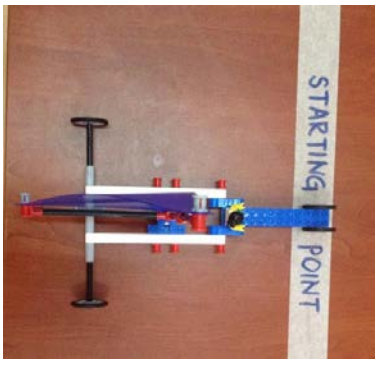

2
2x
1x
27
2
2
262 mm
1x
28
2 1:1

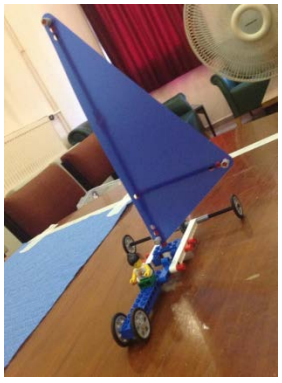
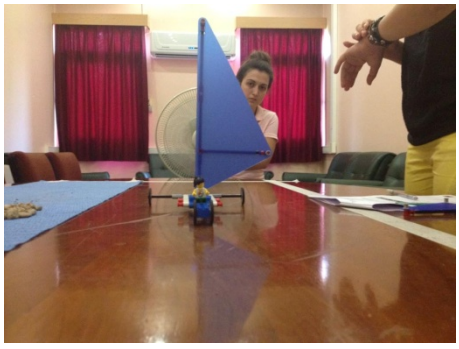

3x
29


30

Ice-Cream Car

How can you make a safe car that is powered by the wind and carries at ice creams box? Let's find out!



Investigation 1:
What difference does the size of sail make?
• Please note that the front wheel should be on the starting point.

• The fan should be placed 20 cm far away from starting point.

• Turn on the fan, predict and test how FAR each model will roll with the same wind speed in normal road with regular surface and in roads with full of stones.

• Test at least 3 times with each sail to achieve a scientifically valid answer
NB. FANS and FINGERS! TAKE CARE!

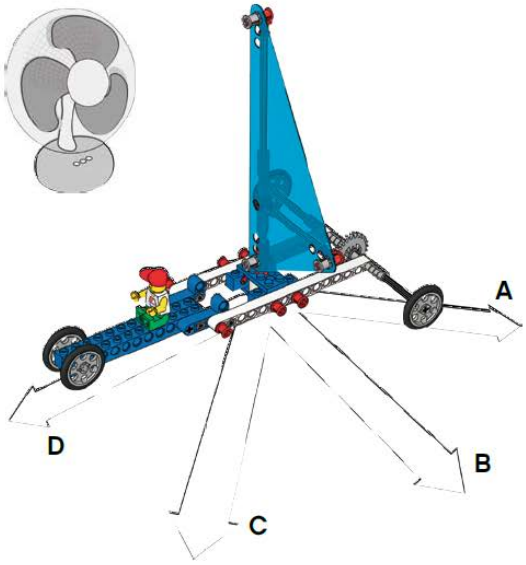
	My prediction (cm)	Actual Distance (In regular surface) (cm)			Actual Distance (surface with full of stones) (cm)		
Small 40 cm^2 sail 							
Medium 80 cm^2 sail 							
Large 160 cm^2 sail 							

Table 1. Size of sail and its effect on the movement of the car

Investigation 2:

What difference does wind angle make in road with full of stones?

- Launch your car at different angles across the wind stream
- How fast does it travel in each time?
- Write the words to the table 2 in the following page to match you saw happening



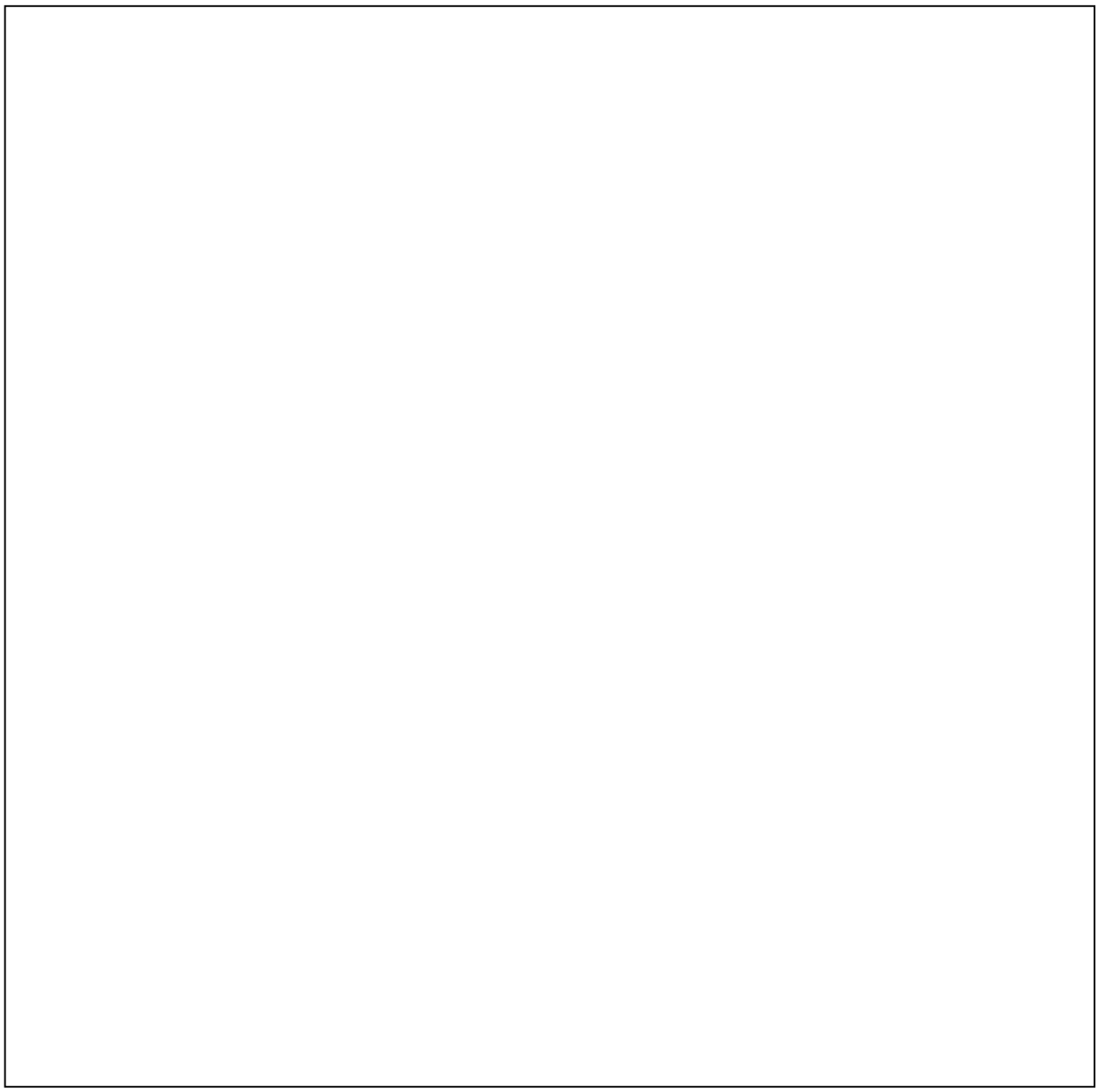
The words
Stopped
Medium speed
Fast
Slow

	Angles	**Large** 160 cm² sail 
My Prediction	**Angle A** **Angle B** **Angle C** **Angle D**	…… …… …… ……
The results	**Angle A** **Angle B** **Angle C** **Angle D**	…… …… …… ……

Table 2. The effects of wind angles on the movement of the car

My Land Sailor

Draw and label your design for a wind-powered vehicle.
Explain how the 3 best bits work.



Teachers' Note

Design and technology
• Using mechanisms – gearing down
• Assembling components
• Combining materials

Science
• Renewable energy
• Measuring area
• Measuring distance
• Measuring time
• Forces
• Friction
• Air resistance
• Pressure
• Scientific investigation

Vocabulary
• Area
• Wind resistance
• Renewable energy
• Gearing down
• Friction

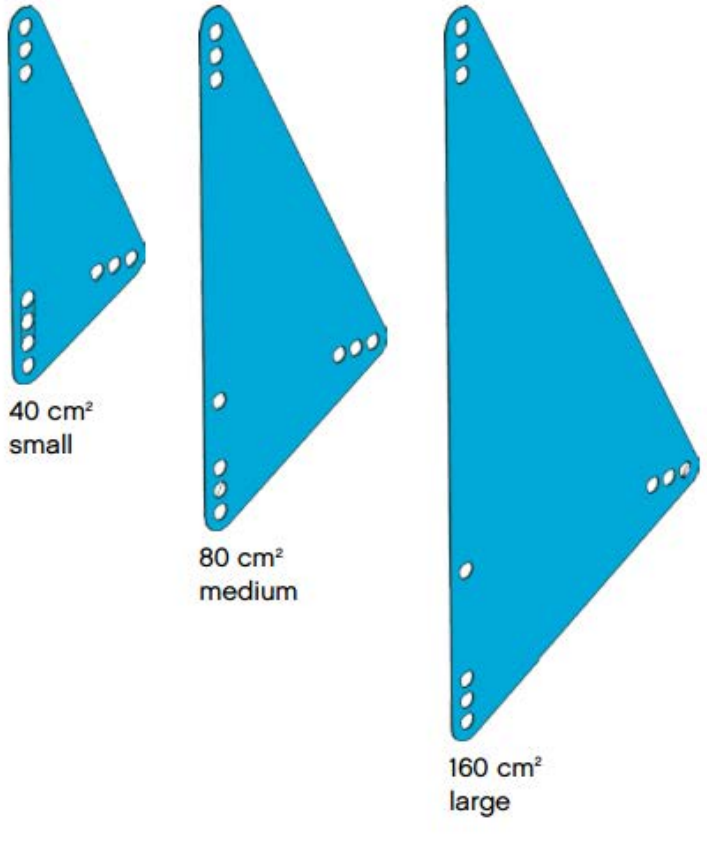
Other materials required
• 4-metre strip of smooth floor
• Masking tape
• Metre rule or measuring tape
• Timer or stopwatch
• 3-speed desk fan
• Optional: card, scissors, pencils and rulers to make your own sails

Course Plan
First lesson: reading scenario and building car
Second lesson: Investigation 1
Third lesson: Investigation 2
Fourth lesson: Assessment and feedbacks

Contemplate

What difference does sail size make?
Predict and test: what difference could there be between the 40 (small), 80 (medium) and 160 (large) cm2 sails on the car. How far will each roll ... and (optional) how fast? Test at least 3 times with each sail attached to obtain a scientifically valid answer.

In our tests, the '40' sail rolled about 1.5 m, the '80' about 2 m and the '160' about 2.5 m, i.e. double the area gathers more wind energy but does not double the distance. Why? The further from the fan, the weaker the wind! Larger sails moved faster at first. But all the sail sizes stopped rolling after about 10 seconds. None of them sail faster than the wind – downwind.

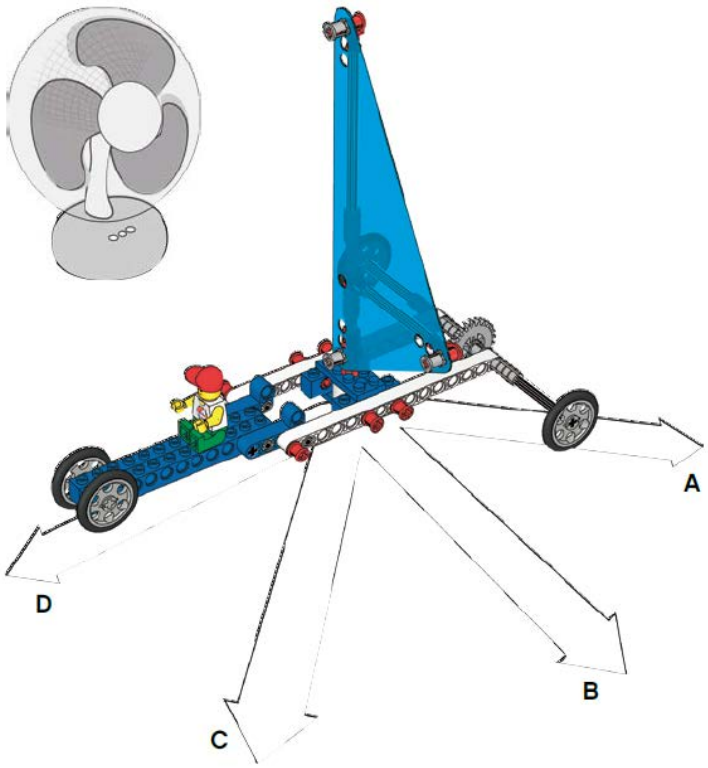


Tip:
Choose ONE speed setting to do all the tests. Any speed will do. We used high speed.

NB.
Your 'serious' scientists might also suggest testing the Land Yacht with just the bare mast, i.e. with no sail at all, so you might wish to try that as well.

What if the wind is blowing from an angle?
Launch your Land Yacht at different angles across the wind stream.

Can you explain what happens?
At most angles except D the car still moves forward! One part of the wind's force is 'deflected' off the sail, propelling it 'forward'. The other part of the force tries to blow it sideways. In fact a Land Yacht sailing across the wind at angles B and C can go very fast – but could also flip over.



Did you know?
The LEGO® figure weighs 3 g. The yacht weighs about 55 g. The weight brick is 53 g. Predict and test how the yacht would perform with a weight brick load.

Does sail shape matter?
Try making card or paper sails with the same area but a different shape. Find out about Square Riggers, Kon Tiki, Chinese Junks and Arab Dhows from books or by searching the internet.

Explanations on the concepts

Renewable energy is made from resources that Mother Nature will replace, like wind, water and sunshine. Renewable energy is also called "clean energy" or "green power" because it doesn't pollute the air or the water. Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services.

A **force** is a push or pull on matter. Forces are the cause of motion. Forces have magnitude (size) and direction. The direction of the force is important. An object that is not subjected to a force will move at a constant speed and in a straight line. Some forces reinforce or cancel each other out. Forces that are different in size and direction will cause changes in the speed or direction of an object's motion. A common unit used to measure force is known as the Newton (N).

Friction is a force that slows down motion. Larger forces create more friction.

Friction is a force that holds back the movement of a sliding object. That's it. Friction is just that simple. Frictional resistance to the relative motion of two solid objects is usually proportional to the force which presses the surfaces together as well as the roughness of the surfaces.

Air resistance is the force that resists the motion of an object through a gas and liquid is called drag. For objects moving through air sometimes instead of drag the term air resistance is used. As an object moves through air, the gas molecules in the air push against the surface of the moving object resulting in friction between the gas molecules in the air and the surface of the moving object.

Pressure is the force over a given area. Given the same force, the smaller the area of contact, the more pressure is applied. One important type of pressure is the pressure exerted on objects from the air or the Earth's atmosphere. This is actually the measurement of the weight of the gas above an object on a given surface area. The higher the elevation, the lower the atmospheric pressure exerted because there is less air pressing down on the object.

ASSESSMENT SHEET

1. Which of the following does not involve any friction?
a. A bicycle rolling down a hill
b. A baseball player sliding into 2nd base
c. A diver falling through the air to a pool
d. All of the above experience some friction.

2. Which surface will produce the least amount of friction?
a. fuzzy soccer field
b. gravel running track
c. smooth glass tabletop
d. grassy soccer field

3. These two factors determine the strength of the force of friction:
a. speed and light
b. how fast the objects are going and on what planet
c. how big the objects are and how hard you push them
d. how hard the surfaces push together and the types of surfaces involved

4. The amount of charge that builds up due to the friction between two materials depends on the
a. weight of the materials
b. surface area in contact
c. electrical conductivity of the materials
d. lattice structures of the materials

5. Sports shoes tend to have rough bottoms. What is the best explanation for this?
a. To decrease friction so you move faster
b. To increase friction so you can change your motion more easily
c. To decrease your mass so you have more momentum
d. To reduce gravity and make you lighter

6. An example of rolling friction is
a. a stack of cartons being pushed across a floor.
b. the use of ball bearings.
c. the fall of a feather through the air.
d. sand placed on an icy sidewalk.

7. Cars have difficulty stopping on ice because of
a. rolling friction
b. sliding friction
c. fluid friction
d. centripetal force

8. The force that opposes the motion of two surfaces sliding past each other is called_____.

a. acceleration
b. inertia
c. resistance
d. friction

9. Friction is a force that keeps

a. two objects together
b. objects that are touching each other from sliding past each other easily
c. objects from touching
d. none of the above

10. Force that works against the movement of two objects is called:

a. Friction
b. Solar
c. Mixing
d. Burning